CHAPTER 17

Committee 12

Neurologic Urinary and Faecal Incontinence

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Abbreviations

Most	abbreviations used in the text are given here
ACE:	antegrade continent enema
BCR:	bulbocavernosus reflex
CC:	condom catheter
CMG:	cystometrogram
CUM:	continuous urodynamic monitoring
CVC:	conventional cystometry
DOA:	detrisor over activity
DSD:	detrusor sphincter dyssynergia
EAS:	external anal sphincter
EMG:	electromyography
GBS:	Guillain Barré Syndrome
ID:	indwelling catheter
IVES:	intravesical electrical stimulation
LBT:	lower bowel tract
LOE:	level of evidence
LUT:	lower urinary tract
MPdet:	maximum detrusor pressure
MUP:	motor unipotential
MS:	multiple sclerosis
MSA:	multiple system atrophy
NVC:	natural fill cystometry
PD:	Parkinson's disease
PSP:	progressive supranuclear palsy
PSC:	suprapubic catheter
TURS:	transurethral sphincterotomy

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A. INTRODUCTION

This chapter deals with all aspects of neurologic urinary and faecal incontinence.

It is known that the lower urinary tract (LUT) and the lower bowel tract (LBT) are interrelated structures. Embryologically bladder and rectum originate from the same basic structure, the cloaca [1]. Anatomically both viscera lay in close communication and share muscular structures of the pelvic floor.

The innervation of both systems depends on autonomic and somatic nerves (**Figure 1**).

In **table 1** a simplified overview is given of the action linked to different peripheral nerves.

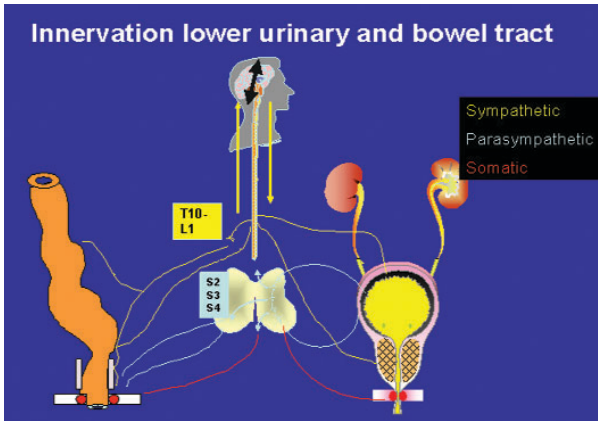

Figure 1. Schematic overview of innervation of LUT and LBT

Central control of both continence and evacuation is similar and is discussed in the chapter on physiology [2].

Very generally LUT and LBT act quite similar: the voluntary control depends on accurate sensation [3]. Continence relates to contraction of smooth closing structures (bladder neck and internal bowel sphincter) and striated urethral and anal sphincters. An inhibitory effect on detrusor and lower rectum resulting from contraction of the pelvic floor and anal or urethral sphincter has been named a "procontinence" reaction. Micturition and defaecation need a proper relaxation of these latter structures to permit a physiological reflex evacuation of urine or faeces.

Interactions between both functions have been demonstrated. The filling grade of the bladder influences sensation in the rectum and vice versa [4]. A vesico-ano-rectal reflex permits voiding without defaecation [5].

Table 1. Overview of function of the abdominal sympathetic (sym), the pelvic parasympathetic (PSym) and somatic (Som) nerves in the lower urinay tract and lower bowel tract. US= urethral sphincter, AS= anal sphincter. Exp= only suggested in animal experimentation , no clinical evidence.

	Sym	Psym	Som
Bladder	-	+	
Bladder neck	+	-	
Extern US	Exp	Exp	+
Bowel		+	
Intern AS	+	-	
Extern AS	Exp	Exp	+
Pelvic floor			+

B. PATHOPHYSIOLOGY

When a neurologic lesion occurs the type of dysfunction that follows in LUT and LBT will depend on the site, the extent and the evolution of the lesion.

Traditionally neurological pathology has been divided in suprapontine, suprasacral spinal cord and sacral - subsacral (cauda equina and peripheral nerve) lesions (**Figure 2**).

I. SUPRAPONTINE LESIONS

Patients with lesions above the pons usually continue to have reflex contractions of the detrusor. But the cerebral regulation of voiding and defaecation is often lost. This is the case in lesions as from stroke, head injury, etc, which mostly continue to have a normal coordinated sphincter function. However these patients may purposely increase sphincteric activity during an overactive detrusor contraction [6], to prevent urinary incontinence which would otherwise occur. This has been termed "pseudo-dyssynergia" because it is indistinguishable from true dyssynergia on a urodynamic record. Urinary incontinence in suprapontine lesions is due to the bladder overactivity [7].

II. SPINAL CORD LESIONS

Suprasacral spinal cord lesion When a lesion is located in the spinal cord below the pons detrusor-urethral sphincter dyssynergia is a common finding. Incontinence may still be caused by detrusor overactivity but the outflow obstruction can also cause retention.

Patients with lesions above the cone usually suffer from an overactive bowel with increased colonic wall and anal tone. The central control of the external anal sphincter is disconnected and the sphincter remains tight thereby retaining stool (dyssynergia). The connections between the spinal cord and the colon remain intact, permitting reflex coordination and stool propulsion. This type of lesion provokes faecal retention at least in part due to the activity of the anal sphincter. Incontinence can be a consequence of faecal impaction and constipation.

Conus lesion If the nuclei of the pelvic nerves are destroyed the detrusor becomes areflexic. Retention of urine can provoke stress incontinence (formerly termed overflow incontinence).

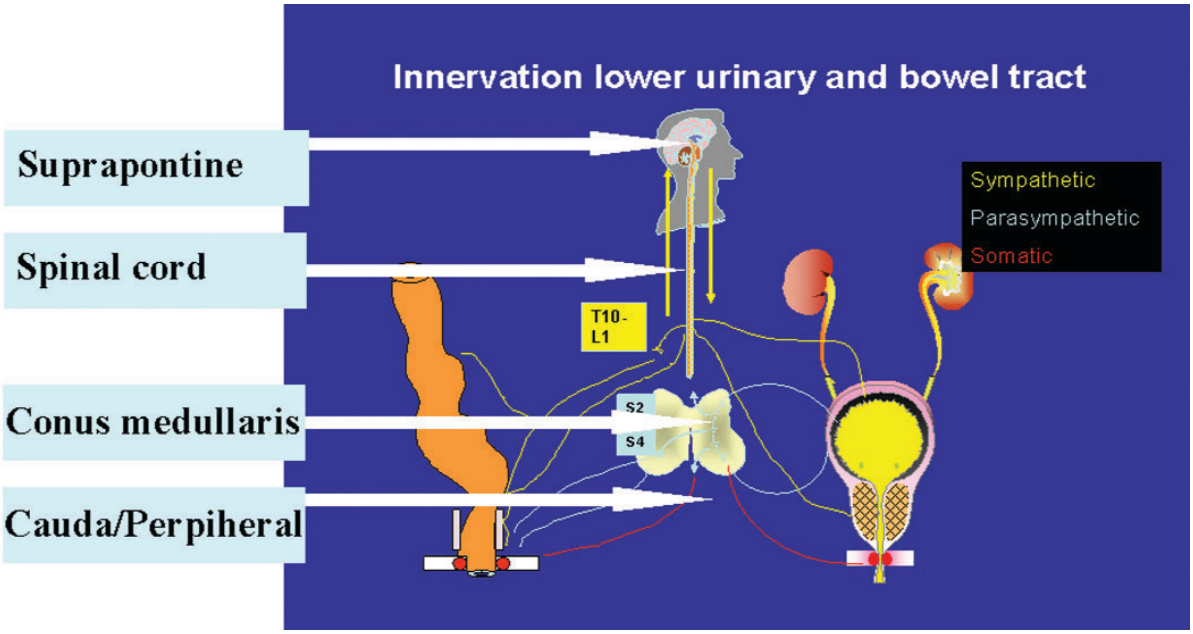

Figure 2. Frequent sites of neurologic pathology with relation to neurologic urinary and faecal incontinence.

III. SUBSACRAL LESIONS (CAUDA EQUINA OR PERIPHERAL NERVES)

The same effect as from lesions of the conus medullaris can result from lesions of the ***subsacral nerves (cauda equina or peripheral nerves***). If the nuclei of the pudendal nerves are lesioned a paralysis of the urethral sphincter and pelvic floor muscles will occur with loss of outflow resistance and stress incontinence.

A neurologic lesion affecting the parasympathetic cell bodies in the conus medullaris will eliminate the pelvic nerve function of the bowel. No spinal-cord mediated peristalsis occurs. The myenteric plexus coordinates segmental colonic peristalsis. If the pudendal nerve is also destroyed , there is an increased risk for incontinence. Apart from the non contractile external anal sphincter, the puborectal muscles also lack tone, which leads to reduction of the rectal angle. Constipation and incontinence are frequent.

While most traumatic spinal cord lesions give LUT and LBT dysfunctions which can be predicted fairly well from the level and completeness of injury [8], the LUT and LBT function in many other neurologic diseases such as meningomyelocoele are more difficult to categorise [9]. Therefore in this chapter a number of neurologic diseases will be dealt with in detail.

C. NEUROLOGIC URINARY INCONTINENCE

This part contains all aspects from epidemiology, pathophysiology, through diagnosis to treatment. The ICS Standardization Committee recently introduced a new nomenclature of LUT dysfunctions. Terms such as reflex incontinence, detrusor hyperreflexia and overflow incontinence are, according to this nomenclature no longer valid. However in the case of neurologic voiding dysfunction « reflex incontinence » reflects the return of a primitive voiding reflex and, associated with it, incontinence, and therefore this term will still be used here in addition to the newly introduced term « neurologic detrusor overactivity »

Madersbacher et al have described in the ICI report 2002 common patterns of neurologic detrusor-sphincter dysfunction in a diagram which is reproduced in **figure 3.** These are easy to use and the development of similar diagrams for neurologic bowel dysfunction is to be recommended.

C1. EPIDEMIOLOGY

I. METHODOLOGY

Pubmed search from 1967 till 2004 with search words: epidemiology, neurologic bladder, neurologic

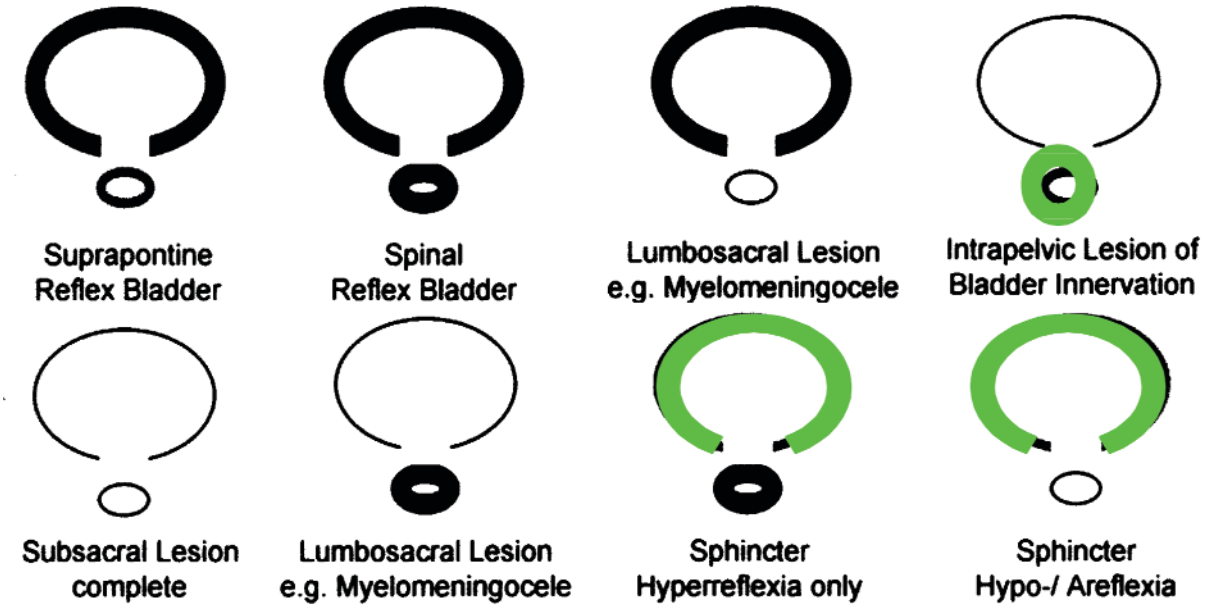

Figure 3. Patterns of neurogenic detrusor-sphincter dysfunction Heavy lines symbolize hyperreflexia, thin lines hypo- or areflexia and green lines a normal innervation of the relevant structure, for futher explanation see text.

incontinence, neurologic patients, prevalence gave several hundreds of references. Unfortunately only a very limited number gave data on prevalence and only in specific diseases for which a separate search was done. Data on incontinence are not always present in data on "neurologic voiding dysfunction" or "neurologic cystopathy". No global meta analysis has been found.

In separate searches for specific diseases the prevalence data were also very limited. Moreover most studies were case series . A small number of retrospective case control studies have been found for a number of diseases and a single study which looks into incontinence in the elderly with and without dementia [13].

Several factors can be the cause for this lack of data:

- Neurologic problems of the LUT are not always specifically studied
- Some diseases are rare or have not been very much studied
- Series on urologic items deal mostly with urodynamic data, urologic complications or outcome of treatment and include only patients with a known neurologic bladder
- In some neurologic disease as spinal cord injury no data are to be found on those who had not developed a neurologic bladder.

II. RESULTS

Following are **tables 2** with the data found and the publications. While making an interpretation of these data one must realise that incontinence can be present because of direct neurologic dysfunction of bladder, bladder neck or sphincter, either because of lack of adequate treatment, infection or other causes. This differentiation can not be made from the literature data.

Conclusions

- **Neurologic dysfunction of the LUT occurs in many patients with neurologic disease but exact figures are seldom available**
- **Metanalysis of prevalence data could give a better idea of how important neurologic bladder is in the patients with neurologic diseases and in the prevalence of incontinence in this population.**

Recommendations

- **Because many diseases or lesions of the innervation can cause pathology of the LUT, patients with known neurologic disease should be evaluated for such dysfunction .**
- **Such evaluation should be made not only when urinary symptoms occur but also as a standard diagnostic approach if prevalence of neurologic bladder is known to be high in a specific disease .**
- **If "idiopathic" LUT dysfunctions occur the possibility of an unknown neurologic cause should be acknowledged and the diagnostic steps taken to make a proper diagnosis.**
- **The committee thinks there is enough evidence to make all three strong recommendations.**

C2. SPECIFIC DIAGNOSTICS

- Diagnostic methods of neurologic LUT dysfunction and neurologic urinary incontinence are not very different from what is done in non neurologic patients. They consist of clinical assessment including voiding history and voiding diary, urodynamic studies including cystometry (+ EMG), video-urodynamics, uroflowmetry, pressure-flow study, diagnostic imaging with voiding cystourethrography and ultrasonography of the kidneys and LUT. These methods will be dealt with in the relevant chapters of this book(basic assessment, dynamic testing, imaging and other investigations) but we will highlight briefly some data specially related to neurologic patients.
- Some tests developed for the diagnosis of neurologic dysfunction have been evaluated more specifically in this chapter: dynamic bulbocavernosus reflex [1], bethanechol supersensitivity test [2], ice water test [3].
- Neurophysiologic studies can be found in the chapter "Clinical Neurophysiological testing", and only some clinical relevant data will be given here.

I. METHODOLOGY

Searching strategy in Medline from 1966 to present (2004) with keywords: neurologic bladder and electrodiagnosis – 311 papers, with keywords: neurolo-

Table 2. Prevalence figures from literature of different causes of neurologic LUT dysfunction

Cerebro-vascular accidents	**poststroke 32 - 79%** **On hospital discharge 25 – 28 %** **after 12 weeks 29% Later 12 – 19 %** ***initial incontinence best single indicator of future disability***	**Brittain et al [1]** **Borrie et al [2]** **Taub et al [3]**
Cerebral tumor	Case reports	Maurice-Williams[4], Lang et al[5]
Normal pressure hydrocephalus	Case reports	Jonas –Brown[6], Black[7], Mulrow et al[8]
Cerebral Palsy	36%	Mc Neal et al[9], Decter et al[10]
Mental retardation depending on grade disorder	12% - 65%	Mitchell-Woodthorpe[11], Reid et al[12]
Dementia	30-100%	Campbell et al[13], Toba et al[14]
Parkinson's disease	37,9 – 70 %	Murnaghan[15] Campos-Sousa et al[16]
Multiple system atrophy	73% incontinence	Chandiramani et al[17]
Multiple sclerosis	52-97 % 37-72%% incontinence	Litwiller et al[18], Giannantoni at al[19]
Myelodysplasia	90% -97%	Smith[20]
Spinal stenosis	61-62%	Tammela et al[21], Kawaguchi[22]
Spine surgery	38%-60%	Boulis et al[23], Brooks[24]
Disc disease	28%-87%	(Bartolin et al[25], O'Flynn et al[26]
Spinal cord injury	? Majority have neurologic lesions	
Diabetes mellitus	25-48% 43-87% insulin dependent	Hampel et al[27] Frimodt-Moller[28]
Rectal carcinoma resection	<70% 20% or even 0% if nerve sparing	Hollabaugh et al[29] Hojo et al[30]
Radical Hysterectomy	8 –10% 57%	Ketcham et al[31], Seski-Diokno[32] Lin et al[33]
HIV	12 % advanced stage	Gyrtrup et al[34] Shin et al[35] LOE2
Guillain Barré	25%- case studies	Sakakibara et al[36]
Herpes	17 / 423	Chen et al[37]
Systemic Lupus erythematosus	3 /314	Min et al[38]

gic bladder and investigation – 133 papers, and with keywords: neurologic bladder and diagnosis – 825 papers. Seventy one relevant papers have been selected for this evaluation.

II. RESULTS

1. Clinical examination

Wyndaele and De Sy [4] found that clinical neurological findings in 47 children with lumbosacral myelodysplasia did not correlate well with the existing dysfunction of the LUT as diagnosed by urodynamic studies. The level of intact skin sensation, and the presence or absence of bulbocavernosus and anal reflexes could not significantly predict the function of the detrusor muscle, proximal urethra and striated urethral sphincter. Therefore, one should not rely on a clinical neurological examination to outline the urological management in such patients. The same conclusion is given by Marshall and Boston [5] who examined the reliability of whether absence of sacrally-mediated anal reflexes in 76 children and adolescents (aged 3 - 18 years) with spina bifida guarantees a safe bladder and whether routine urodynamic studies can be, therefore, safely omitted in this group. They found the absence of anal reflexes to be a poor predictor of safe bladder pressures and thus no justification for depriving such a population of routine urodynamic assessment on this basis. (LOE 3)

In 92 patients with spinal cord lesion, out of spinal shock, Wyndaele [6] compared data from a clinical neurological examination of the lumbosacral area with the data from a full urodynamic investigation, including evaluation of sensation in the LUT. A significant correlation was found between different levels of spinal cord lesion, the function of bladder neck and sphincter and the anal/ bulbocavernosus reflexes. Higher lesions corresponded more with a reflexic LUT and somatic motor activity, lower lesions more with areflexia. In patients with lesions between thoracic 10 and lumbar 2 as many reflexic as areflexic LUT dysfunctions were found. The presence or absence of perineal sensation of light touch corresponded significantly with the presence or absence of sensation in the LUT. Detrusor and striated sphincter reflexia/areflexia corresponded significantly with the presence/absence of bulbocavernosus and anal reflexes.

Shenot et al [7] determined if intact perianal pin sensation (PPS) and bulbocavernosus reflex (BCR) shortly after spinal cord injury are predictive of bladder function recovery in 28 patients, Frankel Classification A-D, spinal injury level C4-T12, admitted within 72 hours of injury. The presence of intact PPS and BCR were correlated with the patient's voiding function and urodynamic evaluation results 1 year postinjury. Although PPS and BCR proved moderately sensitive in predicting the return of spontaneous voiding, they could not predict detrusor hyperreflexia and sphincter dyssynergia.

Therefore, urodynamic study remains an essential component of initial urologic

evaluation after SCI. Also, Schurch et al [8] determined whether early sensory examination, voluntary anal sphincter contraction, or bulbocavernosus reflex (BCR) might predict bladder function in patients with a spinal fracture at the thoracolumbar level. They found that in these patients neurologic voiding dysfunction cannot be predicted by the early sensory evaluation. Pinprick sensation in the perineal area is of negative predictive value: absence of pinprick sensation predicts poor bladder recovery. Most patients with a spinal fracture at T12-L1 did not improve in voiding function.

In men, who were at risk for obstructive uropathy, Nitti et al [9] evaluated whether, after a cerebrovascular accident, the cause of voiding dysfunction could be predicted by the type (obstructive or irritative) or time of onset of symptoms. Presenting symptoms did not predict the urodynamic findings of bladder outlet obstruction or DOA. The significant incidence of onset of symptoms after stroke suggests that the cerebrovascular accident induced voiding dysfunction in the face of preexisting bladder outlet obstruction may exacerbate the symptoms of the latter condition or vice versa.

Conclusion

- **These studies show that a combination of all data from a clinical neurological examination gives useful information which acceptably corresponds with the LUT function in patients with spinal cord injury but not in meningomyelocoele patients.**
- **In elderly male neurologic patients with possible BPH related obstruction, symptoms and clinical examination are not sufficient to differentiate between outflow obstruction and neurologic DOA.**
- **To decide on a detailed individual diagnosis of LUT function in neurologic patients, history and clinical examination prove insufficient.**

2. Urodynamic tests

Classic urodynamic techniques permit the acquisition of multiple functional parameters in patients with neurologic bladder. These techniques are discussed in the chapter on dynamic testing.

The literature gives enough evidence of the value of different techniques in neurologic urinary incontinence: urodynamic investigations in patients with a traumatic SCI permit not only a urodynamic diagnosis but also an objective follow up of treatment such as reeducation techniques, after sphincterotomy and after urethral overdilatation by indwelling catheters [10].

- CMG + EMG has been studied by several authors:

Sundin and Petersen [11] used cystometry-electromyography (EMG) investigation in patients with known or suspected neurologic disorders in whom a defect in bladder emptying, in spite of an active detrusor contraction, was found at cystometry. A voluntary control of the external urethral sphincter **relaxation**—independent of the degree of bladder filling-was found in most of the healthy volunteers. The cystometry-EMG investigation gave reliable information as to whether a DSD exists. Perkash [12] found rhythmic detrusor contractions on cystomanometry with associated marked increase in EMG activity on attempted voiding to be relevant characteristics of patients with DSD. Rodriquez et al [13] used EMG-gas cystometrogram to select SCI patients for removal of the Foley catheter. Important factors governing success were the amplitude of the detrusor contraction, the presence of detrusor-sphincter synergy and the presence of a flaccid sphincter. Mayo and Kiviat [14] used multichannel urodynamic studies in patients with incomplete bladder emptying secondary to suprasacral SCL. They found that bladder pressure and sphincter EMG measurement during voiding, combined with fluoroscopy, are ideal methods to identify the factors responsible for incomplete emptying in problem cases. Also Perlow and Diokno [15] and Koyanagi et al [16] found CMG-EMG very usefull in SCI patients.

Blaivas et al [17] described on the basis of CMG - EMG 3 types of dyssynergia: type 1 had a crescendo increase in electromyographic activity that reached a maximum at the peak of the detrusor contraction, type 2 had clonic sphincter contractions interspersed throughout the detrusor contraction and type 3 was characterized by a sustained sphincter contraction that coincided with the detrusor contraction. There was no correlation between the clinical neurologic level and the type of dyssynergia.

Simultaneous recording of intravesical pressure, sphincter electromyography and uroflowmetry (CMG.UFM.EMG study) was compared by Aoki et al [18] with cystometry + EMG. They found some influence of the catheter in the urethra. Micturition pressure and opening pressure were larger with CMG+ EMG, incidence of detrusor-sphincter dyssynergia was greater. The authors also found that the Credé maneuver exaggerated the DSD. Urodynamics with EMG permitted Kirby [19] to differentiate between patients with pelvic nerve injury, distal autonomic neuropathy, progressive autonomic failure - multiple system atrophy, and idiopathic Parkinson's disease. This influenced the selection of patients for transurethral surgery. Pavlakis et al [20] studied CMG concomitant with perineal floor and rectus abdominis EMG and concluded that the addition of rectus EMG can improve the recognition of intravesical pressure elevation owing to voluntary contraction of the abdominal musculature.

- Perkash and Friedland (1987) found simultaneous transrectal ultrasonography helpful.
- They also recommended not to irritate the bladder when introducing the urodynamics catheter and to examine the entire curve of the CMG and not simply the initial rise.
- Pressure-flow study can demonstrate an obstructive pattern (high pressure voiding) also in neurologic patients due to urethral relaxation failure [22].
- Video urodynamics permit a clear image of bladder neck and urethral sphincter activity during filling and voiding [23].
- Zerin et al [24] found that the urographic position of the bladder neck in relation to the pubic symphysis was correlated with lower motor neuron (LMN) denervation of the urethral sphincter as detected with electromyography in infants and children with myelodysplasia. They concluded that, although not as precise as urodynamic testing, significant descent of the bladder neck is a reliable urographic finding of complete LMN denervation of the external urethral sphincter in infants and children with myelodysplasia.
- CMG filling rate seems to be very important especially in neurologic patients:

De Gennaro et al [25] performed continuous urodynamic monitoring over 6 hours (CUM) in children and compared this with standard urodynamics. They found CUM feasible and permitting a better diagnosis than standard cystometry in some. Zermann et al [26] investigated the diagnostic value of natural fill

cystometry (NFC) in children with neurologic bladder in comparison to conventional videocystometry (CVC). In 45%, NFC detected new findings compared with CVC diagnoses. CVC findings were confirmed in another 45%.

Hess et al [27] studied how closely the intravesical pressures obtained before filling cystometry resembled those obtained during the filling phase of the cystometrogram. Filling pressures during cystometry were significantly higher than the pressures measured at rest. This study also suggests a strong correlation between both. Ko et al [28] determined in spinal cord injured patients with neurologic bladder whether cystometry performed by filling using diuretics (FCMG) reveals different findings compared with conventional cystometry (CMG). Significant differences were found between CMG and FCMG in hyperreflexic neurologic bladders with respect to a decrease in MPdet and increase in compliance with FCMG. However, there were no significant differences in MPdet and compliance in hyporeflexic or areflexic neurologic bladders between the two techniques.

- The determination of CMG filling sensation is important [29]. In 52 SCI patients, 26 % of those with a supposed complete lesion had sensation of bladder filling during cystometry [30]. Also in 41 patients with myelodysplasia the perception of bladder filling proved, rather unexpectedly, to be present in a majority of patients [31].

In a large cohort study it was clearly shown that impaired perception of bladder filling during CMG is a sign of neuropathy [32]. Ersoz and Akyuz [33] investigated bladder-filling sensation in 73 SCI patients with complete lesions above T11 and below T10 and with incomplete lesions Bladder-filling sensation was present to some degree in all incomplete SCI patients, in 82.4% of the patients with complete lesions below T10, and in 38.9% of the patients with complete lesions above T11. Bladder-filling sensation investigations were reproducible in terms of bladder filling sensation category in 36 SCI patients who had second cystometric examination. The authors concluded that presence of bladder-filling sensation in many SCI patients reveal the potential for sensation-dependent bladder emptying, especially in the ones with complete lesions below T10 and the ones with incomplete lesions.

Madersbacher [34] introduced a specially designed, plastic, radiolucent micturition chair especially suitable for the urodynamic evaluation in paraplegics, in myelomeningoceles and other handicapped persons.

Conclusions

- **Urodynamic tests are very useful in patients with neurologic urinary incontinence**
- **A combination with EMG and /or imaging adds to the diagnostic possibilities**
- **Filling rate can influence the outcome of several urodynamic parameters**
- **Evaluating sensation of filling during CMG is important for the neurological diagnosis and probably for treatment options.**

3. Special tests

a) Ice water test

The Ice water test was first described by Bors and Blinn [35] for spinal cord injuried patients. It is based on the principle that stimulation of mucosal temperature receptors by rapid introduction of 100 ml water at 4°C into the bladder can elicit a spinal reflex contraction of the detrusor, a reflex that is normally inhibited by supraspinal centers. A lesion above the detrusor motor cells interrupts these inhibitory pathways, resulting in manifestation of the reflex, whereas a lesion of the motor cells does not result in reflex contraction. A positive test should therefore theoretically occur in patients with suprasacral lesions, whereas those with spinal sacral lesions and neurologically normal patients should have a negative test. Sphincter spasiticity can prevent outflow of the filling fluid. Simultaneous measurement of intravesical pressure permits ruling out false negative tests.

In the more recent literature Geirsson et al [36] showed in a large cohort study that 97% of patients with complete and 91% of those with incomplete neurologic DOA had a positive or a false negative IWT. About 75% of the patients with multiple sclerosis, Parkinson's disease or previous cerebrovascular accident had a positive IWT. All patients with sacral motor lesions or pure stress incontinence had a negative IWT. There was a significant correlation between a positive IWT and an abnormal sensation of bladder filling and inability to inhibit micturition voluntarily, as well as between a negative IWT and the occurrence of phasic detrusor contractions during cystometry. The study shows that the IWT is a sensitive test for differentiating lesions from sacral motor nerves and suprasacral lesions with intact sacral motor nerves. It is also a useful parameter for functional subdivision of overactive bladders.

In patients with voiding dysfunction in the absence of LUT inflammation, a positive test is an indicator of a silent or overt neurological disorder.

Geirsson and Fall [3] used the ice-water test (IWT), in patients suspected of DSD (cystometry and needle EMG). A positive test with a high detrusor pressure indicates detrusor-external sphincter dyssynergia whereas the contrary applies to the negative test. All patients who responded to cold stimulation with detrusor contraction but without fluid leakage, called positive non-leakage IWT, presented DSD according to EMG. The authors conclude that in this situation, the cheap, non-invasive and simple IWT can replace a needle EMG study.

Ishigooka et al [37] evaluated urinary bladder sensation to ice water instillation in patients with diabetes mellitus. There was no apparent relationship between prevalence of peripheral neuropathy and that of negative sensation in the ice water test. Impairment of ice water perception was less frequent than that of mechanoreceptor sensation in patients with diabetic cystopathy.

Ronzoni et al [38] studied ice-water test (IWT) in 148 patients with neurologic bladder dysfunction resulting from a traumatic lesion and in 130 patients with neurologic bladder dysfunction and multiple pathogenic disorders. IWT was positive in 95% of patients affected by complete and in 86% of patients with incomplete medullary lesions. The IWT in patients with lower motor neuron medullary lesions was always negative. The test was used diagnostically in patients with lower motor neuron lesions. In those with upper motor lesions it was used as a rehabilitation method during the spinal shock phase to accelerate the appearance of the micturition reflex. In 9% of patients it was used to induce micturition during cystography. The authors consider IWT as a useful complement to urodynamic examinations in patients with neurological bladder disease.

Chancellor et al [39] determined the clinical utility of IWT during urodynamic evaluation in spinal cord injured (SCI) patients and found that it did not contribute to their management because of the insensitivity and nonspecificity. Autonomic hyperreflexia can occur during evaluation. The IWT did not influence clinical management in this group of SCI patients.

Conclusion

- **The literature results from IWT show some value in the diagnosis of neurologic bladder and in the differentiation between reflex and areflex neurologic bladders. However studies are contradictory and further studies will have to be done to position this test more clearly in the diagnosis of neurologic urinary incontinence.**

Recommendation

- **The ice water test should be interpreted in the light of all data from the diagnostic evaluation. Its use is optional.**

b) Bethanechol supersensitivity test

The Bethanechol test was developed by Lapides et al [40] to try to distinguish between a neurologic and a myogenic etiology in the presence of an acontractile bladder. It is based on the observation that after an organ is deprived of its nerve supply, it develops hypersensitivity to the normal excitatory neurotransmitters for that organ.A neurologically intact bladder should have a pressure increase of less than 15 cm H_2O above the control value 10-20 minutes (or when sweating shows reaction on the drug has started) after subcutaneous injection of 5 mg bethanechol, whereas a denervated or decentralized bladder shows a response greater than 15 cm H_2O. The filling rate should be equal in both tests before and after betanechol to permit comparison. A positive test suggests an interruption in the afferent or efferent peripheral or distal spinal innervation of the bladder. However, the test has been considered not very reliable by Blaivas et al [41].

Penders [42] considered the test reliable when the indications are good (large capacity, hypotonic bladder, clinical suspicion of lower neuron lesion) and when the interpretation is based on a right understanding of its mechanism. Pavlakis et al [20] suggest that the bethanechol chloride supersensitivity test is more sensitive and more specific than perineal floor electromyography in corroborating bladder neuropathy.

Sidi et al [2] studied patients with neurologic or non-neurologic detrusor areflexia with the bethanechol supersensitivity test, EMG of the urethral rhabdosphincter and bulbocavernosus reflex latency and found the sensitivity of these tests in detecting neu-

rologic areflexia to be 90, 87.5 and 78.1 per cent, respectively, and the specificity 95.6, 76 and 80 per cent, respectively. When all 3 tests were performed together the combined accuracy approached 100 %. They conclude that these combined tests are useful in the diagnosis of patients with equivocal bladder neurologic conditions and in those with subtle neurological lesions.

Wheeler et al [43] found the positive BST not diagnostic of neurologic detrusor areflexia because of the many variables that can influence the test.

In a study of 1990 Wheeler et al [44] suggest that flow rate, surface electromyography, and bethanechol supersensitivity test can not help differentiate neurologic from non-neurologic detrusor failure. Although not one test can accurately differentiate neurologic from nonneurologic female urinary retention, careful neurourologic evaluation will help guide to more appropriate management.

Conclusion

- **The literature on the value of the bethanechol test for the diagnosis of neurologic pathology is contradictory. Several authors state that a positive bethanechol supersensitivity test (BST) usually indicates neurologic detrusor areflexia. Others are more cautious and position the test as one of many in the global evaluation of neurologic LUT dysfunction.**

Recommendation

- **The bethanechol supersensitivity test is an optional test for differentiation between neurologic and non neurologic detrusor areflexia but the test has its limitations. Its result should be interpreted in the total of diagnostic results.**

c) Electrodiagnostic tests

1. EMG OF SPHINCTER

Nordling and Meyhoff [45] used cystometry in combination with urethral and anal sphincter EMG in patients with suspected neurologic bladder dysfunction and found anal sphincter EMG to be highly unreliable in the diagnosis of urethral sphincter dysfunction. Koyanagi et al [16] also found in male patients with SCI, discordant activities between the anal and the external urethral sphincters in 39 per cent. The degree of bladder dysfunction was related more to the degree of dyssynergia of the urethral than the anal sphincter.

Bauer et al [46] found EMG of the external urethral sphincter helpful in predicting which children with myelodysplasis and ileal conduit would be continent after undiversion and in managing the neurologic bladder postoperatively.

Fowler et al [47] introduced a technique of recording the EMG activity of striated muscle in the urethral sphincter by using a concentric needle electrode and an oscilloscope with a delay line and trigger. Individual motor units were isolated and measured. Also Vodusek [48] studied individual motor units. Both conclude that quantitative EMG may be a helpful technique in the investigation of patients with disorders of micturition.

Light et al [49] investigated patients with detrusor areflexia and a high spinal cord lesion with EMG of the pelvic floor muscles, lumbosacral-evoked potential to tibial nerve stimulation, the bulbocavernosus reflex and water cystometry. Of those patients with initial detrusor areflexia evidence was found for a subclinical second lesion involving the lumbosacral arc, which accounted for the acontractile bladder. In the remaining patients who had an intact sacral reflex arc, a detrusor contraction developed after a mean of 16.6 months from the date of injury They found that the most predictive neurophysiological test was EMG of the pelvic floor.

Ziemann and Reimers [50] found the sphincter EMG the most sensitive technique in the diagnosis of chronic pudendal lesions. However, pure afferent lesions cannot be detected by the sphincter EMG. In this case, the BCR, using unilateral stimulation of the dorsal nerves of the penis, provides the opportunity to distinguish between afferent and efferent lesions of the sacral innervation.

Fowler [51] concluded that sphincter electromyography (EMG) has proved to be particularly valuable in identifying patients with parkinsonism who have multiple system atrophy. Tests which examine aspects of nerve conduction velocity have proved to be of lesser value both because such investigations test conduction of nerve fibres rather than levels of innervation, and furthermore examine large myelinated fibre conduction rather than that of the unmyelinated fibres which comprise the autonomic innervation.

Conclusion

- **EMG can be valuable in the diagnosis of patients with neurologic bladder dysfunction.**
- **EMG of the anal sphincter can be unreliable for the evaluation of LUT function.**

Recommendation

- **EMG of the urethral sphincter can be recommended as diagnostic method in patients with neurologic LUT dysfunction and neurologic urinary incontinence**

d) EMG of Detrusor muscle

Has been very little studied in neurologic patients. La Joie et al [52] recorded simultaneous electromyographic (EMG) recordings from the bladder detrusor muscle and the inferior rectus abdominis muscle in 6 normal subjects, in 4 patients with LMN bladder disease and in 2 patients with an UMN type of bladder lesion. Results of the study demonstrated that the bladder electrodes did not record remote muscle activity from the abdominal muscles, so that any increased detrusor electrical activity with abdominal contraction must have some other explanation such as a possible abdominal-detrusor reflex or the production of increased intra-abdominal pressure from abdominal contraction.Also Kaplan and Nanninga [53] analysed upper motor neuron type neurologic bladders by bladder EMG. We have to consider the technique as still experimental and not fit for clinical diagnostics at this time.

e) Dynamic Bulbocavernosus reflex (BCR)

Walter et al [1] studied a dynamic BCR (BDC) during micturition induced by using periodic dorsal penile nerve stimulation; the evoked reflex response was recorded with an anal sphincter pressure sensing balloon. Results indicate that an enhanced BC reflex is a major factor causing increased urethral resistance during micturition.

Kaiho et al [54] recorded the evoked potential of the BCR (BCR-EP) by a concentric needle electrode at the periurethral striated muscle. They found BCR-EP suppressed during voluntary voiding in normal subjects, but insufficiently suppressed in the patients with neurologic bladder. It was suggested that the measurement of BCR-EP could distinguish involuntary voiding caused by pathological urethral sphincter relaxation from voluntary voiding.

Kaiho et al [55] investigated the change of sacral reflex activity of the striated urethral sphincter in the urine storage phase using evoked potential reaction of the bulbocavernosus reflex (BCR-EP). In both normal male subjects and male patients with neurologic bladder due to suprasacral spinal cord injury, sacral reflex activity was accelerated by bladder filling; the acceleration in the SCI patients was more remarkable than that in the normal subjects. In addition to the conventional evaluation of the integrity of sacral reflex arc by BCR examination, the observation of changes of BCR affected by bladder filling may provide information regarding the continuity of the sacral segment and supraspinal micturition center.

Conclusion

- **Very little data on bulbocavernosus –external sphincter conduction measurement exists in the literature, and this technique thus still has to be considered as experimental.**

f) Nerve conduction study

In patients with diabetes mellitus, Andersen and Bradley [56] showed decreased conduction velocities in those with a detrusor reflex as well as detrusor areflexia. The findings indicated that diabetic vesical dysfunction is principally the result of segmental demyelination in the peripheral nerve supply to the detrusor muscle and urethra.

Vereecken et al [57] found urethral and anal responses produced by electrical stimulation of penis, bladder neck and anus delayed and the duration reduced in pathologic conditions.

Carbone et al [58] assessed the effect of urinary bladder filling on the excitability of somatic spinal motoneurones in patients affected by overactive bladder secondary to neurologic and non-neurologic causes with the H-reflex evoked by electrical stimuli applied to the tibial nerve at the popliteal fossa and recorded from the soleus muscle. In healthy subjects, a progressive reduction in the H-reflex amplitude during bladder filling was observed. In spinal cord-injured patients affected by a neurologic overactive bladder, bladder filling failed to inhibit the H-reflex amplitude; a decrease in the H-reflex amplitude similar to that displayed by normal subjects was observed in patients with a non-neurologic overactive bladder.

By contrast, H-reflex behavior was unmodified in neurologic underactive bladder patients and was similar to normal subjects in psychogenic underactive patients. H-reflex modulation may be considered a useful tool in the differential diagnosis of voiding dysfunctions.

Conclusion / Recommendation

- **Few data are found in the literature on nerve conduction studies for LUT neurologic problems.**
- **There are some arguments that the technique can be useful in the further differentiation of the nerve deficits in cases in diabetes and spinal cord lesion.**

g) Somatosensory evoked potentials (SSEP)

Badr et al [59] described techniques of recording evoked potentials in humans in response to stimulation of the urinary bladder.

Galloway et al [60] described a simple method of sacral evoked response to measure the integrity and function of the lower sacral segments of the cord by stimulation at the urethral and anal sphincters.

Mochida et al [61] studied evoked spinal cord potentials (ESCPs) in surgical patients with cervical myelopathy. The presence of neurologic bladder was closely correlated with severe limb symptoms and relatively slow ESCP velocity. However, for 47% of the patients with urinary complaints, findings of urodynamic examinations were negative; these patients probably had pathologic or psychosomatic factors other than neurologic bladder due to cervical myelopathy.

Curt et al [62] studied the significance of SSEP recordings in predicting the recovery of bladder function in acute, traumatic spinal cord injury (SCI). They found a good correlation with the recovery of the external urethral sphincter function but not with the urodynamic impairment.

Conclusion

- **Somatosensory evoked potentials can be of use in the further diagnosis of nervous deficits related to LUT dysfunction (Grade C).**

h) Electrosensitivity in the LUT

Measurement of the sensory threshold of the LUT towards electrical stimulation was performed by Frankl-Hochwart and Zuckerkandl already in the 19th century [63]·. After re-introduction of the technique by Markland et al [64] several authors have studied its value in neurologic bladder dysfunction.

Frimodt- Möller [65] described pathological electrosensation in patients with Parkinson's disease, with multiple sclerosis and meningomyelocoele. He also found abnormal electrosensation in half of patients with diabetes and generalized sensory neuropathy, but only in 10% of the diabetic patients with a neurologic bladder.

Kieswetter [66] and Powell and Feneley [67] demonstrated abnormal electrosensation in patients with neurologic LUT dysfunction.

Wyndaele [68] determined the threshold of sensitivity to electrical stimulation in several parts of the LUT in 436 consecutive patients. In the groups with different patterns of disturbed sensation a higher incidence of neuropathy was found than in the group with a normal sensation. Further neurological investigation revealed abnormal innervation in 29% of patients who lacked electrosensitivity in one or more parts of the LUT but who had shown no previous evidence of neuropathy.

Electrosensation proved present in many meningomyelocoele patients with absent skin sensation and absent reflexes and in many patients with suspected complete spinal cord injury on clinical evaluation [30-31].

Standardization is necessary for reproducible results [69]

Conclusion

- **Determination of electrosensation in the LUT is valuable to evaluate the afferent innervation.**
- **Absent electrosensitivity may help to decide on further neurologic tests in patients with LUT dysfunction of unknown cause.**

Recommendations

- **The determination of electrosensitivity in the LUT can be recommended for evaluation of the afferent innervation in patients with a known neurologic disease and in patients with idiopathic LUT dysfunction if neurologic pathology is suspected.**

4. Sympathetic skin response

Schurch et al [70] assessed the degree of sparing of the descending sympathetic spinal tract and correlated these findings with bladder neck function in SCI patients. Evidence is presented that the integrity of the descending sympathetic spinal tract is necessary for a synergic function of the vesicourethral complex and that sympathetic skin responses are of value in the diagnosis of bladder neck dyssynergia. For lesions below the T12 level other investigative methods to exclude bladder neck dyssynergia are necessary.

Rodic et al [71] investigated whether recording the perineal sympathetic skin response, which reflects the sympathetic function of the thoracolumbar spinal cord, represents a reliable and accurate diagnostic tool for assessing bladder neck competence and incompetence. They found that recording the perineal SSR in addition to that of the hand and foot represents a sensitive diagnostic tool for assessing sympathetic nerve function within the thoracolumbar spinal cord. It is of diagnostic value for evaluating neurologic bladder neck incompetence in spinal cord injured patients.

Conclusion

- **These publications indicate that sympathetic skin responses seem of value to evaluate the integrity of the LUT related sympathetic function and especially for bladder neck competence, incompetence and dyssynergia**

Recommendation

- **From the publications sympathetic skin responses seem promising and the further study of them are recommended for the evaluation of the LUT sympathetic innervation.**

C3. CONSERVATIVE TREATMENT

- **Therapeutic Principles in different pattern of LUT dysfunction**

Neurologic urinary incontinence may be due to

1 **dysfunction of the detrusor**

2 **dysfunction of the sphincter** and

3 **a combination of both.**

Neurologic detrusor overactivity leads to reflex-incontinence, detrusor areflexia to incontinence with retention (overflow incontinence). An areflexic (incompetent) sphincter causes neurologic stress-incontinence, a **hyperreflexic (spastic) sphincter overflow-incontinence. Q**uite often **detrusor and sphincter are affected simultaneously** by the neurologic lesions with basically four combinations.

In most patients the storage problem, leading to incontinence, is associated with an emptying problem; therefore both aspects have to be considered at the same time.

Therapy of neurologic incontinence is primarily a conservative one. Timed bladder emptying, by whatever means, controlled fluid-intake and avoidance of urinary tract infections are the prerequisites for successful treatment.

In (a) **SUPRASPINAL LESIONS** neurologic detrusor overactivity is mostly combined with normal sphincter function, reflex incontinence is the main symptom and anticholinergic therapy together with behavioural treatment, especially in patients with cognitive impairment, is the method of choice.

(b) **SPINAL LESIONS** mostly cause simultaneous dysfunction of the detrusor and the sphincter.

In **suprasacral lesions** the combination of a **overactive detrusor with a hyperreflexic sphincter** is characteristic for the **spinal reflex bladder.**

Basically spontaneous reflex voiding is possible; however, it is uncontrolled, causing *reflex-incontinence* and is mostly unbalanced and basically unphysiologic. Detrusor contractions are mostly inadequate, and detrusor striated sphincter dyssynergia is present, both leading to unbalanced voiding.

Triggered reflex voiding is recommended only if it is urodynamically safe and reflex incontinence is manageable. The method of choice nowadays to empty an unbalanced reflex bladder and to manage reflex-incontinence is *intermittent (self-) catheterisation*. However, to achieve the aims of therapy, - a low pressure LUT situation and continence between catheterisations - additional *pharmacotherapy* may be necessary.

If bladder relaxing agents fail or are not tolerable, *electrotherapy* is an alternative in incomplete lesions : ano-genital electrostimulation (penile, clitoral, vaginal and anal) can inhibit neurologic detrusor overactivity by stimulating pudendal nerve afferents.

If none of the above mentioned treatment modalities

is effective to control reflex incontinence and if operative procedures are not indicated or possible, appliances, pads or condom-catheters, are the first choice in males and pads in females. To improve outflow, treatment to lower tone and spasticity of the urethral sphincter can be used.

The indwelling catheter – a suprapubic catheter is preferable to transurethral – remains the last resort for conservative therapy.

For complete **conus lesions**, also named lower motor neuron lesions, **areflexia of the detrusor with areflexia of the sphincter** is characteristic. Sphincter incompetence causes neurologic urinary stress incontinence and may be combined with overflow-incontinence if adequate emptying is not achieved.

Basically, regular bladder emptying achieved by bladder expression, according to the individual bladder capacity, in combination with controlled fluid intake may decrease neurologic urinary stress incontinence. However, continence is hard to achieve. *Bladder expression* is potentially dangerous. Pharmacotherapy is not helpful in this situation, appliances and condom catheters are therefore often necessary. Continence can often be achieved only by operative therapy.

Areflexia of the detrusor combined with hyperreflexia of the sphincter may occur in epiconal lesions; however, this pattern may be also due to a decompensation of a neurogenic overactive bladder after chronic urinary retention. With this combination overflow incontinence can be controlled by intermittent catheterisation mostly without adjunctive additional pharmacotherapy. If intermittent catheterisation is not possible, an indwelling catheter, preferable suprapubic, may be needed.

If **overactivity of the detrusor is combined with areflexia of the sphincter**, a pattern sometimes found in epiconal lesions, especially in myelomeningoceles, reflex incontinence is combined with neurologic stress incontinence. Bladder relaxant agents may abolish or diminish neurologic detrusor overactivity. In incomplete lesions electrical stimulation of the pelvic floor musculature may improve sphincter function. Thus the combination of pharmacotherapy to treat reflex incontinence with electrotherapy of the pelvic floor muscle may improve continence. However, with this type of neurologic LUT dysfunction conservative treatment alone is generally unable to restore continence; therefore either appliances or operative treatment must be considered.

(c) SUBSACRAL (CAUDA EQUINA AND PERIPHERAL NERVES) LESION are often incomplete lesions. Overactivity or areflexia of the detrusor may be combined with a normally functioning external striated sphincter, a combination which can be seen after intrapelvic surgery, when the pudendal nerves remain intact. On the other hand if the pudendal nerve is lesioned and the pelvic plexus remains more or less intact, a combination of a normally functioning detrusor with a hypo- or areflexic external sphincter may be present. For the neurogenic overactive detrusor, again, pharmacotherapy is the first choice. In the hyporeflexic detrusor cholinergics may increase the tone. If the lesions were incomplete, intravesical electrotherapy was reported to increase detrusor contractility. The chances for pharmacotherapy to improve external sphincter weakness as well as to decrease external sphincter spasticity are poor. Injection of botulinum toxin in the striated sphincter has created a new tretament option.

If conservative treatment fails several surgical options are available. They will be discussed in the corresponding part of this chapter.

Since only some conclusions and recommendations are changed and some new references are added, when comparing with the 2002 chapter, this chapter presents only the new literature, justifying the changes and actual conclusions and recommendations. For previous references as well as for general outlines please refer to the ICI 2002 chapter.

The following text will not deal specifically with the period of spinal shock or cerebral shock in acute neurological lesions when the urologic treatment consists of proper bladder drainage. For the post shock period or for slowly developing dysfunctions several conservative treatments exist:

I. BEHAVIORAL THERAPY
1 Triggered reflex voiding
2 Bladder expression (Crede and Valsalva maneuver)
3 Toileting assistance

II. CATHETERS
1 Intermittent catheterization
2 Indwelling catheterization
3 Condom catheter and external appliances

III PHARMACOTHERAPY

IV. ELECTRO STIMULATION
1 Electrical Neuromodulation
2. Electrical stimulation of the pelvic floor musculature
3. Intravesical electrical stimulation (IVES)

I. BEHAVIOURAL THERAPY

1. Triggered reflex voiding (references see ICI 2 report)

• *Background*

The true automatic or reflex bladder occurs following recovery from spinal shock in spinal cord lesions not involving the conus or cauda equina. If the latters or the efferent branches of the pelvic nerve are involved, the reflex emptying is much less complete, and considerable voluntary straining is required to empty the bladder to a satisfactory degree. The stimulation of the sacral and lumbar dermatomes should be used to elicit reflex contractions of the detrusor in cases with upper motor neuron bladders.

The aims of regular triggered reflex voiding are to achieve balanced voiding, to decrease incontinence and/or to achieve continence. Prerequisites for this type of bladder emptying are: the possibility of collecting the urine in a socially acceptable way and an adequate time needed for bladder emptying.

Bladder reflex triggering comprises various manoeuvres performed by patients in order to elicit reflex detrusor contractions by exteroceptive stimuli. The most commonly used manoeuvres are: suprapubic tapping, thigh scratching and anal/rectal manipulation.

Frequency of use, intervals and duration has to be specified for each patient. Integrity of sacral reflex is requested for such voiding manoeuvres.

Today, learning triggered voiding should not be done without considering bladder outlet obstruction management, continence, appliances, gender, and level and type (complete or incomplete lesions, para- vs quadriplegic patients) of lesion.

Assessment of management by triggered reflex voiding is difficult because of the mostly retrospective nature of the reports and because the management of concomitant bladder outlet onstruction is not specified or incompletely described.

An additional indication could be a quadriplegic patient who is unable to perform self-catheterization but is able to do tapping or triggered voiding. They may choose this option because it gives more independence.

Before considering triggered reflex emptying, one must check if the bladder situation is urodynamically safe (mainly low pressure bladder) and if regular follow-up is guaranteed. The frequency of check-up is not validated, depends on risk factors, but should be between 6 months and 2 years.

To improve emptying and, control autonomic dysreflexia related to bladder filling and contraction as well as to avoid upper tract damage, alpha-blockers [1] (LOE 3) or botulinum toxin sphincteric injections (see related part of this chapter) should be tried before sphincterotomy and/or bladder neck incision is performed.

Triggered voiding should not be recommended as first line management of bladder hyperreflexia and neurogenic LUT dysfunction. Intermittent catheterisation has become the gold standard to achieve continence, upper urinary tract protection and improvement of quality of life (see recommendations in the section of intermittent catheterisation).

Conclusions

- **Reflex voiding is based on an unphysiological sacral reflex. It is potentially dangerous and has a limited role in managing the reflex bladder (LOE3).**
- **The long-term complication rate is not as high as with indwelling catheter, but enough to suggest a trend to avoid this triggered reflex voiding in detrusor overactivity (LOE2).**
- **Costs of appliances and of adjuvant therapies (pharmacotherapy, surgery, urethral prosthesis etc) have to be evaluated (LOE 2).**
- **Treatment of co-existing sphincteric spasticity (botulinum toxin, α-adrenolytics) and comorbidity should be taken into consideration (LOE 3).**

Recommendations

- **Triggered voiding could be recommended for patients whose situation has proven to be urodynamically safe and stable, and who can manage reflex incontinence. Moreover it is recommended for patients after sphincterotomy and/or bladder neck incision and/or alpha-blockers and or intrasphincteric botulinum toxin injections, in order to improve spontaneous reflex voiding (Grade C).**
- **Reflex voiding can be recommended only if an adequate follow-up is guaranteed (Grade C).**

2. Bladder expression (Credé and Valsalva) (References see ICI 2 report)

• *Background*

Bladder expression has been recommended for a long time for patients with a combination of an areflexic detrusor with an areflexic sphincter or with an incompetent urethral closure mechanism of other origin (e.g. after sphincterotomy).Difficulties in emptying the bladder by expression may be due to an inability to open the bladder neck. However, especially in men, these techniques induce a functional obstruction at the level of the striated external sphincter despite complete paralysis of the musculature of the pelvic floor.

Bladder expression comprises various techniques aimed at increasing intravesical pressure in order to facilitate bladder emptying. The most commonly used are the Valsalva (abdominal straining) and the Credé (manual compression of the lower abdomen).

With increasing time, using Valsalva and Credé techniques, more than 50 % of patients could show demonstrable reflux into the prostate and the seminal vesicles and other complications, e.g. epididymo-orchitis. Moreover, the high pressures could cause reflux into the upper urinary tract with all known complications. The stress to the pelvic floor with these techniques several times a day also has a negative influence on the existing minimal storage function of these structures and therefore makes incontinence worse, causes additional genital-rectal prolapse and haemorrhoids.

Adjunctive therapy to decrease outflow assistance includes alpha-blockers, sphincterotomy or botulinum toxin injections. If effective, they usually cause or increase neurologic urinary stress incontinence. Expression of the bladder for voiding by Credé and Valsalva can be effective. To empty the bladder, the pressures measured may be high and potentially dangerous for the upper urinary tract. **Bladder expression is often not safe.** Sphincter-hyperreflexia and detrusor-sphincter dyssynergia are contra-indications for bladder expression.

Conclusions

- **Bladder expression by Valsalva or Credé is potentially hazardous for the urinary tract due to functional obstruction at the level of the pelvic floor (LOE 3).**
- **It is contraindicated if it creates a high intravesical pressure, or/and if vasal reflux or/and vesico-uretero-renal reflux are present. In addition, hernias, recto-genital prolapse and hemorrhoids as well as urethral pathology (stricture formation) and recurrent symptomatic UTIs are further contraindications (LOE 3).**
- **It may have a negative influence on an existing minimal outflow resistance of a flaccid pelvic floor and therefore incontinence may become worse (LOE 3).**
- **Alpha-blockers, sphincterotomy or botulinum toxin may reduce the outflow resistance, but may also induce or increase urinary stress incontinence (LOE 3).**

Recommendations

- **Before recommending bladder expression by Valsalva or Credé, it must be proven that the situation in the LUT is urodynamically safe. Basically the method is dangerous.Grade B**
- **Exclude contraindications, such as a vesico-uretero-renal reflux, vasal reflux, genito-rectal prolapse, hernias, urethra pathology and symptomatic UTIs before recommending this type of bladder emptying. Grade B**
- **In general, bladder expression should be replaced by CIC in most patients with neurologic bladder-sphincter dysfunction. Grade B**
- **Adjunctive therapy of outflow obstruction can be considered. Grade B.**
- **Valsalva and Credé guarantee a good quality of life and are cost-effective in the long term only when the indication is proper and when the situation remains stable throughout the years. Grade B**

3 Toileting assistance: timed voiding, habit retraining, prompted voiding (references see ICI 2 report)

For a more complete overview consult the chapters “adult conservative treatment” and “frail elderly”.

a) Background

Adaptation of the drinking and voiding regimen is determined by education and can be implemented by the patient and/or caregivers.

In patients with neurologic incontinence related to brain diseases, when independent continence cannot be achieved, social and/or dependent continence is sometimes achievable.

The aim of the behavioural process in adults is to re-establish the control of urinary continence. The goals include correcting faulty habit patterns of frequent urination, improving ability to control bladder urgency, prolonging voiding intervals, increasing bladder capacity, reducing incontinent episodes, and building a patient's confidence in controlling his/her bladder.

Behavioural measures would seem to be beneficial for most neurologic patients in one way or another. Good indications are most common in brain diseases as cerebro vascular disease, Parkinson's disease, multiple system atrophy, dementia, and cerebral palsy. Other diseases can also be good indications such as multiple sclerosis, incomplete spinal cord injury, transverse myelitis, diabetes mellitus and others. Frail elderly neurologic patients who need assistance can also benefit from these techniques independent of the disease they suffer from.

In dependent patients all these techniques can be proposed and tried, provided that caregivers (physiotherapist, nurse, member of the family…) are aware of them and are motivated to use them.

The following toileting assistance techniques require caregivers/ assistance in many of the patients:

- Timed voiding
- Prompted voiding
- Habit retraining
- Bladder retraining
- Patterned urge response toiletting

1. Timed voiding

Timed voiding is characterized by a fixed interval between toileting. It is a passive toileting assistance program. It is initiated and maintained by caregivers. This technique is considered appropriate for patients who cannot participate in independent toileting. It has been used in patients whose incontinence may be associated with cognitive and/or motor deficits. Its aim is more to avoid incontinence than to restore a normal bladder function.

For neurologic patients it has also been considered as an adjunct therapy to tapping and/or crede manoeuver and/or intermittent catheterisation. Timed voiding is one of the first steps of treating too high bladder volumes, as in diabetes patients with loss of bladder filling sensation.

2. Habit retraining and prompted voiding

Both of these techniques have to be inititated and maintained by caregivers. They are more adapted to patients with brain diseases than to spinal cord diseases and for patients with cognitive and/or motor deficits.

The aim of habit retraining is to help patient to avoid incontinence and/or involuntary bladder contractions by decreasing voiding intervals. Such program has to be adapted to each patient and needs a specific analysis of voiding patterns to select a good individual schedule for voiding. Such a program is very useful for instutionalised patients.

Prompted voiding is used to teach people to initiate their own toileting through requests for help and positive reinforcement from caregivers when they do this. This technique needs an outside individual's participation in the process. There are no specific evaluations on neurologic patients in literature, though the technique may be useful in patients with incomplete neurologic lesions, and in patients with high dependence and good cognitive function.

Conclusions

- **Behavioural techniques have to be used in conjunction and/or in addition with other therapies (pharmacological treatment, catheterisation) (LOE 2)**
- **There is no consensus, either on the definition of each technique nor on the population that can benefit from it. When available, toileting assistance should be used to improve continence of neurologic impaired patients. (LOE 3)**
- **There is still some evidence that prompted voiding is able to decrease incontinence episodes. Long-term effect of this therapy is not validated. Moreover there is evidence that patients who should have more benefit of this technique are those with less cognitive impairment and higher dependency (LOE 2/3)**

Recommendations

- **Behavioural techniques could be recommended as a part of each individual rehabilitation program. Grade C**
- **No guidelines or consensus on correct intervals between bladder emptying has been reported. They should be fixed, but have to be adapted to voiding diary and other related factors as was detailed in the previous report: bladder volume, fluid intake, post-void residual urine volume, urodynamics parameters. Grade C**
- **The mental status of a patient must be taken into consideration, and a rehabilitation program realistically tailored to the patient's possibilities. Grade B/C.**

II. CATHETERS

All technical aspects of incontinence devices can be found in the chapter "Technical aspects of continence devices" of this report. Detailed description of catheter use in neurologic patients can be found in the previous ICI 2 report under "Conservative management in neurologic urinary incontinence", page 697 and following. Only literature data published since are summarized here.

1. Intermittent catheterization [IC]

a) Background

Intermittent catheterization (IC) and self-catheterization (ISC) have become properly introduced during the last 40 years. In general, the purpose of catheterization is to empty the bladder and of IC is to resume normal bladder storage and regularly complete urine evacuation. With IC and ISC there is no need to leave the catheter in the LUT all the time, thus avoiding complications of indwelling catheterization (ID).

It is clear that IC can improve incontinence or make patients with neurologic bladder continent if bladder capacity is sufficient, bladder pressure kept low, urethral resistance high enough, and if care is taken to balance between fluid intake, residual urine and frequency of catheterization.

The main aims of IC and ISC are to empty the bladder and to prevent bladder overdistension in order to avoid complications and to improve urological conditions. The optimal post-void residual indicating the need to start bladder catheterization remains to be clarified, though Dromerick et al [2], (LOE 2) demonstrated in a series of stroke patients that a post-void residual greater that 150ml is an independent risk factor for development of UTI.

b) Technique

There exists neither one best technique nor one best material, as both depend greatly on patients' individual anatomic, social and economic possibilities [3] (LOE 1).

Two main techniques have been adopted, a sterile IC (SIC) and a clean IC (CIC). The sterile non-touch technique [4] involves the use of sterile materials handled with sterile gloves and forceps. In an intensive care unit, some advocate wearing a mask and a sterile gown as well.

In a prospective, randomized cross-over trial done in children with neurologic bladder, Schlager et al [5] (LOE 3) demonstrated that a new sterile catheter for each void did not decrease the frequency of bacteriuria in comparison with re-usable clean catheters.

Giannantoni et al [6] (LOE 3) compared prelubricated non-hydrophilic catheters with conventional Nelaton catheters, finding that pre-lubricated catheter use resulted in less urethral injuries and better patient satisfaction.

- ***Frequency of catheterization***: This depends on many factors as bladder volume, fluid intake, postvoid residual, urodynamic parameters (compliance, detrusor pressure). Usually it is recommended to catheterize 4 – 6 times a day during the early stage after spinal cord lesion. Some will need to keep this frequency if IC is the only way of bladder emptying. Others will catheterize 1 – 3 times a day to check and evacuate residual urine after voiding or on a weekly basis during bladder retraining
- ***Adjunctive therapy***: To overcome high detrusor pressure antimuscarinic drugs or other bladder relaxants can be indicated. For those who develop a low compliance bladder, upper tract deterioration or severe incontinence, injection of Botulinum toxin in the bladder wall or surgery, such as bladder augmentation, may be necessary.

If catheterization is begun by patients with recurrent or chronic UTI and urinary retention, the incidence of infection decreases and patients may become

totally free of infection. If symptomatic infections occur, improper CIC or misuse often can be found. Chronic infection persists if the cause of the chronicity remains. Treatment of UTI is necessary if the infections become symptomatic. The incidence of urethral strictures increases with a longer follow-up.

Bladder stone formation was found to be associated with long-term use of CIC [7] (LOE 2).

Conclusions

- **CIC is effective and safe to treat the neurologic bladder in the shortterm and in the longterm. (LOE 1)**
- **Complications such as UTI are regularly seen and seem to be related to both the catheterization itself and the existing LUT condition (LOE 2)**
- **Urethral and bladder complications seem to increase in the longterm (LOE 2)**
- **In order to reduce and prevent complications, appropriate materials and correct techniques should be taught and performed (LOE 3)**
- **Adequate frequency of CIC, a non-traumatizing technique and suitable materials are the key factors for a successful outcome (LOE 2)**

Recommendations

- **It should be recommended to use CIC as the first choice of treatment for those with inability to empty the bladder adequately and safely. It is a valuable tool for achieving continence in the neurologic voiding dysfunction. Grade A**
- **Proper education and teaching are necessary to permit a good outcome. Grade B**
- **To prevent and reduce complications, a non-traumatizing technique (external lubricant or lubricant coated catheters) with adequate frequency of catheterization and complete emptying should be strictly performed. Grade B**
- **Minimal requirements for regular once a year follow-up are history taking, physical examination, imaging, laboratory results and urodynamic tests, in order to early detect risk factors and complications. Grade B/C**

2. Indwelling Urethral Catheters – transurethrally/suprapubically

a) Background

In early 19th century, a urinary catheter with a balloon bag (Foley cathether) was developed. After the World War I, the majority of spinal cord injured (SCI) as well as other neurologic patients were treated with *indwelling urethral cathetherisation (ID)* or *suprapubic catheterisation (SC)* due to difficulty in voiding or urinary incontinence. Nowadays, *intermittent catheterisation (IC)* is recommended for neurologic patients. Nevertheless many choose ID as a mean of treating urinary incontinence due to difficulty in performing IC or persistent leakage between catheterisations. In developing countries ID is still the method of choice for those with urinary retention or incontinence.

Studies have shown that ID causes various complications such as urethral trauma and bleeding, urethritis, fistula due to pressure effect caused by improper size of the urethral catheters and improper technique of securing the catheters, bladder and renal stones, cystitis, acute and chronic urinary tract infection (UTI), bladder neck incompetence, meatus and urethral sphincter erosion and bladder carcinoma. Many of these complications were related to long-term use. Therefore many experts advocate removal of the urethral catheter as soon as possible, and usage of other methods such as IC or SC to decrease urethral complications. However, nowadays the complications of ID seem less, due to better materials, the use of smaller size catheters and a proper technique of securing the catheter.

Transurethral ID needs a lot of meticulous skill and care. Materials used should be sterile and handled properly by a well-trained person. In some centers, a well-trained catheter team has proved to lessen complications related to catheterisations.

It is suggested that more frequent catheter change should be performed in patients with recurrent urinary tract infections (once a week or every two weeks) [8] (LOE 4).

The study by Pannek [9] (LOE 3) reported 0.11% incidence of bladder cancer amongst SCI individuals (48 out of 43,561 patients) which is similar to that observed in the general population. However more than 60% of the patients with SCI initially presented with muscle-infiltrating bladder cancer. The expression of inducible nitric oxide synthase was demonstrated in patients with SC or ID by Wall et al [10] (LOE 3), a finding which may potentially lead to the

sustained production of nitric oxide and its oxidative products, the nitrosation of urinary amines and the formation of potentially carcinogenic nitrosamines in the bladder. Hamid et al [11] LOE 3 however ,in their retrospective series, did not find bladder cancer on bladder biopsies in patients with SC and a mean catheter time of 12.1 years.

A case of osteomyelitis of the pubis was rapported by Stern et al [12] (LOE 3)

b) Antibiotic prophylaxis

Routine antibiotic prophylaxis for patients with SC or ID is not recommended. Attempts at eliminating bacteriuria associated with indwelling or intermittent catheters are generally unsuccessful [13](LOE4).

For prevention of UTI, general cleanliness and local hygiene should be encouraged. If the patient has a symptomatic UTI, it is important to check for catheter blockade and complications as urinary stones. Symptomatic urinary infections have to be treated with the most specific, narrowest spectrum antibiotics available for the shortest possible time.

Guidelines for selecting antimicrobial agents in SCI patients are similar to guidelines for the treatment of complicated urinary infections in the general population. Characteristics of the quinolones make them well suited for treating UTI in SCI patients [14] (LOE 4).

Conclusions:

- **Transurethral ID is not a safe method for a long-term use in neurologic patients. (LOE 2)**
- **To control urinary incontinence, ID is effective if there is no blockade or urethral/bladder neck erosion (LOE 3)**
- **Catheters size 12-16F with as large a lumen as possible and smaller (5-10 ml) self-retaining balloons are recommended for adults to minimise the pressure effect on the bladder neck and to maximise time to blockage by incrustation. (LOE 4)**
- **Use of less irritating catheters and closed drainage system should be encouraged to minimise complications. (LOE 2)**
- **If available siliconised catheters may be used with more frequent change. (LOE 3)**
- **Frequency of change largely depends on materials and size of catheter lumen e.g., every 1-2 weeks for siliconised latex catheters, every 2-4 weeks or longer for silicone or hydrogel-coated catheters. (LOE 3)**

Recommendations:

- **Whenever a transurethral catheter is applied, full silicone or hydrogel-coated catheters are preferable. (Grade A/B)**
- **Use sterile materials and aseptic technique followed by the routine catheter care to maintain aseptic closed drainage system. (Grade C/D)**
- **Catheters should be changed regularly, if possible, before obstruction or infection occurs. (Grade C/D)**
- **Bladder irrigation and antibiotic prophylaxis are not recommended as a routine infection-control measure. Symptomatic UTI should be treated with narrowest spectrum antibiotic possible (Grade B)**
- **Patient education on daily cleanliness and hygiene care and a thoroughly urological check-up are mandatory. (Grade C)**
- **A short-term ID during the acute phase is still a safe method for neurologic patients. (Grade B)**
- **Long-term ID may be safe only if a careful check-up of urodynamic, renal function, and upper and lower tract imaging are performed regularly at least yearly. (GradeB)**
- **Bladder screening for bladder cancer is mandatory especially those with ID/SC more than 5-10 years. (Grade C)**
- **Annual cystoscopy and biopsy may be necessary for those after 10 years of ID and those with an episode of gross hematuria, chronic symptomatic UTI refractory to therapy. (Grade C)**

c) Suprapubic catheterisation – special aspects

An alternative to indwelling urethral catheterization is an indwelling catheter placed through the lower abdomen into the dome of the bladder, called a suprapubic catheter (SC).

Overall the benefit and risks of the SC are very similar to the indwelling urethral catheter including the risk for urinary tract infection, stone formation, bladder cancer, and maintenance cost of catheter and bag. However, there are several benefits and one key disadvantage. Its advantages include: minimized risk of urethral trauma in men and women, minimized risk of urethral destruction in neurologically impaired women with even relatively short-term indwel-

ling urethral catheters, and minimized urethral pain. The key disadvantage is that it requires a minor 'surgical' produce to insert the suprapubic catheter with potential to injure structures adjacent to the bladder, especially the large intestine. The preferred insertion technique appears to be quite variable by region and country. There is no evidence that there is one best way to insert the SC.

Long-term management of the neurologic bladder with the SC is a controversial topic in neurourology. The issue of controversy is that some rehabilitation centers across the world highly favor the suprapubic catheter as a safe and effective long-term management of the neurologic bladder. On the other hand, a large number of experts have personal experience with suprapubic tube complications during its long-term use.

The literature on suprapubic catheterization is limited, and most of publications are 20 years or older. There are no prospective studies and no RCT's on suprapubic catheterization. The bias of single center case series is the short follow-up with a worrisome large number of patients who are lost for follow-up. It is unclear if these patients may have developed complications and have died or were treated with alternative bladder management at a different hospital.

Conclusions

- **Suprapubic catheter is a reasonable alternative to indwelling urethral catheter, but both are clearly inferior to intermittent catheterization (LOE 3).**
- **It is a safe and effective short-term management of urinary retention. (LOE 3)**
- **It is not recommended for the routine use for the long-term management of the neurologic bladder. (LOE 2)**
- **Complications of SC are similar to that of ID, except the unique complication of bowel perforation and no urethral complications. (LOE 3)**

Recommendations

- **Suprapubic catheters are not recommended as a safe method for long term use in neurologic patients. (Grade B)**
- **Nowadays with less irritating catheter materials, improved closed drainage systems and regular urological check-up, long term complications can be decreased. Nevertheless SC is still the last resort when other methods fail or are not applicable or are not accepted by the patient. (Grade C)**
- **One should consider patient comfort, convenience, sexuality and quality of life before prescribe SC as a long-term management for neurologic patients. (Grade C)**

3. Condom catheter and external appliances

a) Background

Male patients with neurologic bladder and chronic urinary incontinence can be candidates for a condom catheter (CC) connected to a urine or leg bag to collect the urine. However some have difficulty in applying CCs, e.g. due to overweight and/or some degree of penile atrophy or retraction.

Conclusions

- **CC still has a role in controlling urinary incontinence in neurologic male patients (LOE 3)**
- **Long-term use may cause bacteriuria, but it does not increase the risk of UTI when compared to other methods of bladder management. (LOE 3)**
- **Complications may be less if applied properly with good hygiene care, frequently change of the CC and maintainance of low bladder pressures. (LOE 3)**
- **Special attention should be paid to people with dementia (LOE 3)**

Recommendations (All grades of recommendation = B/C)

- **To have better control of leakage, a more secure CC should be used, and patients should be educated and cooperative.**
- **To prevent latex allergy, a silicone CC should be used and serological examination of latex-specific IGE is recommended in addition to patient history to better identify patients at risk.**
- **To prevent compressive effects, choose proper size CC with self- adhesive.**
- **To prevent infection, a daily change of the CC could help.**
- **To prevent bladder and upper tract damage, regular bladder emptying with low bladder pressures and low post void residual should be persued.**

III. PHARMACOTHERAPY

Detailed data on pharmacotherapy are presented in a specific chapter (10) of the Committee for Drug Treatment. This chapter deals only with specific issues of pharmacotherapy in neurologic patients. We strongly recommend consulting the Drug Treatment chapter for levels of evidence and recommendations. References can also be found in the ICI 2 chapter on conservative management of the neurologic bladder.

The principal causes of urinary incontinence in this subpopulation are detrusor overactivity (neurologic OAD) and/or incompetence of urethral closing function. To improve urinary incontinence the treatment should aim at decreasing detrusor activity, increasing bladder capacity and/or increasing bladder outlet resistance. This picture is blurried by the occurence of detrusor/sphincter dyssynergia which can be present concomitantly with OAD.

Pharmacologic therapy has been particularly helpful in patients with relatively mild degrees of neurologic bladder dysfunction. Patients with more profound neurologic bladder disturbances may require pharmacologic treatment to improve results of other forms of management such as intermittent catheterization.

Although the two most commonly used classes of agents are antimuscarinic and alpha-adrenergic blockers, the drugs used for treating neurologic bladder/urethral dysfunction should be classified as follows (mainly drugs with known studies in neurologic bladder are presented here, i.e. their action was evaluated in neurologic patients).

1. DRUGS FOR INCONTINENCE DUE TO NEUROLOGIC DETRUSOR OVERACTIVITY AND/OR LOW COMPLIANT DETRUSOR

a) Bladder relaxant drugs

1. OXYBUTYNIN
2. PROPIVERINE
3. TROSPIUM
4. TOLTERODINE
5. PROPANTHELINE
6. OXYPHENCYCLIMINE
7. FLAVOXATE
8. TRICYCLIC ANTIDEPRESSANTS

b) Drugs for blocking nerves innervating the bladder and urethra

1. VANILLOIDS

• *Capsaicin*

• *Resiniferatoxin*

2. BOTULINUM TOXIN

2. DRUGS FOR INCONTINENCE DUE TO NEUROLOGIC SPHINCTER DEFICIENCY

a) Alpha-adrenergic agonists

b) Estrogens

c) Beta-adrenergic agonists

d) Tricyclic antidepressants

3. DRUGS FOR FACILITATING BLADDER EMPTYING

a) Alpha adrenergic blockers

b) Cholinergics

1. DRUGS FOR INCONTINENCE DUE TO OAD AND/OR LOW COMPLIANT DETRUSOR

a) Bladder relaxant drugs

Antimuscarinic agents are by far the most useful drugs in the management of the neurologic bladder: they are used to suppress DOA.

General indications of pharmacological treatment in DOA are to improve or eliminate reflex incontinence, eliminate/ prevent a high intravesical pressure and enhance the efficacy of intermittent catheterization (IC), triggered voiding and indwelling catheters. Neurologic OAD is mostly associated with a functional outflow obstruction due to detrusor-sphincter-dyssynergia (DSD). For the most part, pharmacotherapy is used to suppress reflex detrusor activity completely and facilitate IC. On the other hand bladder relaxant drugs would seem to decrease detrusor-contractility also during voidimg. With this situation residual urine may increase and must then be assisted or accomplished by IC. It must be stressed that with the current level of knowledge antimuscarinic therapy is not a causative treatment, but a symptomatic one.

1. Oxybutynin

Oxybutynin hydrochloride is a moderately potent antimuscarinic agent with a pronounced muscle relaxant activity and local anesthetic activity as well

• Oral Administration

Dose-dry mouth analysis showed that the probability of dry mouth with an increasing dose was significantly lower with oxybutynin XL than with immediate-release oxybutynin also in patients with neurologic bladder (LOE 3). In a 12-week, prospective, dose-titration study of extended-release oxybutynin (oxybutynin XL) in 10 SCI patients with urodynamically defined detrusor hyperreflexia, O'Leary et al showed clinical improvement within one week (decreased urinary frequency and fewer incontinence episodes) with oxybutynin therapy following titration to 30 mg per day. All patients chose a final effective dosage of greater than 10 mg, with 4 patients taking the maximum of 30 mg per day. Mean cystometric bladder capacity increased. No patient experienced serious adverse events [15]. Youdim and Kogan had similar findings in a small group of neurologic children [16]. Transdermal oxybutynin is another therapeutic option of delivering oxybutynin, avoiding most of the side effects, but no clinical studies are available in neurologic patients.

• Intravesical application

Intravesical instillation of oxybutynin is another interesting option of by-passing systemic side-effects. The study performed by Lehtoranta K. et al [17] (LOE 2) has demonstrated that in case of intravesical administration, the systemic effect of oxybutynin is prolonged due to prolonged elimination of the parent drug and its metabolite. The rate of symptomatic improvement ranged from 55 % to 90 %. No antimuscarinic systemic side effects have been reported in early short-term follow-up studies. However a study performed in children with neurologic bladder revealed that intravesical oxybutynin produced central nervous system–related side effects [18] (LOE 3). Intravesical instillation of oxybutynin is recommended for selected neurologic patients, who are already on IC but are still incontinent in between, due to persistent DOA, if oral medication is not successful or not tolerated (Grade C). The usual dose is 5 mg dissolved in 10-30 ml saline or water. The solution is instilled intravesically twice daily and retained for at least 30 minutes. There is so far no commercial preparation of this medication for direct instillation into the bladder.

Recently intravesical electromotive administration of oxybutynin solution has been reported. This method of administration is believed to increase bioavability and tolerance [19] (LOE 3).

Another interesting option is intrarectal administration of oxybutyn [20], but this has not been evaluated in neurologic patients yet.

2. Propiverine

Propiverine hydrochloride is a benzylic acid derivative with in vitro musculotropic (calcium antagonistic) activity and moderate antimuscarinic effects. It has a well documented effectiveness and a favourable tolerability and safety profile [21] (LOE 1).

3. Trospium

Trospium is a quaternary ammonium derivative with mainly antimuscarinic actions, it's effectiveness and safety was confirmed by recent meta-analysis [22] (LOE 1).

4. Tolterodine, Propantheline, Oxyphencyclimine, Tricyclic Antidepressants

are used by many clinicians around the world for bladder relaxation in patients with neurologic bladder. Local reports claim good clinical effectiveness. In literature no new data in neurologic patients on their effect and safety have been reported since ICI 2. Flavoxate does seem to be greatly ineffective for treating detrusor overactivity.(references in ICI 2 report)

b) Drugs for blocking nerves innervating the bladder

1. Vanilloids

Have been discussed in the ICI 2 report, and references before 2002 are to be found there

• Capsaicin

The use of capsaicin is still largely experimental and limited by the fact of prolonged and painful excitation of the sensory c-fibers.

• Resiniferatoxin

Resiniferatoxin (RTX) is a much more potent sensory antagonist than capsaicin. It is approximately 1,000 times more potent than capsaicin, based on the Scoville Heat Scale. Like capsaicin, it possesses vanilloid receptor agonist activity, resulting in desensitization. However, RTX acts without the potent neuronal excitatory effect of capsaicin, and therefore elicits less discomfort.

Giannantoni et al [23] (LOE 2) demonstrated that resiniferatoxin instillation is superior to that of capsaicin in terms of urodynamic results and that it does not cause the inflammatory side effects associated with capsaicin.. The use of this vanilloid promises an alternative for capsaicin that would be potentially therapeutic for overactive bladder. However, formal controlled trials still have to be performed to determine the precise use and dosage for this agent. The key advantage of RTX is that it is at least as effective as capsaicin, without much of the local and systemic side effects, such as pain and, inflammatory neuropeptide release and autonomic dysreflexia.

Recently Kuo et al [24] (LOE 2) rapported results of intravesical instillations of 10 μM RTX solution in 20 patients with spinal cord injury and detrusor sphincter dyssynergy. The mean maximum cystometric capacity increased significantly after treatment, but the detrusor pressure showed no significant change. The clinical effect was observed in two-thirds of patients with a spinal cord lesion. No changes in detrusor sphincter dyssynergy were observed.

RTX seems to have a beneficial effect on neurologic DOA (LOE 3). Randomized controlled studies are needed to determine its place in the treatment of neurologic DOA. Also the optimum doses (concentration) as well as the intertreatment intervals need to be determined.

2. Botulinum toxin A

Botulinum toxin A (BTX) is the most potent biological toxin known to man. The toxin acts by inhibiting acetylcholine release at the presynaptic cholinergic junction. Inhibited acetylcholine release results in regionally decreased muscle contractility and muscle atrophy at the site of injection. The chemical denervation results in a reversible process, as axons resprout in approximately 3-6 months.

There are two urological indications for botulinum toxin: detrusor overactivity and detrusor/sphincter dyssynergy (reversible shincterotomy).

Recently De Seze et al [25] (LOE 3) performed a randomized, placebo controlled study of transperineal intrasphincteric injections of botulinum toxin in spinal cord injured patients with detrusor-sphincter dyssynergy. They used 100 IU of Botox versus lidocaine. After botulinum toxin therapy the post void residual and maximum urethral pressure decreased significantly whereas no significant improvement was shown in the lidocaine group.

In another study by Kuo [26] (LOE 3) patients with detrusor hypocontractility due to peripheral neuropathy were studied. Treatment consisted of 50 IU of Botox transurethral injections in the sphincter. Success rate of 90% was reported. Median voiding pressure and maximum urethral clossure pressure decreased and were followed by post void residual decrease which remained stationary for 3 months. In a bigger study on a non-homogenous population of neurologic and non-neurologic patients Kuo [27] (LOE 3) obtained similar results with Botox doses 50-100 IU

An analysis of 200 cases treated with BTX intradetrusor for neurologic detrusor overactivity demonstrated a significant reduction in pressure parameters and increase in bladder compliance [28] (LOE 3).

A recently finished double-blind, multi-centre, randomised, placebo-controlled study evaluated botulinum toxin intradetrusor efficacy in 59 patients (53 spinal cord injury; 6 multiple sclerosis). Significant reductions in number of incontinence episodes compared to baseline ($p \leq 0.05$) were observed within the BTX group, but not in the placebo group.

Effects were apparent by the first assessment (week 2) and were maintained throughout the study period. Also improvement in functional parameters was observed for BTX but not for the placebo group (Significant increases in mean maximum cystometric capacity and significant decreases in maximum detrusor pressure) (*Schurch B. 2004, personal communication , LOE 2).*

Schulte-Baukloh et al [29](LOE 2) demonstrated the clinical benefit of botulinum toxin (Botox) detrusor injections in children with myelomeningocoele. They injected 85 to 300 IU of botulinum toxin into 30 to 40 sites of the detrusor muscle. The maximal bladder capacity increased and the maximal detrusor pressure decreased.

In another studies by these authors [30] (LOE 2) performed in children with neurologic detrusor overactivity resistant to anticholinergic therapy, they injected 30-50 sites of the detrusor muscle at 12 UI/kg of body weight up to a maximum of 300 UI and observed similar results as mentioned above.

Recently a case report of succesful therapy with botulinum toxin type B in a patient with multiple sclerosis was also published [31](LOE 4).

There have been 3 publications so far showing that BTX injections into the sphincter /or detrusor can cause transient general muscle weakness. Dykstra and Sidi saw such an effect after injection in the urethral sphincter in 3/5 SCI patients and documented it with electromyography of the deltoid muscle [32]. Generalised muscle weakness after BTX injection was also described in 2 SCL patients by Wyndaele and Van Dromme [33]. Del Popolo reported hyposthenia with reduced supralesional muscle force in 5.3 % of 93 patients with neurologic DOA (Del Popolo, Li Marzi, Panariello, and Lombardi: ISCoS meeting Athens, September 26-29, 2004, abstract oral 25 page 80). They suspected high dose and high spinal lesion to be contributing factors. Some caution is warranted about such possible side effects, and it is recommended to evaluate these further as more patients are treated in this way (Grade B).

2. Drugs for incontinence due to neurologic sphincter deficiency

Several drugs, including alpha-adrenergic agonists, estrogens, beta-adrenergic agonists and tricyclic antidepressants, have been used to increase outlet resistance. No adequately designed controlled studies of any of these drugs for treating neurologic sphincter deficiency have been published. In certain selected cases of mild to moderate stress incontinence a beneficial effect may be obtained.

3. Drugs for facilitating bladder emptying

a) Alpha adrenergic blockers

Alpha-adrenoceptors have been reported to be predominantly present in the bladder base, posterior urethra and prostate. Alpha-blockers have been reported to be useful in neurologic bladder by decreasing urethral resistance during voiding (references ICI 2 report).

Schulte-Baukloh et al [34] (LOE 3) studied the effect of alfuzosin in children with neurologic bladder and found that the detrusor leak point pressure decreased significantly. Additionally they demonstrated the lack of severe side-effects of such therapy.

b) Cholinergics

In general, bethanechol chloride seems to be of limited benefit for detrusor areflexia and for elevated residual urine volume. Elevated residual volume is often due to sphincter dyssynergia. It would be inappropriate to potentially increase detrusor pressure when concurrent DSD exists.

Conclusions

- **Bladder relaxant drugs, including oxybutynin, propiverine, trospium and tolterodine have a documented suppressive effect on incontinence by controlling overactive bladder, thereby improving storage function (LOE 1).**
- **However, all of these drugs presently available have considerably high incidence of side effects (dry mouth, constipation, urinary retention, etc.), which limits their usage. Tolterodine, propiverine, trospium and controlled-release oxybutynin have significantly less side effects compared to immediate-release oxybutynin (LOE 1).**
- **Although the oral application is the usual way, intravesical instillation or intrarectal (oxybutynin) may be an alternative (LOE 4).**
- **Intravesical instillation of capsaicin/resiniferatoxin has been reported to improve spinal reflex incontinence for several months after instillation (presumably blocking sensory input). Resiniferatoxin is preferable (LOE 3).**
- **Botulinum toxin injections into the detrusor muscle was reported to improve incontinence and increase functional bladder capacity in spinal cord injured patients with neurologic DOA (LOE 2).**
- **Botulinum toxin sphincteric injections were reported to decrease outlet resistance in case of detrusor sphincter dyssynergy in patients with neurologic bladder (LOE 2)**
- **There is no adequately designed controlled study of any drug for neurologic sphincter deficiency.**

5. Recommendations for practice

- **Bladder relaxant agents should be recommended for the treatment of reflex incontinence evoked by neurologic detrusor overactivity in patients in whom IC alone is unable to control it (Grade A).**
- **Titration of the dosage of these drugs individually should be done to achieve maximum therapeutic effect and minimal side effect. If one drug is not tolerated, try another drug as it may have less side effects (Grade C/D).**
- **Botulinum toxin injections may be an alternative for DOA if conventional therapy fails (Grade B).**
- **Vanilloids intravesical therapy still remains experimental and therefore is not recommended except within clinical trials (Grade C/D)**
- **Further attempts for the treatment of OAD should be undertaken to develop the ideal drug in terms of good efficacy, tolerability and safety (Grade D).**
- **For decreasing outlet resistance in neurologic bladder a-adrenergic antagonists may be used (Grade C)**
- **Botulinum toxin sphincteric injections may be an alternative to sphincterotomy in case of detrusor –sphincter dyssynergy (Grade B)**
- **For neurologic sphincter deficiency no effective drugs are available up to now; further research is needed (Grade D).**
- **For detrusor areflexia no effective drugs are avaliable up to now (IC remains the gold standard) ; further research is needed**

IV. ELECTROSTIMULATION

1. Electrical Neuromodulation

a) Background

In the last decade sacral nerve neuromodulation has been confirmed as a valuable treatment option to treat patients with symptoms of overactive bladder. The success with sacral neuromodulation has increased the interest in other neuromodulation techniques.

The current techniques of neuromodulation for treating overactive bladder – which includes detrusor overactivity of neurologic origin - are (a) anogenital electrical stimulation, (b) transcutaneous electrical nerve stimulation (TENS), (c) sacral nerve neuromodulation, (d) percutaneous posterior tibial nerve stimulation (Stoller afferent nerve stimulation, SANS) and (e) magnetic stimulation.

It is not really known how neuromodulation works, however, there is strong evidence that neuromodulation works at a spinal and at a supraspinal level.

The most important spinal inhibitory mechanisms of the micturition reflex are the guarding reflex (increased activity of the striated urethral sphincter in response to bladder filling, reflexively reducing detrusor contraction), Edvardsen´s reflex (increased activity of the sympathetic nervous system in response to bladder filling shown in animals), anal dilatation (afferent pathway: anorectal branches of the pelvic nerve, prevents voiding during defecation), gentle mechanical stimulation of the genital region (afferent pathway: dorsal clitoral or penile branches of the pudendal nerve; prevents voiding during intercourse) and physical activity (afferent pathway, muscle afferents from the limbs prevents voiding during fighting or fleeing).

At least two potential mechanisms are possible: activation of efferent fibres to the striated urethral sphincter reflexively causes detrusor relaxation and activation of afferent fibres cause inhibition at a spinal and a supraspinal level.

Dalmose et al [35] (LOE 3) reported an increase in cystometric capacity by conditional short duration electrical stimulation of the penile/clitoral nerve in patients with spinal cord injury. Lee et al [36] (LOE 3) described a case of self-controlled dorsal penile nerve stimulation for bladder overactivity in a 33-year-old man with C6 incomplete quadriplegia with beneficial effect on leakage between catheterization.

Amarenco et al [37](LOE 2) described results on urodynamic parameters of acute percutaneous posterior tibial nerve stimulation in 44 patients with neurologic bladder overactivity. He observed an increase in mean first involuntary detrusor contraction volume as well as in mean maximum cystometric capacity.

So far no reports refer to chronic percutaneous tibial nerve stimulation and magnetic stimulation in patients with neurologic OAB.

Conclusions

- **Electrical neuromodulation mostly is not the first line treatment for neurologic detrusor overactivity. There are some limited reports showing that it may be beneficial (LOE 3).**

Recommendation

- **If pharmacotherapy fails to relax the hyperreflexic detrusor, electrical neuromodulation may be optional in patients with neurologic detrusor (Grade C/D)**

2. Electrical stimulation of the pelvic floor musculature

a) Background (See ICI 2002 page 740)

The aim of electrical stimulation in patients with neurologic urinary stress incontinence is to improve the function, which are strengh and/or timing of the pelvic floor muscle contraction.

Electrical stimulation is provided nowadays mostly by portable battery powered stimulation. It offers a seemingly infinite combination of wave forms, frequencies, intensities, electrode placements etc.

In patients with incomplete denervation of the pelvic floor muscle and of the striated sphincter, electrostimulation via anal or vaginal plugs performed over months, may improve pelvic floor function, and may thus improve incontinence. The incompleteness of the lesion should be as such that the patient is able to contract voluntary the pelvic floor, even if such contraction is weak.

Conclusions

- **Although from the theoretical point of view and based on limited personal clinical experiences electrical stimulation via anal or vaginal plugs could be able to improve the strength of pelvic floor musculature, including that of the striated sphincter muscle, there is no study published which deals with this matter (LOE 5)**

Recommendations (Unchanged since ICI 2002)

- **In patients with incomplete denervation of the pelvic floor muscle and the striated sphincter, electrostimulation via anal or vaginal plugs performed over months, may be an option to improve pelvic floor function, thus improve incontinence.**
- **The incompleteness of the lesion should be as such that the patient is able to contract voluntary the pelvic floor even if this is weak (Grade C/D)**

3. Intravesical electrical stimulation (IVES)

• Background (read ICI 2002 page 741 and following)

The afferent stimuli induced by IVES travel along afferent pathways from the LUT to the corresponding cerebral structures. This "vegetative afferention" results in the occurrence of sensation for bladder filling/urge to void, with subsequent enhancement of active contractions and possibly also in voluntary control over the detrusor. A feedback training is mediated by enabling the patient to observe the change of the detrusor pressure on a water manometer, which enables the patient to notice when a detrusor contraction takes place. This also facilitates voluntary control.

The technique involves a catheter with a stimulation electrode, introduced into the bladder and connected to the stimulator. Saline (0,9 %) is used as the current leading medium within the bladder. The neutral electrode is attached to the skin in an area with preserved sensation, usually in the lower upper abdomen.

Intravesical electrical stimulation of the bladder (IVES) is still a controversial therapy for patients with neurologic detrusor dysfunction.

It is worthwhile to apply intravesical electrostimulation, bearing in mind inclusion and exclusion criteria, especially to verify functional afferent fibres within the bladder and the cortex. Intravesical electrotherapy is able to improve neurologic bladder dysfunction, primarily by stimulating a-delta mechanoafferents inducing bladder sensation and the urge to void and consequently increasing the efferent output with improvement of micturition and conscious control. Therefore IVES is the only available option to induce/improve bladder sensation and to enhance the micturition reflex in incomplete central or peripheral nerve damage. However, proper indication is crucial and this type of therapy should only be applied in those with afferent fibres between the bladder and the cortex, proved by the evaluation of viscerosensor cortical evoked potentials. If these conditions are respected, IVES can be effective. In ICI 2002 30 studies about IVES have been reviewed. The conclusions for this consultation are not different from what was given in 2002.

TECHNIQUES OF ELECTROSTIMULATION INVOLVING SURGERY ARE TO BE FOUND IN THE SURGERY SECTION.

Conclusions

- **Basic research during the last decade has proved the underlying working concept of IVES (LOE 3)**
- **The results reported in the literature are controversial, mainly because of different inclusion and exclusion criteria (LOE 3).**
- **In the only sham-controlled study the treatment period is too short and the inclusion and exclusion criteria are not really defined (LOE 3).**
- **The alternative may be either life long intermittent catheterisation or bladder augmentation. In this regards IVES is cost-effective (LOE 3)**

Recommendations

- **Intravesical electrotherapy is able to improve neurologic bladder dysfunction, inducing bladder sensation and the urge to void and consequently increases the efferent output with improvement of micturition and conscious control.Grade B/C**
- **IVES is the only available option to induce/improve bladder sensation and to enhance the micturition reflex in patients with incomplete central or peripheral nerve damage.Grade B**
- **Selection of patients is crucial and IVES should be applied only if afferent fibres between the bladder and the cortex are still intact and if the detrusor muscle is still able to contract. If these premises are respected, IVES is effective. Grade B**
- **The ideal indication is the neurologic hyposensitive and hypocontractile detrusor Grade C**

C4. SURGICAL TREATMENT

I. INTRODUCTION

Neurologic urinary incontinence may primarily result from dysfunction of the sphincter, the detrusor, or both in combination. Surgery may correct the incontinence, but it is usually indicated only after all conservative measures have been attempted and have proved to be ineffective.

Although preservation of renal function is a major goal of surgical treatment in this group, improvement in quality of life is the primary focus of therapy in most cases. Thus other factors to be considered in deciding on therapy will include: 1) social circumstances, 2) degree of disability, 3) cost effectiveness, 4) patient motivation and 5) complications.

The following section is a critical overview of the surgical procedures available to manage the various forms of neurologic urinary incontinence.

II. FAILURE TO EMPTY

1. SURGERY TO ENHANCE DETRUSOR CONTRACTILITY

Restoration of the bladder's reservoir function in combination with efficient voluntary emptying has been the aim of the bladder stimulation over the past decades. A variety of implants have been used in patients with spinal cord injury or disease, with electrodes on the bladder wall, the splanchnic pelvic nerves, the conus medularis, the mixed sacral nerve and the sacral anterior roots.

Direct bladder stimulation has produced poor results and has been abandoned [1]. Splanchnic pelvic nerve stimulation has also been abandoned due to difficulties encountered with surgical access and because these nerves also include sympathetic fibers to the bladder neck and afferent fibers [2]. Stimulation at the conus medularis level has been reported, with electrodes implanted directly into the grey matter of the cord [3]. When repeated, this work could not be reproduced [4].

a) Sacral anterior root stimulation

Brindley, in London, started animal experiments in order to develop a system for intradural sacral anterior root stimulation in the 70's. The first successful sacral anterior root stimulator in a human subject with traumatic paraplegia, was implanted in 1978 [5]. Since then more than 3000 patients have been implanted worldwide. The technique of intradural sacral anterior root stimulation consists of the combination of complete posterior rhizotomies (S2, S3, S4) and simultaneous implantation of the Finetech-

Brindley electrodes on the remaining anterior roots. Posterior rhizotomy promotes detrusor areflexia and normal compliance, thus avoiding reflex incontinence.Posterior rhizotomy will also abolish reflex bowel emptying, and sexual function. With this technique more than 80% of the patients were able to achieve sufficient intravesical pressure to produce efficient voiding. Several attempts since then have been made to improve this technique. The principal purpose of the Finetech-Brindley bladder controller is to achieve bladder emptying. Stimulation of the anterior sacral roots, mainly S3 and S4, results in bladder contraction with simultaneous activation of the urethral sphincter and pelvic floor. The nerve roots contain a mixed population of somatic fibers innervating leg musculature, pelvic floor muscles, urethral and anal sphincters and pre-ganglionic parasympathetic fibers innervating the detrusor muscle.

The somatic nerve fibers supplying the urethral sphincter have a larger calibre than the parasympathetic fibers; since large diameter fibers need a lesser stimulus for activation than the smaller ones, activation of the smaller diameter fibers is always accompanied by activation of the larger ones. The result is simultaneous activation of the detrusor and the urethral closure mechanism. The striated muscle of the sphincter relaxes more rapidly than the smooth muscle of the detrusor, which continues to contract after the cessation of the stimulation. Intermittent stimulation with bursts of impulses produces a rapid contraction of the urethral sphincter and a slow but more sustained contraction of the detrusor. Micturition occurs during the gap at the end of each burst of impulses. Electrical micturition occurs at physiologic pressures in 4 to 8 spurts, within one minute in most patients. The bladder then remains areflexic until the next micturition sequence. [6 to 9](LOE 4).

Several additional methods have been investigated to obtain a more physiological voiding pattern. These include surgical interruption of the somatic fibers, blockage of pudendal nerve transmission, fatiguing of the urethral sphincter, and selective small fiber activation. Some work has been done on the selective activation of the small diameter parasympathetic fibers on the ventral sacral nerve roots, using a selective anodal block. The principle of this technique is based on the observation that close to an anodal contact, the propagation of an action potential can be blocked by hyperpolarization of the fiber membrane. If the membrane is sufficiently hyperpolarized, action potentials cannot pass this zone and are wiped out. As large diameters fibers need a smaller stimulus for blocking than do the smaller fibers, a selective blockage of the large fibers is possible. Thus, selective small fiber activation can be obtained by a combination of excitation of both large and small diameter fibers and by blockage distal to the excitation point of the propagation of the induced action potentials in the larger fibers. This can be achieved with rectangular pulses or by the application of multichannel-generated quasitrapezoidal pulses in an anodal block stimulation technique. These studies have shown feasibility in animals, with the hope that dorsal rhizotomy can be avoided. [10 to 14]

Other attempts to avoid posterior rhizotomy have used selective urethral sphincter blockade and reversible deafferentation using cryotherapy. If these results can be reproduced in chronic trials and during intra operative evaluation, this technique may play some role in clinical practice [15].

Another technique recently described by Kirkham et al [16] is that of combining sacral anterior root stimulation for electromicturition with electrostimulation of the posterior sacral roots to suppress the detrusor hyperreflexia (SPARSI), thus also achieving efficient emptying and avoiding the rhizotomy. Results are reported on only five patients, and persistent dyssynergia prevented complete bladder emptying.

Recommendations

- **Sacral anterior roor stimulation combined with posterior rhizotomy is a valuable method to restore bladder function in selected spinal cord injury patients suffering from neurogenic detrusor overactivity refractory to medical treatment (Grade C))**
- **More studies are awaited to validate techniques to make doral rhizotomy unnecessary.**

b) Muscle augmentation (LOE 4)

Though neurostimulation, especially of the ventral sacral roots, is effective in inducing contraction in spinal cord lesions above the micturition centre, it has no role to play in the flaccid neurologic bladder due to lesions at or below the sacral micturition centre. The treatment of choice for the atonic bladder is clean intermittent catheterisation. However, in an attempt to eliminate catheter related morbidity and improve quality of life, restoration of bladder contractility may be desirable. The use of a striated muscle flap that can be electrically stimulated to augment bladder contractility is an attractive idea.

Some authors have evaluated the use of the latissimus dorsi muscle wrapped around an artificial reservoir or wrapped around the atonic bladder, after division of its motor supply and its reanastomosis to an active nerve [17 to 19]. Others have tried using the rectus abdominus because of its proximity to the urinary bladder [20]. Latissimus dorsi bladder myoplasty involves muscle transposition with microsurgical vascular and nerve anastomosis. It has been shown that the latissimus dorsi wrapped around the bladder is able to generate enough intravesical pressure to promote voiding. Although initial experience was promising [21, 22] later chronic studies showed failure to empty mostly related to electrode problems [23]. (LOE 4)

Recommendations

- **More studies are needed to evaluate the clinical applicability of muscle augmentation techniques**

2. Surgery to decrease outlet resistance

a) Sphincterotomy

Transurethral incision of the external urinary sphincter (TURS) has been used to promote bladder emptying and prevent urologic complications in male spinal cord injury patients for nearly 50 years [24]. The goal is to reduce the intravesical voiding pressure mediated by bladder contractions against a dyssynergically contracted external urethral sphincter.

The primary indication for sphincterotomy is in those individuals who have elevated residual urine volumes in the presence of good but involuntary detrusor contractions and who have failed conservative management. Other indications are repeated episodes of autonomic dysreflexia [25], typically in a tetraplegic patient with poor hand function, whose bladder drainage through intermittent catheterization (IC) is difficult, repeated urinary tract infections, difficult catheterizations due to urethral false passages [26], and/or secondary bladder neck obstruction due to a ledge formation [27]. Inadequate bladder drainage resulting in upper tract changes, decreased renal function, vesico-ureteral reflux, stone disease and prostate-ejaculatory reflux, with associated epididymo-orchitis, may also be considered indications for TURS. Following sphincterotomy, improvement in bladder emptying and stabilization of the upper urinary tract function has been reported in up to 90% of patients [28].

Transurethral external sphincterotomy can be performed with either a knife electrode or using a resection loop [29]. Following electrosurgical TURS significant intraoperative and postoperative bleeding may occur. In addition, urethral strictures, and need for re-operation has been reported in 30 to 60% [30, 31] of patients. Other failures reported are due to inadequate surgery, post TURS bulbous urethral strictures and poor detrusor contractility. In order to improve these results both contact and beam lasers have been used [32]. Bladder leak point pressure below 40 cm water seems to be a useful urodynamic parameter for the successful outcome of TURS [33].

Following TURS, some patients may have difficulty keeping the external condom in place. Although such patients have been helped in the past by placement of a semi rigid penile implant,.the incidence of infection, erosion and implant failure in this patient population has been significant compared to non paralyzed patients. Thus this procedure is now reserved for a very selected group. With adequate control of urinary tract infection, implant failure rate has been reduced in some series to 8% [34]

In practise, the use of sphincterotomy has significantly declined, over the past ten years due to indifferent results, lack of good outcome studies and increased reliance on intermittent catheterisation (LOE 4).

Recommendation

- **Transurethral incision of the external sphincter is an option to adequately drain the bladder and prevent urological complications in the spinal cord injury male patients (Grade C).**

b) Implantable stents

External sphincter stents have the potential to obviate dyssynergic external sphincter activity and reduce the incidence of recurrent obstruction. In addition some stents may be truly reversible. The UroLume prosthesis is made of a superalloy mesh that expands and shortens, similar to a Chinese finger toy when deployed from the insertion tool. The geometry, elastic property, and the radial force of the stent material allow it to maintain its position and continuously prevent obstruction by the external sphincter. The large lumen (42 Fr) created by the prosthesis permits catheterization and cystoscopy after epithelialization. In 153 patients at 15 centers, sphincter stent placement has achieved clinical success with up to two years of follow-up. The simplicity of placement and

minimal associated morbidity makes the sphincter prosthesis an attractive modality to treat external sphincter dyssynergia. A prospective randomized study between the UroLume stent versus sphincterotomy at three model SCI centers has just been reported. Decrease in voiding pressure was significant for both sphincterotomy and stent patients. No significant change in bladder capacity occurred after either sphincterotomy or stent placement. Residual urine decreased in both sphincterotomy and stent patients. The mean length of hospitalization and operation were significantly shorter for stent patients rather than sphincterotomy [35]. Long-term results confirming the initial results have also been reported, however it should be noted that out of 160 patients, only 42 were evaluable after 5 years, throwing some doubt on the positive conclusions of this study [36]. A smaller long-term study, on 7 patients who were 12 years out from stent placement has been reported. Again the positive conclusions must be tempered with the fact that all needed some further surgical intervention during follow-up [37] (LOE2). There have been several non-randomized studies on the use of different stents with disappointing results [38 to 40]. The main reported complications are migration of the stent, persisting urinary tract and prostatic infection leading to autonomic dysreflexia , calculus formation, encrustation, tissue growth in addition to pain and irritative symptoms [41] (LOE 4)

Despite the above-mentioned randomised study, stents have not been accepted as standard practice in the neurologic patient.

Recommendation

- **Intraurethral stents are an option to decrease outlet resistance but longterm results do not seem to be very good (Grade C)**

III. FAILURE TO STORE

1. Surgery to decrease detrusor contractility

Management of detrusor hypercontractility will be directed at restoring storage function to as close to normal as possible, reducing the associated incontinence and possibility of upper tract changes. This management cannot be carried out in isolation as the patient's ability to empty may be compromised by the lesion itself or the therapy for the hyperreflexia, and must therefore also be considered [42, 43].

Surgery to decrease detrusor contractility by altering the sacral reflex arc has historically been unsuccessful. Mainly because of this, enterocystoplasty and its alternatives have achieved a 'gold standard' position in the management algorithm of these cases. Continued concern regarding long-term complications of these procedures has prompted several alternatives to enterocystoplasty to be developed. These include gastrocystoplasty, autoaugmentation, ureterocystoplasty and the use of demucosalised bowel segments. This has also prompted a 'resurgence' of methods to peripherally denervate or neurologically decentralize the bladder and the development of techniques to modulate the sacral reflexes. These techniques will be discussed in the following section.

a) Enterocystoplasty

It has been accepted practise for many years that patients with intractable detrusor hyperreflexia and or low compliance, with associated incontinence and/or upper tract deterioration, can be managed successfully by enterocystoplasty. This assumes that the patient can empty the bladder appropriately, the neurologic disease is not rapidly advancing and that all conservative measures have been exhausted. Despite this, the levels of evidence to support this in the literature are poor. There are multiple series of studies describing retrospective results of this procedure. The results are uniformly good in terms of continence and improvement or stabilization of upper tracts. Many studies also confirm the associated improvement of urodynamic storage characteristics [44 to 48]. In this most recent paper, the long term improvement in clinical and urodynamic outcome was achieved with half the patients requiring further surgical procedures.

As a general critisism, these papers vary greatly in number of patients studied. They are retrospective in nature and very often refer to a heterogeneous group of patients, not all of whom have a neurologic etiology. Techniques, including choice of bowel segment, vary from series to series and many patients require additional surgery (outlet enhancement, reflux prevention, catheterizable stomas etc.) to achieve success. In addition results are not generally evaluated in any standardized fashion, such that there is significant physician bias in the interpretation of results, and attempts to compare series is compromised. Follow up is often too short to be truly meaningful [45, 46].

A universal theme found in all is that complications are common. These include recurrent infection (37 –

59 %), stones (22 %), recurrent incontinence, bowel obstruction, and perforation. More remote complications included malignancy and metabolic abnormalities. The complication rate in some series reached more than 40%. Re-operation rates were similarly high, and intervention was needed both in short and long term follow up in up to 44 % (>10 years).

Despite these observations, all authors refer to the overall success of this procedure. However, they do generally qualify this in their conclusions by commenting that careful patient selection is required along with life time follow up (LOE 4).

Recommendation

- **Enterocystoplastie has passed the test of time in achieving a low pressure reservoir but complications and reinterventions are common (Grade C)**

b) Alternatives to enterocystoplasty

1. GASTROCYSTOPLASTY

Gastrocystoplasty was popularized as a more suitable segment for augmentation in the pediatric neurologic population. The absence of metabolic acidosis and thinner mucus were some of its advantageous characteristics. There are very few meaningful studies on the use of gastrocystoplasty in the adult neurologic patient, so discussion of this will be dealt with in the pediatric section.

2. URETEROCYSTOPLASTY

Similarly, there are very few papers on the use of this technique in adults.

3. DETRUSOR MYECTOMY (AUTO-AUGMENTATION)

Detrusor myectomy (auto-augmentation) was introduced in 1989 by two separate research teams, one concentrating on children, and the other on adults. The treatment is intended to allow the bladder to enlarge when the functional capacity is reduced by detrusor overactivity or low compliance, in patients with neuropathology, who are refractory to anticholinergic medication. Patients have been followed for up to ten years [49, 50].

In this technique, a large part of the detrusor muscle is excised, leaving the mucosa intact and thereby creating an "artificial diverticulum". As a result the emptying contraction is reduced, and thus patients must use intermittent catheterisation.

Bladder enlargement following detrusorectomy develops relatively slowly, taking about 1-2 years. During this period medical treatment with anticholinergics (mostly in a much lower dose then before surgery) may be beneficial [51]. Occasionally, late reduction of capacity, caused by fibrosis, has been reported. Securing omentum to cover the serosal side of the mucosa after the detrusorectomy has been described to avoid this. However, results do not confirm that this maneuver makes any difference [52 to 54]. A study on 62 adult patients with various neuropathies (about 75% traumatic spinal cord injury) and a minimum follow-up of 2 years has been reported [55]. The average follow-up was two and a half years. The only complication noted was intra-operative mucosal perforation in one third of patients. Following the procedure, most patients required no or significantly reduced anticholinergic use. Sixteen failures were reported: In those patients who responded well to auto-augmentation, most reported a much better quality of life (LOE 4).

It has been suggested that this procedure may be used prior to enterocystoplasty and would not preclude the use of this modality if required later. It is of interest however, that there have not been any reasonable studies on the use of this technique in adult neurologic patients, since 1999 and also that this technique has not achieved wide acceptance in practise.

Conclusions

- **Alternatives to enteroplasty have been little documented. Some data exist on auto-augmentation but these are also limited and evidence remains low (LOE 4)**

c) Denervation or neurologic decentralization techniques

Historically many techniques have been used and described in the literature to try and convert the overactive neurologic bladder (upper motor neuron lesion) to an underactive bladder (lower motor neuron lesion). These methods will be briefly described. In general they are rarely used now because of poor long-term results, and significant complications.

• ***Bladder distention (Helmstein's technique):*** successful outcome of up to 70% has been reported. This has never been reproduced in the long term and the occasional reports of bladder rupture have discouraged the establishment of this technique [56].

• ***Cystolysis:*** mostly used for the treatment of inter-

stitial cystitis and other sensory conditions, with a few series including patients with hyperreflexic neurologic bladder. Short term results reported as good, but no long term results available. The late complication of bladder contracture in 10% has precluded its further use [57].

• ***Inglemann Sundberg procedure:*** transvaginal denervation has been used in patients with overactive bladder with some short term success. Series are all relatively small and there is no experience of this technique in the neurologic population [58].

• ***Bladder transection:*** various techniques have been described ranging from circumferential incision to an endoscopic supratrigonal technique. Patients in these small series were generally suffering from detrusor overactivity (non-neurologic) or had sensory disorders (interstitial cystitis) [59].

• ***Subtrigonal injection:*** the logical extension of the above was the use of phenol or alcohol injected trans-trigonally to effect a denervation of the bladder. Little experience is reported in neuropaths and effects were usually short lived. The occasional complication of fistula formation has further doomed these procedures to the 'history' books [60].

• ***Sacral rhizotomy:*** Of all the techniques used to denervate the hyperreflexic bladder, sacral rhizotomy has achieved the best success. In most series, presently, it is combined with implantation of sacral anterior root stimulator. In this way the hyperreflexia is significantly reduced and functional bladder capacity is increased [6, 7, 9, 10]. The stimulator allows the patient to empty the bladder without resorting to catheterisation. The rhizotomy also reduces the development of sphincter dyssynnergia during anterior root stimulation.

Rhizotomy is conventionally performed via a limited lumbo-sacral laminectomy to expose S2-S4 nerve roots bilaterally (L4/5- S1/2). Visual magnification and continuous cystometry aid identification of the appropriate nerve roots. The nerves that evoke an adequate detrusor contraction when stimulated are selected and severed.

Complications frequently referred to are fecal incontinence and erectile dysfunction. The latter may be overcome by using the anterior root stimulator for this purpose. Fecal incontinence is rarely reported in published series [7, 8, 10, 61] (LOE 4).

Recent developments focus on techniques to reversibly block the posterior roots during stimulation so that formal rhizotomy can be avoided.

d) Sacral nerve stimulation / neuromodulation.

Suppressing detrusor overactivity using a neuromodulation approach has been in the development stage for many years. Presently several clinical studies are available to demonstrate the efficacy of this technology. Unfortunately there are no good studies on its use in the neurologic bladder patient. The exact mechanism, by which sacral nerve stimulation inhibits bladder contraction, is not fully understood. However it is thought that sacral nerve stimulation induces reflex mediated inhibitory effects on the detrusor through afferent and or efferent stimulation of the sacral nerves. In addition, activation of the pelvic floor muscles may occur via stimulation of the somatic fibers of the nerves, causing further detrusor inhibition [62].

The technique of initial percutaneous nerve stimulation to assess efficacy, followed by surgical implantation of the sacral nerve stimulator is well known.

Several reasonable clinical studies are available showing significant reduction in incontinence episodes etc. Unfortunately, as stated, the majority of patients in these studies, suffered from refractory urge incontinence, and those with neurological conditions were specifically excluded. Complications of the technique included pain at implant site, infection, change in bowel habit and technical problems including lead migration [63].

This technique is certainly a promising development in a difficult group of patients. Technical details still need to be improved and results are mixed [64, 65]. In this most recent report [65] only 8 out of 12 implanted patients had any therapeutic benefit, for a maximum of 96 months for 7 of them. The complication rate was high with side effects in 4 and early removal in 1. It remains to be seen if this will be appropriate for neurologic patients. (LOE 4)

Conclusions

- **In general, surgical intervention to decrease detrusor contractility should only be used when all conservative measures have failed.**
- **Choice of intervention at present will depend on many factors including the underlying pathogenesis of the condition, its natural history, the patients' mobility, motivation, age and home support to name the most significant.**
- **Although augmentation cystoplasy gives the most reproducible results its complication rate is still relatively high.**

- **Of the alternatives to cystoplasty, only autoaugmentation has some merit but will have to be carefully evaluated in the long term.**
- **Neuromodulation and denervation techniques such as rhizotomy have less morbidity than cystoplasty and their role will continue to evolve.**

Recommendations

- **The most pressing need in this field is to develop standardised methods of evaluating results. It is too much to ask for controlled trials for these surgical techniques, but a uniform method of assessing results would be extremely helpful.**

2. Surgery to increase sphincteric resistance

Patients with sphincteric incontinence due to neurologic disease or injury are candidates for surgical procedures to increase urethral resistance, assuming that associated detrusor compliance and contractility abnormalities can be satisfactorily managed. As all the procedures to increase urethral resistance in neurologic patients produce compression, urinary retention is not uncommon after the surgery.

Patient selection and preoperative evaluation play a critical role in the process of increasing urethral resistance. The work-up should include history and physical examination, urine culture, cystourethroscopy, upper urinary tract imaging and urodynamics.

The minimal conditions that a neurologic patient should meet in order to be considered as a candidate for any of these procedures are: incontinence primarily due to intrinsic sphincter deficiency, a non contractile detrusor or controllable detrusor hyperactivity, a healthy, well-vascularized bulbar urethra or bladder neck, absence of significant vesicoureteric reflux. In addition the patient should have sufficient intelligence, motivation, compliance and manual dexterity and must be established on intermittent catheterisation. The neurologic disease should be already stabilized. Thus patients who have a progressive disease such as multiple sclerosis, are generally poor candidates.

There are several surgical options to increase urethral resistance in neurologic patients. These include artificial urinary sphincter, sphincteric muscle augmentation, implantable valves and bulking agents. The rational for procedure selection depends on a number of patient's factors and the surgeon's preference and experience.

a) Artificial urinary sphincter

Although the artificial urinary sphincter (AUS) has been recommended for the treatment of sphincteric incontinence, and it is commonly used in patients with congenital neuropathy, there has not been a significant degree of popularity or success in the adult neurologic population [66 to 76]. In most of the reported series, the difference between the number of patients initially implanted and the number of patients using the device at the end of follow-up is unclear. Success rates reported range from 70% to 95% with a revision rate varying between 16% and 60% [66 to 76]. In a recent review on long-term outcome (more than 10 years) of 100 patients treated with the artificial urinary sphincter it has been shown that, in spite of the high revision rate, the artificial urinary sphincter is an effective long-term treatment for incontinence in male patients. In female patients the risk of erosion is high, although overall long-term continence is satisfactory [77] (LOE 4). Changes in bladder compliance and upper urinary tract deterioration may occur with any procedure to increase outlet resistance without bladder augmentation. This problem has been most frequently associated with the artificial urinary sphincter. The mechanism of these changes in bladder function is not fully understood but clearly the myelodysplasic population is most at risk [78]. Changes in compliance after artificial sphincter implantation are not documented in the adult incontinent population without myelodysplasia. It has been suggested that these changes might be associated with an increase of the alpha-adrenergic innervation [79], but could also be related to detrusor behaviour, not identified preoperatively. When urodynamics reveals detrusor overactivity not demonstrated preoperatively, anticholinergic therapy is needed. If maximal doses of anticholinergic drugs do not control the detrusor overactivity, bladder augmentation may be necessary. Timing of the augmentation procedure in these patients is controversial, simultaneously or later on. This procedure may be carried out as a first stage, prior to the sphincter implantation. It may be performed simultaneously, or as a secondary procedure if abnormal bladder behaviour is unmasked. Some authors advocate a staged approach, fearing sphincter infection if implanted at the same time as the cystoplasty [78] Conversely other authors have not found a higher complication rate using the synchronous technique [68, 73].

b) Sphincteric muscle augmentation

1. Dynamic myoplasty

Attempts have been made to correct intrinsic sphincter deficiency using a stimulated Gracilis muscle flap (dynamic myoplasty). First reported by Janknegt et al [80], initial experience has been gained in men and women with neurologically impaired sphincter function. Its use is based on the transposition of this muscle to the bladder neck [81] or to the urethral area [82]. The skeletal muscle is then converted into a functional sphincter by electrical stimulation. During an increasing stimulation protocol the fatigable type 2 fibres, the main fibres in skeletal muscle, are replaced by type 1 fibres, which can sustain long lasting contractions. A subcutaneously placed pulse generator provides continuous low current electrical stimulation via electrodes, enabling the maintenance of constant sphincter tone. Urination is achieved by temporary termination of the neuromuscular stimulation. There have been very few reports on the dynamic graciloplasty for the treatment of urinary incontinence although results are encouraging with few complications. Presently, this technique could be applicable in incontinent patients with severe sphincteric intrinsic deficiency who are not candidates for conventional treatment, including the artificial urinary sphincter, or in whom such treatment has failed [83]. (LOE 4)

2. Slings

There have been many reports on the success of pubovaginal slings for the treatment of intrinsic sphincteric deficiency in the neurologic population in both children and adults.

The procedure is established in the neurologic female patient as an alternative to the artificial urinary sphincter. It should be assumed that following PV sling, patients will have to empty their bladders by intermittent catheterisation [84]. The reported continence rate is generally high [85 - 87], with few complications, including difficulty with catheterisation, ventral hernia at the graft harvest site, bladder calculus and hyperreflexia .

There have been a few reports on using slings to correct male neurologic urinary incontinence. Although some authors recommend its use in these patients, it is a procedure that has not gained much acceptance. The number of male patients in each series is small and there is a lack of long-term outcome [87, 89, 90, 91]. Walker et al have reported their results in a series of 15 patients with a 3-year follow-up who underwent a rectus fascial wrap. They found continence rates comparable to that of other bladder neck sling procedures in patients with spina bifida [92]

Recent reports suggest that the bulbourethal and puboprostatic sling procedure for male incontinence, achieves continence by increasing urethral resistance in a dynamic fashion when intra-abdominal pressure increases, similarly to the pubovaginal sling used to treat female stress urinary incontinence [93](LOE 4).

3. Bulking agents

Periurethral injection of materials to provide bulk for urethral closure and continence has applicability for patients with neurologic bladder dysfunction, although this has not gained much popularity. The reported continence rates achieved with the use of bulking agents in children ranges from 30% to 80% in the short term and 30% to 40% in the long-term [94 – 99]. (LOE 3) At present there are no studies reporting the use of bulking agents in the adult neurologic population.

c) Implantable valve/cath

During the last few years several intraurethral implantable devices for the treatment of intrinsic sphincteric incontinence in women. have been introduced The reported success varies in between 72 % and 94% [100 to 102] High withdrawal rates have been observed in most studies as well as a significant number of complications. These include device migration, leakage around the catheter or through its lumen, blockage of the valve by sediment or stone formation, urinary tract infection, urethral/meatal bladder irritation, device malfunction and hematuria [103 – 104] . A remote controlled intraurethral insert has been used for artificial voiding. In 49% of the patients the device had to be removed due to local discomfort or urinary leakage around the insert, rendering the results unsatisfactory [105 – 106]

Conclusions and recommendations

- **There are several alternatives to surgically manage urinary incontinence due to neurologic sphincteric deficiency.**
- **Increasing urethral resistance is possible only in those patients who have a good bladder capacity and accommodation or pharmacologically controlled hyperreflexia. Otherwise when planning to increase the urethral resistance in these patients, bladder augmentation procedure should be considered.**

- **The implantation of an artificial urinary sphincter is the technique which has gained most popularity and which has passed the test of the time. (Grade C)**
- **As an alternative to the artificial sphincter a sling procedure might be used, assuming that the patient can perform intermittent catheterisation. (Grade C)**
- **Dynamic myoplasty appears promising although a cost-efficacy analysis needs be done. (Grade C)**
- **Intraurethral valves need to be evaluated with longer follow up before they can be accepted.**
- **Bulking substances may play a limited role in the treatment of neurologic sphincter deficiency. (Grade C)**

3. Surgery to circumvent bladder

a) Orthotopic bladder

This technique aims to create a low pressure reservoir in patients with severely damaged bladder wall by a partial cystectomy replaced by a substitution cystoplasty [107 – 109]. A severely thick and fibrotic bladder wall can result from supra sacral neurologic bladder often complicated with recurrent infection or stones. Urodynamics usually shows detrusor overactivity associated with high vesical pressure, severe low compliance and low capacity. Failure of conservative treatment is an indication for bladder surgery. In these cases, conventional augmentation cystoplasty cannot be used and the majority of the diseased bladder wall needs to be excised. The cystectomy in these cases is supratrigonal, leaving the bladder neck and the trigone intact. The ureters are left in place or reimplanted in the intestinal segment if high grade reflux or an abnormal urethrovesical orifice is identified.

Numerous factors must be taken into consideration. Urethral stricture or other outlet abnormality must be excluded. The patient must be able to carry out intermittent catheterisation (often this non-contractile reservoir and persistent dyssynergia require catheterisation to empty); the patient must be taught to perform catheterization before surgery. Urethral sphincter deficiency can be treated by a sling [110] or implantation of an artificial sphincter [111]. These may be performed simultaneously or be held in reserve if it is anticipated that the reduction in bladder pressure by the orthotopic bladder reconstruction alone will be sufficient for continence.

The choice of bowel segment and configuration of that segment may differ but most authors agree that the segment should be detubularized in order to achieve a large capacity and a low pressure reservoir according to Laplace's law. The segment of bowel used is often a 40 cm length of terminal ileum reconfigured in an S or W shape. Resection of a longer segment of ileum may be associated with diarrhea due to the increased amount of bile acids reaching the colon [112]. This risk is increased in myelomeningocele patients and in those with short or diseased intestine. The diarrhea often resolves with diet and medication. The use of the caecum with the adjacent terminal ileum has been advocated, but ileocecal valve resection aggravates the risk of digestive disturbance due to reduction in transit time compared to ileum alone. The true incidence of diarrhea after the resection of ileum, ileocecal valve or colon is not known [112]. Absorption of urinary components, particularly chlorides, can lead to metabolic acidosis when a large resection or proximal ileum resection is associated with renal insufficiency, but with limited ileal resection and normal renal function patients do not develop acidosis [113]. In time, villous atrophy reduces the bowel's absorbative properties as well as mucus secretion [114]. Incomplete emptying and mucus stagnation can lead to bladder calculi. Although bladder stones can develop in all types of neurologic bladder, the main risk is intermittent catheterisation. However, the incidence of stones does not seem to be influenced by enteroplasty [115]. In a few cases, spontaneous overdistension leading to perforation has been reported [109].

The precise risk of malignancy in intestinal segments used for urinary recontruction [116] is unknown. The incidence of adenocarcinoma of the ileum is far less than that of the colon. There is no consensus on cancer surveillance in these patients, but abnormal symptoms and hematuria should be investigated.

Ureteral reflux on pre-operative cystography is corrected by an antireflux procedure, as part of the reconstructive surgery. Severely dilated ureters can be reimplanted into the pouch using either an extramural tunnel, or a mucosal sulcus (Le Duc/Camay) or long afferent loop of bowel (Studer). Severe impairment of renal function is a contraindication, but this surgery can be considered if renal transplantation is planned. Low urine output after reconstruction will require bladder irrigations in order to prevent mucus retention and pyocystitis. (LOE 4)

b) Continent diversion

Continent cutaneous urinary diversion provides an extra-anatomic bladder outlet associated with a valve for urinary continence, which is catheterised to empty. The urinary reservoir must have low pressure and good capacity. The continent catheterisable stoma can either be implanted into the native bladder or into an intestinal neo-reservoir. In most cases of supra sacral neurologic lesions and myelomeningocele, a bladder augmentation is carried out at the same procedure. In some cases the native bladder outlet needs to be closed to achieve continence. This is a difficult procedure, with recanalization observed in up to 25% [117]. In men a secondary closure may be particularly difficult, but in women a secondary closure can be carried out transvaginally. If the bladder outlet is suitable, it may be preserved, maintaining continence with either a sling or endoscopic transurethral injections [118], or just left as access to the bladder and as a pop-off mechanism [119].

Indications for a continent catheterisable stoma are: inability to perform self-catheterization through the normal anatomic route and intractable incontinence, particularly in women and in men with condom problems. These may be due to severe urethral stricture, severe outlet lesions, i.e. erosions related to permanent indwelling catheter, urethral pain, non accessible meatus (obesity or upper limb neurologic partial deficit or spinal abnormalities, or transfer difficulties). If patients are to be managed safely with long term indwelling catheters, they must adhere to a strict care guideline to avoid complications. Thus, altering management to a continent stoma may be a better prospect. In addition, in some tetraplegic patients, a continent abdominal stoma is much more accessible and requires less dexterity than catheterising the native urethra [120].

In some patients this continent reconstruction may be performed in conjunction with orthopedic procedures to improve upper limb function (tendon transfer). In other patients, the continent stoma provides easier bladder access for the patients' attendants. Finally, a continent stoma provides better self-image than an external appliance, further improving quality of life.

The continent conduit is constructed using the appendix or a segment of ileum, although the ureter has been used occasionally [121]. If the conduit is as narrow as to admit a 14 Ch catheter, it can be implanted in a submucosal tunnel in the bladder or neo-reservoir. The Mitrofanoff procedure uses the appendix [122 – 124] and the Monti procedure [125 – 126] uses a short ileal or colonic segment sutured transversally. A narrow continent conduit can also be constructed by tapering the terminal ileum segment if it is combined with a right colon pouch (Indiana etc.). The continence mechanism in this case is the ileocecal valve reinforced by ileocecal plication [127 – 129]. Other techniques that have been used in conjunction with ileal reservoirs are the intussuscepted ileal nipple (Kock) [130], or the Benchekroun hydraulic valve [131]. Whichever mechanism is used, continence rates of more than 80% in short term have been reported.

Unfortunately complications are relatively frequent, especially with longer tubes and with intussuscepted valves (dessusception, parastomal hernia, fistulae) [132] compared to narrow tube techniques [133]. These small bore-outlets (Mitrofanoff, Yang-Montie) are currently the commonest techniques used. They are however not without their own problems, with stoma stenosis being reported in 12 to 30% of cases. Liard [134] reported on 23 Mitrofanoffs continent with a minimum of 15 years follow-up. Complications that required surgical revision were: stomal stenosis or persistent leakage in 11 cases. Stenosis, particularly at skin level can be simply dilated or a V flap advancement used if necessary. The umbilical site for the stoma is popular and has cosmetic advantages, but may have a higher risk of stenosis [135]. Bladder stones can be treated endoscopically through the conduit or through a percutaneous route [136] . If the urethra is closed, patients should be advised to perform frequent and regular catheterizations and also to perform bladder irrigation with a minimal Ch14 catheter, in order to evacuate the mucus. Metabolic disorders can occur in association with these reservoirs. A 20% rate of hyperchloremia has been reported without significant acidosis [127]. Vitamin B12 deficiency and cholelithiasis have been reported, but occur very rarely [112].(LOE 4)

c) Conduit diversion

The indications for conduit (non-continent) supravesical diversion have been reduced significantly since the introduction of appropriate management, such as intermittent catheterisation, in these patients. However this procedure may be considered in the case of intractable incontinence in bed bound patients, the devasted LUT following multiple failed surgery or where the use of long bowel segments for reconstruction is contraindicated (short bowel syndrome), It may also be considered in patients who do not accept the potential complications of a continent

diversion, who are not able to perform catheterisation, or where the upper urinary tract is severely compromised. Proper location of the stoma must be determined before surgery by stomatherapist and urologist. This location is especially important in patients who are chair bound or who have specific deformities, such as patients with severe kyphoscoliosis or a small abdomen. The most common technique is to use a short ileal segment with the ureters anastomosed directly end to side. There is no evidence that an antireflux procedure is required and this may in fact increase the risk of implantation stenosis. Patients should be followed up indefinitely as stomal stenosis and or ureteral anastomotic stricture can occur years after surgery. Large bowel segments can be used when patients have a severe renal insufficiency in order to prevent metabolic disorders [137]. In the long term, complications will occur, namely pyelonephritis and calculi. Renal impairment has been estimated to occur in 16.5% to 50% of patients with 10 years or more follow-up [137 – 139]. (LOE 4)

d) Undiversion

Conversion from a conduit to a continent diversion or to the reconstructed bladder may be indicated in few cases. This will usually be considered in younger patients who have a strong desire to improve their body image by avoiding the use of an external appliance [109, 140 – 141]. These young adults must be carefully counseled and must be compliant in following the medical instructions. The conduit can be anastomosed to the reconstructed bladder or to a continent self-catherized pouch [127]. In some cases it can be anastomosed to the rectum or sigmoid [142 – 144]. The latter is an internal diversion that requires normal fecal continence and an efficient ureteral antireflux mechanism. It must be remembered that it does expose the patient to a greater risk of renal deterioration than external diversion (LOE 4).

Recommendation

- **Although less frequently used, after failure of more conservative treatment in patients with neurogenic bladder, continent or non continent urinary diversion is an acceptable treatment option for selected cases.(Grade C)**

4. Bladder reinnervation

A major step forward in the treatment of neurologic urinary incontinence would be the restoration of nerve and/or muscle function.Though only a very limited number of small series have been published so far they are interesting.

Livshits et al [145] showed that a restitutive process occurs in the bladder after intercostal nerve to spinal nerve root anastomosis in chronic spine-injured patients. Spinal cord lesions that might benefit from this nerve crossover surgery would be located at the conus. In this series in 11 SCI L1 patients significant improvements in bladder function were observed during the 10th to 12th postoperative months. Restoration of reflex voiding occurred in all patients; in eight of the 11, paresthesias in the groin and scrotum and reappearance of the bulbocavernous, anal and cremasteric reflexes were noted.

Xiao et al [146] made, in 15 male volunteers with overactive neurologic bladder and detrusor external sphincter dyssynergia (DESD) caused by complete suprasacral SCI, micro anastomosis, usually between the L5 and S2/3 ventral roots. The L5 dorsal root was left intact as the trigger of micturition after axonal regeneration. Mean followup was 3 years. Ten patients (67%) regained satisfactory bladder control within 12 to 18 months with average residual urine decrease to 10 % of the original, urinary infection as well as overflow incontinence disappearing. Urodynamic studies revealed a change from detrusor hyperreflexia with DSD and high detrusor pressure to almost normal storage and synergic voiding without DSD.

Conclusion

- **Much more research is needed to further clarify the possible clinical value of bladder reinnervation techniques (LOE 4).**

D. NEUROLOGIC FAECAL INCONTINENCE

Introduction

The aetiopathogenesis of gut dysfunction in neurological disease is poorly understood, but putative mechanisms include: loss of voluntary control of striated pelvic musculature, hindgut sensory and autonomic denervation, colonic dysmotility (related

to enteric neuropathy or patient immobility), drug adverse effects and psychological disturbance related to loss of independence.

Chapter 15 of last ICI already reminded us that neurologic incontinence in the literature often denotes faecal incontinence presumed to be secondary to damage to the pudendal nerve during childbirth, rather than that associated with major neurological disease. It is recommended that the term neurologic faecal incontinence should not be used in the former condition since it is in principle identical with idiopathic incontinence and may be confused with incontinence due to neurological disease, which is quite distinct. Consequently, when, for example, studies with anal endosonography were performed in women believed to be suffering from "neurologic faecal incontinence", unsuspected internal and external sphincter defects were identified.

In the following neurologic faecal incontinence will only refer to faecal incontinence in patients with a more general neurologic disease.

D1. EPIDEMIOLOGY

Complete bowel emptying at an appropriate time and place requires the culmination of multiple, interdependent physiological and psychosocial events. When the integrity of this chain of events is disrupted at any point, faecal incontinence can occur. However, in most cases, numerous dysfunctions combine, so that faecal incontinence has a multifactorial aetiology. The principal causes of incontinence in these patients are faecal impaction with overflow diarrhoea, anal sphincteric incompetence and diarrhoea from other causes. Dietary factors can cause either excessively loose stools or constipation with impaction and overflow incontinence. The importance of diarrhoea in faecal incontinence cannot be overemphasized. One case series noted that 51% of individuals with chronic diarrhoea were incontinent [1]. A patient with poor mobility can become incontinent of faeces simply due to inadequate care or facilities, and those with cognitive decline or decreased communication abilities (e.g. post stroke) can suffer from incontinence, despite having an intact sphincter mechanism. Faecal leakage without awareness causing soiling is usually associated with dysfunction of the smooth muscle of the internal sphincter or impacted stool in the rectum. Faecal urgency and urge incontinence are generally related to dysfunction of the striated external anal sphincter or to high bowel pressures and a normal sphincter, as may occur with diarrhoea. Sensory defects can result in impaired sensation of rectal fullness or an inability to distinguish between faeces or flatus.

The medical literature is confusing. "Neurologic bowel incontinence" can denote both incontinence secondary to damage to the pudendal nerve during childbirth or be associated with major neurological injury or disease such as due to spinal cord injury. Moreover, incontinence and constipation frequently coexist in most of the neurological diseases. A broad range of reported prevalence in the literature is due to varying definitions used for faecal incontinence and to the selection of differing populations with a range of disabilities. For the purpose of this chapter, "neurologic bowel incontinence" refers to faecal incontinence that occurs in any patients with any chronic pathological process affecting the central or peripheral nervous system. Many neurologic conditions are associated with neurologic bowel: multiple sclerosis, Parkinson's disease, spinal cord injury, systemic sclerosis, stroke, cauda equina injury, diabetic neuropathy and myopathies like myotonic dystrophy. Most of these conditions directly affect mobility and ability to perform daily living activities, cause diarrhoea, constipation, faecal impaction and faecal incontinence.

The prevalence of faecal incontinence in the general adult population varies from 1% to 20%, depending which definitions are applied. Whereas the prevalence of faecal incontinence is probably around 2% for community-dwelling persons and may increase with increasing age to about 7% of healthy independent adults over the age of 65, among nursing home residents the prevalence approaches 50%. Moreover, faecal incontinence is one of the most common reasons for nursing home admission [2 - 4]. In the most broadly based survey, the most prominent risk factors for faecal incontinence seem to be physical disability, poor general health, and communication and/or mobility problems [5].

Pubmed search from 1964 till 2004 with search words: epidemiology, prevalence, neurologic, neurological, neurological bowel, neurologic bowel, incontinence, faecal gave 4528 references. However, only a very limited number of references gave data on prevalence and only in specific diseases for which a separate search was done.

Prevalence strongly depends on the definition of faecal incontinence (incontinence of solid faeces, diarrhoea, or flatus), and frequency (daily versus episo-

dic) of faecal incontinence varies greatly in each population. Moreover, the accuracy of prevalence estimates for faecal incontinence may also be diminished by difficulty in ascertaining those figures and the common underreporting of faecal incontinence owing to patients' reluctance to report symptoms or seek treatment [1, 6 – 7]. It has been shown that women are more willing to report faecal incontinence than men [5].

Most reports of the prevalence of faecal incontinence have come from single institutions, and the patients described therein have been subject to referral bias when demographics and aetiology are discussed. Studies mentioned below were retrospective, comparative or case series rated with a low level of evidence (LOE 3/4).

1. Spinal cord injury (SCI) patients discharged from rehabilitation units have a reported incidence of faecal incontinence from 11–75% [8 – 15]. This broad range of reported prevalence seems related to definitions used for faecal incontinence and severity of it. Most studies did not grade incontinence with a validated score. Indeed a few patients experienced daily incontinence, whereas most experienced this just a few times per year [11]. While colorectal and sphincteric function is affected by level of injury, it can not be deduced from available literature if prevalence and severity of faecal incontinence depends on level of injury. However, bowel function is a source of distress in over 50% of SCI patients, which is associated with the time required for bowel management and the frequency of incontinence [10]. Ninety five percent of 115 consecutive SCI outpatients required at least one therapeutic procedure to initiate defecation, and 50% needed help to manage their bowel [10]. In many surveys of SCI, subjects rank bowel dysfunction as one of their major life-limiting problems [10, 16 – 18].

2. Multiple sclerosis (MS) patients frequently complain of bowel problems. The prevalence of constipation and/or faecal incontinence ranges from 20% to 73% when MS patients were directly questioned [19 – 22]. Both symptoms frequently co-exist [19]. Bowel dysfunction is a source of considerable psychosocial disability for MS patients. In a study of 890 patients, the main factors limiting the ability of MS sufferers to work were spasticity, incoordination, bladder and bowel symptoms [23], indicating that bowel dysfunction is a major hurdle to full rehabilitation.

3. Stroke patients had a reported incidence of faecal incontinence of 23% in 135 consecutive patients within one year [24]. Older patients, women and those with the most severe strokes seemed to be most at risk, 40% reporting incontinence at admission and 9% at 6 months follow-up [25]. From a community-based UK Stroke Register, prevalence of poststroke FI was 30% (at 7 to 10 days), 11% (3 months), 11% (1 year), and 15% (3 years). Sixty-three percent of those incontinent at 1 year had been continent at 3 months. Interestingly independent associations were anticholinergic drug use and needing help with toilet use. Moreover, faecal incontinence at 3 months increased the risk of long-term placement and death within 1 year period [26].

4. Parkinson's disease (PD) affects bowel function and evacuation disorders affect up to 50% of patients [27]. In 1 study profiles of over 79'000 nursing home residents with PD at admission about 30% of PD residents were bowel incontinent at the time of their admission, 9% were frequently bowel incontinent (2–3 times per week), and 7% were occasionally (once a week) bowel incontinent [[28]. The QOL index for PD patients was significantly higher for bowel (46%, 59%) as compared with a control group. In the PD patients, faecal incontinence was associated with urinary incontinence, and bowel dysfunction increased with age [29].

5. Autonomic neuropathy is associated with constipation and faecal incontinence. Most knowledge is based on studies of diabetes mellitus. Constipation has been reported in 12% to 88% of diabetic patients, with a debated direct correlation with the incidence of autonomic neuropathy [30 – 31]. Twenty per cent of diabetics complain of faecal urgency and episodes of incontinence, with evidence of decreased rectal sensation or impaired function of the anal sphincters, or both [32 – 34]. Faecal incontinence was reported by 13% of 423 subjects with diabetes at least sometimes, compared with only 4% of controls [35]. Patients with long-standing diabetes mellitus have increased incidence of faecal incontinence and severely impaired function of both the anal sphincters and the rectum [36].

Conclusion

- **The prevalence of faecal incontinence increases with age but is present in all age groups and both genders.**
- **The prevalence of faecal incontinence in people suffering from neurological diseases seems to be higher than in the general population but exact figures are not available and the level of evidence is low.**

- **As populations age, comorbid disease becomes a significant component of incontinence risk.**
- **Epidemiologic investigations of faecal and urinary incontinence should be performed jointly.**

Recommendations

- **Because neurological diseases can cause bowel dysfunction patients with known neurologic disease should be evaluated for such dysfunction**
- **Bowel dysfunction should be evaluated as a standard diagnostic approach if prevalence of neurologic bladder is known to be high in a specific disease**
- **Because bowel dysfunction might be frequently associated with LUT dysfunction, those latter patients should be evaluated concomitantly for both dysfunctions.**
- **Prospective studies are urgently needed to address this.**
- **These recommendations are all graded C and the committee thinks there is enough evidence to make all these strong recommendations.**

D2. SPECIFIC DIAGNOSTICS

I. SEARCH STRATEGY

Pubmed search from 1996 till 2004 with search words neurologic, faecal, incontinence, neurologic, bowel gave from 1 to 1112 references depending on the combination.

When all combinations were separately evaluated it became evident that there was not one single meta analysis available on this topic. After further analysis 22 references were found dealing with specific topics on diagnosis of bowel function in neurologic patients.

These data will be presented and should be looked at as an addendum on similar topics discussed in other chapters.

II. GENERAL PRINCIPLES

From a diagnostic point of view the specificity of neurologic faecal incontinence should focus on global assessment. This must include a thorough history, full neurological examination associated with assessment of global higher mental functions, and in some cases targeted investigation. The diagnostic approach should give strength to overall assessment. Assessment of faecal incontinence in neurologically impaired patients requires a holistic approach that must take into account the patient's environment, physical and psychological disabilities, and general medical conditions. This will usually require a multidisciplinary team.

A review of the literature, the relevance to clinical practice and the consensus opinion of a group of expert resulted in minimum standards for performing anorectal tests [2]. Targeted investigations for neurologic incontinence are not yet well-defined.

The American Gastroenterological Association recommends as tests of value in the diagnosis and management of fecal incontinence: anorectal manometry, anal ultrasound examinations and rectal and anal sensory testing (as an indication of rectal irritability or poor compliance, and for identification of patients with afferent nerve injury as a contributing cause of incontinence). Procedures of possible value include surface EMG (for the evaluation of sphincter function and for performance of biofeedback training) and evacuation proctography [3 – 4].

Faecal continence depends on different anorectal functions that can, apart of the clinical evaluations, be examined with specific techniques as shown in **table 3**.

Table adapted from Bharucha AE [5]. The application of these techniques in neurologic patients has been described, but not their value for neurologic incontinence.

- **Balloon distension with an air-filled rectal balloon** will provide a gross measurement of sensory function and compliance. The thresholds for the first perceived sensation (smallest volume of rectal distension), the sensation of urge to defecate, and the maximum tolerable volume are measured. These thresholds depend on the neural balance between the ability to feel, retain and tolerate rectal content by inhibiting defaecation and by voluntary contracting the pelvic floor muscles [6].Wald [7] found that rectal sensation as determined by

Table 3. Anorectal Functions That Help Maintain Continence

Function	Measurement
Anal sphincter: levator ani complex	Anal manometry, saline continence test: anorectal barrier function
	Endoanal ultrasound/MRI: sphincter integrity Dynamic MRI: global pelvic floor motion
	Pudendal nerve latency, sphincter EMG: neural injury
Rectal accommodation	Rectal compliance
Rectal sensation	Rectal perception of distention
Anal sensation	Mucosal electrosensitivity, temperature perception

balloon distension test is a useful predictor of success with biofeedback in meningomyelocele patients.

- **Mucosal electrostimulation** using an electrical stimulus passed across the anal and rectal mucosa can obtain a quantitative assessment of ano-rectal innervation and may help distinguish between functional and neurological disorders [8]. When it is uncertain whether incontinence is directly related to impaired central innervation of the gut, or is 'idiopathic', this test may be helpful. In patients with neurological disease affecting the hindgut innervation, the rectal mucosal electrical sensory threshold is usually grossly abnormal. Studies in patients with cord injury have demonstrated the sensitivity of electrical sensation testing in defining impaired innervation (LOE 2).
- **Saline enema and faecoflowmetry** has been used in 5 patients with tethered cord syndrome [9] and has shown diagnose of hyperactive rectum, diminished rectal saline retention ability and diminished maximal flow as major contributing factors to incontinence. The authors state that the test permits detection of neuropathy in symptomatic and non symptomatic patients with tethered cord (LOE 4). However few people perform this test and think it is useful in the daily practice for neurological or even non neurological patients.
- **Electrodiagnostic tests**. Neurophysiological studies which evaluate the integrity of the pudendal nerve in patients with fecal incontinence include pudendal nerve terminal motor latencies and concentric needle EMG recordings from the external anal sphincter or puborectalis muscle. These studies are usually not indicated for the diagnosis of neurologic faecal incontinence.

Podnar and Vodusek [10] compared the sensitivities of motor unipotential (MUP) parameters in revealing "neurologic" changes in the external anal sphincter (EAS) muscles in 56 patients examined 5-240 months after damage to the cauda equina or conus medullaris and compared them with normative data from 64 controls. The cumulative sensitivity of multi-MUP analysis using both mean values and "outliers" was 62%. The combination of MUP parameters showed to improve the diagnostic yield of MUP analysis (LOE 3).

Vallderiola et al [11] showed a limitation in the power of anal sphincter electromyography for differential diagnosis by showing that patients with progressive supranuclear palsy (PSP) may have electromyographic signs of denervation in the anal sphincter, which make them indistinguishable by using this test alone from patients with multiple system atrophy (LOE 4). This was confirmed by Vodusek [12] in a critical review of the literature (LOE 1-2). Constipation in patients with complete spinal cord injury was studied by De Looze et al [13 – 14] with colonic transit time, anal manometry, electrophysiologic testing, and sensory-evoked potentials. They concluded, that loss of rectal sensation, dyssynergic pelvic floor contraction during straining, associated peripheral nerve damage, and insufficient rise of intraabdominal pressure could not be held responsible for constipation in their patients. A prolongation of the colonic transit time was the most important mechanism (LOE 4). The same group found in a questionnaire survey that faecal incontinence was rare in spinal cord injury and much less a problem than constipation. But faecal incontinence if present has a strong impact on quality of life.

Kiff and Swash [15 – 16] have in two studies evaluated conduction time in the pudendal nerves in neurologic faecal incontinence and could show that conduction delay occurs distally in the pelvic innervation (LOE3 both studies). The importance of internal anal sphincter EMG has been shown by Lubows-

ki et al [17]. In a small patient study their findings indicate that, in neurologic faecal incontinence, neurologic weakness of the external anal sphincter and pelvic floor muscles is associated with damage to the internal anal sphincter (LOE3).

In patients with suspected neurologic bowel disorders, comprehensive electrodiagnostic approach, performed by experienced clinical neurophysiologists should complement data obtained by other methods [18 – 19].

- **Thermal sensation** is thought to be important in sensory discrimination between different substances. Rectal heat thresholds might be relevant to assess rectal sensory afferent mechanisms [20], which have not yet been tested in neurologic patients. Similarly, measures of level of activity of extrinsic autonomic gut innervation might possibly be done with Laser Doppler measurement of rectal mucosal blood flow [21]. Again, this has not yet been tested in neurologic patients.
- **Balloon expulsion test** with a 50 ml water-filled rectal balloon will help identify those patients with pelvic floor dyssynergia [22].
- **Quality of life:** One study assesses quality of life in 118 patients with neurologic faecal incontinence by using the Direct Questioning of Objectives quality-of-life measure. They found that continence scores focus heavily on the physical aspects of incontinence such as soiling and hygiene, aspects which seem to be less important to the patients themselves.

They state that it is important that assessments of fecal incontinence should include reference to quality of life, and in particular to its impact on activities relating to "getting out of the house" [23] (LOE 4).

Conclusions

- **Diagnosis of faecal incontinence in neurologic patients relies mostly on the same techniques as in non neurologic patients**
- **Technical diagnostics have permitted a better understanding of pathophysiology of faecal incontinence in patients with neurologic disease.**
- **Electrodiagnostic tests seem to be the most specific to show neurologic deficits**
- **Some tests have been shown to permit selection of patients for treatment options but only in small series.**
- **Most studies are case series LOE 3-4.**
- **Especially in neurologic faecal incontinence quality of life evaluation should be part of a diagnostic evaluation.**

Recommendations

- **More studies are needed to better define the optimal diagnostic evaluation of faecal incontinence preferably at a higher level of evidence**

D3. CONSERVATIVE TREATMENT

For a general overview of conservative management of faecal incontinence please refer to the specific chapter.

Major objectives during acute rehabilitation are to educate the patient about the changes that occur and to manage the neurologic bowel with an effective bowel program. The two basic objectives of an effective bowel program are continence and regularity, to avoid complications such as constipation and diarrhea. An ineffective program affects virtually every aspect of the patient's life, including physical, psychological, social, vocational and sexual goals [2] as well as the ability to maintain an activity level, functional independence, and social interaction [1].

- *Bowel care* is a procedure devised to initiate defecation and accomplish faecal evacuation.It should be individually developed. A prescribed procedure should be carried out by the patient or the attendant to periodically evacuate stool from the colon [3]. According to Han et al [4], the concept of what contributes to an ideal bowel care is very different for physicians and for patients: *'ideal bowel care of physician'* is defined as spontaneous or reflex defecation without enema or suppository, at least once every 2 days and within 30 min, while *'ideal bowel care of patient'* is defined as lack of defaecation difficulty. The concept of 'satisfactory' varied considerably among individuals. A bowel care regimen needs to fit to the person's long-term routine and aims at effective colonic evacuation without FI. In addition, appropriate equipment, such as commode chairs and wheelchair able toilets, needs to be supplied for an adequate long-term programme [5]. Correa and Rotter [6] designed a bowel program, in order to achieve an effective and efficient evacuation in a

predictable and socially acceptable time, to avoid short and long term complications and eliminate inadequate intestinal evacuation habits.They assessed the state of the neurological bowel in 38 chronic SCI patients with complete lesion and found that the most frequent GI symptom was abdominal distention (53%). Rectoanal inhibitory reflex was present in 88%, pre and post SCI difficulty in intestinal evacuation (DIE) (defecation frequency < 3 times per week, hard stool, prolonged bowel management time > 45 min) was increased (from 2.6% to 26.3%). After the comprehensive bowel management, the incidence of DIE was reduced to 8.8%, manual extraction was reduced from 53% to 37%, excellent and good results were obtained in 56% of the patients.

- *Bowel training* is any program that includes scheduled attempts to defecate. This includes dissimilar programs that are indicated for different patient populations. Doughty [7] proposes two terms: *'bowel reeducation'* and *'scheduled, stimulated defecation program'*. The bowel reeducation is indicated for a person with intact sensory and motor function and chronic bowel dysfunction, while the scheduled, stimulated defecation program is indicated for persons with diminished or absent ability to sense rectal distention, or to voluntarily contract the external anal sphincter.

The guideline of 'scheduled, stimulated defecation program' consists of cleansing of the colon, normalization of stool consistency with adequate fluid intake and adequate fibre intake, and stimulating evacuation of stool on a regularly scheduled basis. The bowels are usually evacuated daily or every other day according to the patient's premorbid bowel elimination patterns and/or to correspond to patient and family preference. An appropriate stimulus has to be selected to stimulate peristalis or mass movement so that stool is delivered to the rectum for evacuation.

Physiologic mechanism of action and probable effectiveness for the specific patient, any known adverse effects, cost factors and patient preference should be considered. Menter et al [8] classified bowel management into 4 categories of bowel emptying: a) mechanical stimulation including digital (-rectal) stimulation and manual evacuation; b) chemical stimulation of the colorectal reflex including suppositories and enema; c) increased intra-abdominal pressure (Valsalva) or manually-generated external pressure; and d) no intervention required (near normal but with hyperactive anal rectal reflex).

I. REGULARITY OF BOWEL TRAINING PROGRAMME (LOE 3)

In a retrospective study King et al [9] emphasized patient/family education and a regular, consistently timed, reflex-triggered bowel evacuation. They found that young neurologic children often began on a twice a day schedule, after breakfast and supper. Older children were usually trained to a daily schedule within 30 minutes after supper. Adolescents usually successfully shifted to an every other day schedule. Longer than every other day had not previously been effective.

Venn et al [10], in persons with stroke, compared 4 bowel programmes based on the use of suppositories and scheduled bowel care. Fourty six were assigned to one of the following protocols: mandatory morning suppository, optional morning suppository if the patient had not had bowel movement within the previous 4 hours, mandatory evening suppository, and optional evening suppository if the patient had not had a bowel movement within the previous 4 hours. Those assigned to morning schedules were more likely to establish a successful bowel regime than those assigned to evening schedules ($p<0.01$). No difference between uses of mandatory or optional suppositories was noticed. Munchiando and Kendall [11] suggested a daily digital stimulation during bowel training program to regulate bowel evacuation in stroke patients.

Timing a bowel movement to take advantage of the gastrocolic reflex may be useful to achieve evacuation at a scheduled time of day and to keep the rectum free of stool. These measures substantially decrease the likelihood of incontinence [12].

II. REFLEX-TRIGGERED BOWEL EVACUATION

1. Digital mechanical stimulation and evacuation (LOE 3)

According to Stiens et al [3] and Doughty [7], digital rectal stimulation is a technique utilized during bowel care to open the anal sphincter and facilitate reflex peristalsis. A gloved lubricated finger is inserted into the anal canal to just above the internal sphincter and is rotated to cause relaxation of the internal sphincter and activation of the autonomic pathway. It is an inexpensive approach and requires

only a finger, glove and lubricant. It is usually effective for persons with suprasacral lesions because the parasympathetic pathways that stimulate peristalsis in the left colon remain intact in these patients.

Lynch et al [5] found digital stimulation and manual evacuation to be the most common methods of defaecation for patients with high complete SCI. Regular manual evacuation was more frequent among those with complete injuries (67%) than in those with incomplete injuries (25.4%).

Those with lower injuries are more likely to require manual evacuation and those with high injuries use digital stimulation to provoke reflex defecation, as it can result in a reflex wave of conus-mediated rectal peristalsis .The intact rectoanal inhibitory reflex then causes internal anal sphincter relaxation and defecation.

Constipation was found more among persons with paraplegia ($p<0.05$) and those using digital stimulation, manual evacuation, or increased abdominal pressure [8]. SCI patients also spent longer at the toileting than controls ($p<0.0001$), especially those patients doing manual evacuation [13] (LOE 3).

Digital stimulation is part of the program designed by Correa and Rotter [6] including high-fiber content diet, sitting position for defecation, applying pressure and massage to the abdomen and suppository use. With the program, the incidence of difficulty in intestinal evacuation was reduced and manual extraction was also reduced.

2. Chemical stimulation

a) Suppositories (LOE 3-4)

When fluids, fiber supplements, and scheduled bowel management are insufficient, or if the patient has problems with incontinence, suppositories that stimulate the large intestine to evacuate within 60 minutes can be prescribed [12]. According to King et al [9], correct suppository insertion and/or digital stimulation techniques permitted triggered defecation in over 90% of neurologic children without the use of oral bowel stimulant medications. This is supported by Gleeson [14] who states that the most common cause of failure at any step of bowel program was *inadequate technique*, especially with *suppository insertion*, and that the correct technique of suppository use is to insert it high, past the internal sphincter. Moreover it must be placed against the wall of the rectum, not in a bolus of stool. The time required to produce evacuation is variable, and the completeness of evacuation is inconsistent [7].

Suppositories are low cost and are typically well accepted by patients and care givers. The two suppositories most commonly used are *glycerine* and *bisacodyl*. Glycerine works by a combination of lubricant and local stimulant effect, and bisacodyl stimulates peristalsis by activating parasympathetic pathways. According to the study of Stiens et al [15], polyethylene glycol based bisacodyl suppositories may stimulate reflex defaecation sooner and shorten the total bowel care time as compared with hydrogenated vegetable oil based bisacodyl suppositories (LOE 2).

b) Enemas (LOE 3-4)

Enemas were used by 10.9%, and by approximately twice as many patients with complete SCI than with incomplete injuries ($p<0.0001$) [16]. They are often used when suppositories or digital stimulation fail. Long-term use can result in enema dependence, and side effects such as rectal trauma and autonomic dysreflexia can occur [5]. In the study of Menter et al [8], 36.4% of chronic SCI patients using chemical stimulation reported having faecal incontinence. Haemorrhoids were found more among those using primarily suppositories and enemas to manage their bowels.

Regarding *mini-enemas*, the most commonly used is TheraVac, containing a combination of docusate and soft soap. It initiates defecation through the combined effects of a local stimulant and a softener. It seems to be more effective, working more quickly and possibly with less mucus production than other stimulants. It produces more predictable and consistent evacuation. Long-term effects are not known. In addition, they are also more expensive, with a cost of 1 to 2 $ US [7, 12].

In a comparison by Cornell et al [17] in SCI during rehabilitation, mechanical evacuation with *tap water enema* without oral stimulant laxatives was associated with the most effective evacuation compared with both the irritant- and the stimulant-medication groups. A regular use of enemas is helpful in patients with sacral cord lesions, poor sphincter function and no rectal sensation and faecal incontinence and constipation. Its value has also been shown in those for whom other medical measures are unsuccessful [18].

Though no results are known in adult patients, Eire et al [19] showed good results with R*etrograde Colonic Enema* (RCE) in 33 Spina Bifida children with LMN neurologic faecal incontinence who had failed all other treatment. R*etrograde Colonic*

Enema (RCE) with a special 100% silicone catheter with balloon and lukewarm water (with one teaspoon of salt per 500 ml) 15-20 ml/kg was given every 48 hr. All but one achieved continence; none developed allergic phenomenon or side effects. An average of 30 months follow up gave the same degree of success. The RCE or low-volume tap water enema is however time-consuming and needs some help in its use. Instead of lukewarm water, one can use low-volume (200 to 500 ml) tap water with the volume titrated to provide adequate colonic distention [7].

Puet et al [20] introduced a new device, called *Pulsed Irrigation Evacuation* (PIE) for managing impaction in SCI patients. The principle behind the PIE is the use of intermittent, rapid pulses of warm water to break up stool impactions and stimulate peristalsis. They evaluated and reported their experience in 173 SCI patients. Regarding efficacy, the procedure was successful in removing stool in all but 1 patient with a very large, distended rectum that could not retain the water despite maximum inflation of the cuff. Two patients with a history of haemorrhoids had rectal bleeding on insertion of the speculum.

3. Valsalva or manually-generated external pressure (LOE 3)

With complete or partial injuries to the cauda equina a LMN pattern develops with flaccid external anal sphincter (EAS) and pelvic muscles. There is no reflex response to increased intraabdominal pressure, and Valsalva can result in faecal leakage. In such case the rectum has to be kept empty to avoid faecal incontinence. Stool has to be removed digitally, assisted by Valsalva and abdominal massage [5].

Yim et al [21] found that the Valsalva manoeuver was the most frequently used method by patients with lower motor neuron lesions. According to Menter et al [8], 38.5% of chronic SCI patients who used abdominal pressure reported having bowel accidents, but only 7.7% of those using abdominal pressure had faecal incontinence.

4. Oral Medications (LOE 3/4)

a) Stool softeners, such as docusate sodium, increase the amount of water in the stool without increasing volume and have no effect on bowel motility. They can affect the intestinal absorption of other drugs, resulting in higher plasma levels. The stool is more likely to be liquid. These softeners are useful where faecal incontinence is not a risk and straining should be avoided, such as for those with haemorrhoids or autonomic dysreflexia [5].

b) Stimulant laxatives act by increasing intestinal motility, resulting in less time for water reabsorption. *Senna* has a direct stimulant effect on the myenteric plexus and also increases intraluminal fluid. Chronic use can result in a progressive unresponsiveness [5]. Adding a mild oral stimulant, such as senna, 6 to 8 hours before the desired bowel movement may increase the amount of stool present in the sigmoid colon ready for evacuation after colonic stimulation [12]. *Bisacodyl* has a similar mode of action. Dose dependent side effects can occur, such as abdominal cramping, diarrhea and electrolyte imbalance [5].

Laxative use was found almost 10 times more frequent among SCI patients, becoming even more frequent with increasing time from injury [5].

Kirschblum et al [1] retrospectively studied bowel care practices in 100 chronic SCI patients: 56% used oral medications as part of their bowel program. C*olace* and *senokot* were usually used in combination. However, senna is usually better tolerated than bisacodyl given orally. Orally administered agents combining a softening with a stimulating compound were found more difficult to use than each of these compounds seperately [12].

c) Prokinetic agents such as cisapride have been used to reduce constipation in SCI. According to the systematic review study of Coggrave et al [22], *cisapride*, a drug used to accelerate GI motility, does not seem to have clinically useful effects in patients with SCI [23 - 25]. Cardiac arrhythmias have been noted with long-term use [26].

5. Diet modification (LOE 3-4)

While laxatives can improve colonic motility, looser and more frequent bowel motions may result in an increased incidence of faecal incontinence. Regular fibre and adequate fluid intake is recommended because of bulking and stool softener properties, thus facilitating transit and preventing impaction [16]. To normalize stool consistency, adequate fluid of 30 ml/kg body weight/day, and adequate fibre intake of 30 gm/day for adults is suggested. The usual approach is to begin with 1 to 2 tablespoons of bulk laxative or bran mixture daily and to increase the daily dose by 1 tablespoon every week until the desired results are obtained. A sudden increase of fibre to 30 gm/day can cause bloating, gas and diarrhea [7].

Stolp-Smith et al [12] suggested adequate intake of fluids (60 oz daily), a high-fiber diet, use of *fibre supplements* and bulking agents such as *Metamucil* twice daily, and a regular schedule as primary mea-

sures for achieving a reasonable bowel program (LOE 4). *Psyllium*, a soluble fibre aimed at absorbing water and increasing bulk to stimulate normal peristalsis and bowel motility, was associated with increased stool frequency in Parkinson disease but did not alter colonic transit time [27]. According to Cameron et al [28], significantly increasing dietary fibre in a group of SCI patients resulted in an increase in mean colonic transit time from 28.2 h to 42.2 h ($p<0.05$), and rectosigmoid transit time from 7.9 h to 23.3 h ($p<0.02$). Thus increasing dietary fibre in SCI patients does not have the same effect as has been previously demonstrated in persons with normally functioning bowels.

6. Biofeedback (LOE 3-4)

Though Wald [29], Blanco et al [30] described improvement in the frequency of soiling and decrease of rectal perceptual volume in meningomyelocoele patients, no results in adult neurologic patients are to be found as yet. The minimal criteria for successful treatment appear to be normal threshold of rectal sensation and the ability to contract gluteal or related muscles.

Girona et al [31], in a review, concluded that the overall success rate of biofeedback in general anorectal incontinence and chronic constipation is reported to be 50-92% and 35-90%, respectively. But in patients with neurologic incontinence, the results were poor.

7. Electrical stimulation (LOE 3- 4)

Riedy et al [32], used perianal (surface) electrical stimulation to increase anal sphincter pressure (with currents from 0-100 mA, 300 us pulse duration, 35 Hz) in 5 complete SCI patients. Four had strong anal contractions. The one who failed had LMN neurologic bowel. The increases in anal pressure were not sustained over the length of the applied stimulation. Patients found the device cumbersome and did not feel that their occasional episodes of faecal incontinence warranted use of this device.

Han et al [33] retrospectively reviewed the effect of *intravesical electrical stimulation* (IVES) on neurologic bowel dysfunction in 24 children with meningomyelocoele. The mean number of overall faecal incontinence episodes decreased significantly and a greater than 50% decrease in the episodes of faecal incontinence were observed in 75% of the patients. However, there was no significant change in the number of daily bowel movements. No studies in adult neurologic patients are as yet available.

8. Functional magnetic stimulation (FMS) (LOE 3)

Lin et al [34] evaluated the usefulness of FMS as a non-invasive method to stimulate the colon in patients with SCI by using commercially available magnetic stimulators and placing the magnetic coil on the transabdominal and lumbosacral regions. An increase in rectal pressure and a decrease in colonic transit time were found.

Conclusions(LOE 3-4)

- **Bowel training program is comprehensive, individualized, and aims at regular bowel evacuation.**
- **Intensive patient education and bowel training on regular, consistently timed, reflex-triggered bowel evacuation can lead to social bowel/faecal continence.**
- **Failure of bowel care is usually due to inadequate or incorrect techniques used.**
- **Appropriate stimulations added to the regular bowel training program can trigger/achieve complete bowel evacuation.**
- **Successful bowel care provides patients with their full potential, helps them to become integrated in society and to be as independent as possible.**

Recommendations: Grade B

- **Emphasize patient/family education and a regular, consistently timed, reflex-triggered bowel evacuation.**
- **Conservative bowel management should consist of an individualized and person-centered bowel program, which may include diet, oral/rectal medications, appropriate stimulation and equipment, and scheduling of regular bowel care.**
- **If conservative bowel management fails, consult for surgical management.**

Recommendation for research

- **More studies to evaluate effects and safety of the long-term use of different bowel managements in adult neurologic patients are needed.**
- **Studies to evaluate the efficacy of biofeedback, electrical stimulation and functional magnetic stimulation in neurologic bowel/colorectal dysfunction should be done in adult patients**
- **Further research is required to examine the optimal level of dietary fibre intake in neurologic patients.**
- **Investigation is needed on the actions of colonic neuropeptides to promote coordinated colonic peristalsis as possible therapeutic modality in the future.**

D4. SURGICAL TREATMENT

Surgery should be normally reserved for patients who have failed conservative therapy.

Surgical treatment of fecal incontinence in the general population is overviewed in the Chapter on the Surgery for Fecal Incontinence. Therefore, this section focuses on specific aspects in neurogenic patients. Although traumatic lesion of external sphincter is treated by reconstruction of the external sphincter, functional impairment of anal sphincter without mechanical defect of the sphincter in neurogenic patients can not be treated by this simple surgical repair, and thus options for surgical treatment of neurogenic bowel dysfunction are limited. However, they consist of 1) sacral nerve stimulation, 2) antegrade continent enema procedure, 3) dynamic graciloplasty, 4) artificial anal sphincter, and 5) elective colostomy.

I. SACRAL NERVE STIMULATION (SNS)

Electrical stimulation of sacral nerve roots has been reported to restore continence in patients with structurally intact muscles. The procedure is divided in three steps: acute percutaneous testing, temporary percutaneous nerve evaluation and permanent electrostimulation phase with an implantable neurostimulation device. An electrode inserted into the S3 sacral foramen provides low grade stimulation. Only when patients respond to acute and temporary percutaneous sacral nerve stimulation tested for 2 to 3 weeks, permanent stimulation via a chronic stimulator implanted under the anterior abdominal wall is applied. The first case report with this technique was published by Matzel et al [1] in 1995 who described a successful outcome in three patients with fecal incontinence. Since then, ten articles have been published [2 – 11] (**Table 4**). Recently, Matzel et al. [2] reported a multicentre, prospective trial with chronic sacral nerve stimulation in a series of 34 patients at a median follow-up of 23.9 months. At least 83 % of patients had a 50% or greater improvement in total number of incontinent episodes per week and at least 71% of patients a 50% or greater improvement in total number of days per week with incontinence during the course of follow-up. Continence was fully restored in at least 12 (37%) patents. Quality of life improved in all four ASCRS (American Society of Colon and Rectal Surgeons) scales ($p<0.0001$) and in seven of eight SF-36 scales, though only social functioning was significantly improved ($p=0.0002$). Although 12 patients had 19 device-related adverse events including pain(ten episodes in 9 patients), lead breakage in one patient, recurrent infection needing device removal in one patient and deterioration of bowel symptoms in three patients, resolution rate was 63.2% and 100% for all and severe complications, respectively. However, this study excluded patients with neurological diseases.

Similar success rates (73-100%) with this technique have been reported from other centres [3 – 5, 7 – 11] Among these reports, only one case-series by Rosen et al [7] targeted mainly on fecal incontinence in patients with neurological lesions. In that study, 20 patients (15 neurogenic, 5 idiopathic) with severe fecal incontinence were initially treated by temporary external stimulation over a period of 10-14 days. Sixteen patients (11 patients with neurogenic causes including 5 spinal cord injuries, 4 post spinal cord surgeries, 1 myelomeningocele, 1 multiple sclerosis, and 1 Friedreich ataxia, and 5 idiopathic patients) who had shown a positive response to the temporary stimulation subsequently underwent permanent implantation. The median follow-up was 15 months (range, 3-26 months). All patients who had received a permanent implant revealed a marked reduction in their incontinent episodes as well as an increase in retention time. In the neurogenic subpopulation, the median numbers of incontinence episodes decreased

Table 4. Summary of reported data on sacral nerve stimulation for fecal incontinence

Authors reference no., year	Level of evidence	No. of patients (neurogenic patients) with chronic stimulation	No. of patients underwent test stimulation	Median follow up (months) (range)	Success rate (fully continent rate)
Matzel et al[2], 2004	Level 3	34 (0)	37	23.9	83% (37%)
Ripetti et al[3], 2002	Level 4	4 (0)	21	15 (6-24)	100%
Ramussen et al[4], 2002	Level 4	10	14	4.5	90%
Kenefick et al[5], 2002	Level 4	14 (0)	ND	24 (13-60)	100% (73%)
Matzel et al[6], 2001	Level 4	6 (1)	ND	36 (5-66)	100%
Rosen et al[7], 2001	Level 4	16 (11)	20	15 (3-26)	75%
Ganio et al[8], 2001	Level 4	16 (2)	ND	15.5 (3-45)	100%
Leroi et al[9], 2001	Level 4	6 (0)	9	6	50%
Ganio et al[10], 2001	Level 4	5	23	19.2 (5-37)	100%
Malouf et al[11], 2000	Level 4	5	ND	16	100%

ND: not determined

significantly ($p<0.01$) from 7 (4-15) to 2(0-5), and a median retention time significantly ($p<0.01$) increased from 2 minutes (0-5) to 7 minutes (2-15) after chronic stimulation. Assessment of QOL scales using ASCS questionnaire after 6 months treatment showed significant improvement on all scales. Three patients (2 neurogenic and 1 idiopathic) had severe infections needing explantation of devices and wound drainage 0-3 months after implantation. Another one patient had dislocation of the permanent electrode. No complications were observed in the remaining 12 patients (60% of total series). All of those patients with functioning systems have shown improved incontinence during the follow-up period. Although the mechanism of SNS to improve fecal incontinence is uncertain, rises in anal resting and squeezing pressures and changes in rectal sensitivity and motility have been proposed. Particularly in neurogenic patients, neuromodulation of sacral reflexes and regulation of rectal sensitivity appear to be the major reasons for the functional improvement [7].

Although there are no controlled studies comparing SNS with artificial anal sphincter or dynamic graciloplasty, unlike the two other operations this is a minimally invasive procedure, and seems to be an option applied to fecal incontinence due to functional deficit of anal sphincter without structural defect (LOE 4). However, studies on large series with long term follow-up are needed to determine its role in the treatment of fecal incontinence associated with neurological lesions.

II. ANTEGRADE CONTINENCE ENEMA (ACE)

The original procedure was developed by Malone et al [12]. The principles of antegrade colonic washout and the Mitrofanoff non-refluxing catheterisable channel were combined to produce a continent catheterisable colonic stoma. The intention was that antegrade washouts delivered by this route would produce complete colonic emptying and thereby prevent soiling. Malone et al reported successful results in five children with intractable fecal incontinence. This procedure has been applied mainly to pediatric population with neuropathic bowel dysfunction and anorectal anomaly, and successful outcome was achieved in 70-100% [12 – 33] (**Table 5**). Overall, stomal stenosis is the most common complication, affecting 10-41%. In a study of 62 children with median follow-up of 5.4 (3.25 to 8.25) years, 84 percent were completely continent or had soiling less than once a month [14]. There was a significant correlation between the level of continence and satisfaction with the procedure [14]. Improvement of self-esteem and psychosocial function after the ACE procedure in children with myelomeningocele has been reported [16]. Several modifications have been reported including laparoscopic technique, left colonic continence stoma, etc [17 – 19, 21 – 23]. This procedure was also applied to adult neurogenic patients with fecal incontinence [13, 22, 24], and similar success rates (83-100%) were reported.

Table 5. Summary of reported data on antegrade continent enema for fecal incontinence

Authors Reference no., year	Level of evidence	No. of patients	Mean age (range)	Median follow up (range)	Success rate	Overall complication rate	Stomal stenosis
Teichman et al [13], 2003	Level 4	7	34	4.5 yrs.(all>4 yrs.)	83%	67%	
Dey et al[14], 2003	Level 4	62	11.5(3.8-17.6)	5.4 yrs.(3.25-8.25)	84%	66%	42%
Liard et al[15], 2002	Level 4	24	15	3.7 yrs.	100%		
Aksnes et al[16], 2002	Level 4	20	10.9(6.8-17)	16(9.5-23)mos.	80%	30%	20%
Liloku et al[17], 2002	Level 4	7	8-21	(1.5-18 mos.)	71%	29%	14%
Tackett et al[18], 2002	Level 4	45	10.5(3.8-25.8)	25.3(4-65)mos	87%	22%	18%
Perez et al[19], 2001	Level 4	12	14(7-20)	15 mos.	92%		58%
Kajbafzadeh et al[20], 2001	Level 4	40	9.5(4-22)	22(8-48) mos.	100%	2.5%	
Van Savage et al[21], 2000	Level 4	16	12(4-21)	1.5 yrs.	100%	50%	6.3%
Bruce et al[22], 1999	Level 4	7	33.6(23-54)	22.4(3-34)mos.	100%		14%
Robertson et al[23], 1999	Level 4	30	9.5(5-16)	>1yr. (3mos.-3.5yrs.)	90%	33%	27%
Teichman et al[24], 1998	Level 4	7	32	11 mos.	100%	57%	28%
Meier et al[25], 1998	Level 4	20	10(4-18)	24(9-45)mos.	90%	10%	5%
Driver et al[26], 1998	Level 4	29	10(5-16)	28(7-71)mos.	79%		38%
Hensle et al[27], 1998	Level 4	27	16(10-31)	(9-30mos.)	70%	37%	18.5%
Levitt et al[28], 1997	Level 4	20	(3-27)	(1-29mos.)	95%	25%	10%
Goepel et al[29], 1997	Level 4	10	13.2(6-26)	18.5 (8.5-36)mos.	100%	20%	
Dick et al[30], 1996	Level 4	13	8(6-14)	32(24-60)mos.	85%	46%	38%
Ellsworth et al[31], 1996	Level 4	18	12(5-31)	6.6 (2-24)mos.	96%	22%	17%
Koyle et al[32], 1995	Level 4	22	13(5-26)	>4 mos.	77%	36%	9%
Squire et al[33], 1993	Level 4	25	(3-18)	13(2-61)mos.	88%	24%	20%
Malone et al[12], 1990	Level 4	5	(8-18)	(2-8 mos.)	100%	40%	

yrs: years, mos.: months

This procedure is effective for controlling fecal incontinence and constipation associated with neurogenic bowel dysfunction especially in neuropathic children (LOE 4). Patients should be properly selected to determine appropriate motivation.

III. DYNAMIC GRACILOPLASTY

This procedure consists of transposition of the gracilis muscle around the anal canal and subsequent implantation of a pulse generator to stimulate the gracilis muscle. Before continuous stimulation is applied, the muscle is trained for 4 to 8 weeks according to a protocol. During a stimulation program the fatigable type 2 skeletal fibers are replaced by slow type 1 fibers, which are able to sustain a long lasting contraction. Satisfactory continence has been reported in 56% to 81% of patients [34 – 43] (**Table 6**). Recently, a prospective study of 200 consecutive patients with a follow-up of at least two years showed a 72% overall success rate [34]. Complication rate is rather high (42%-92%), especially infectious complications which occur in about one fourth of the patients. Impaired rectal emptying has occurred in 16% to 29%. A prospective controlled comparative study of single stage with the conventional two-stage procedure showed no significant difference in infection rates, continence rates, morbidity or quality of life between the two groups after a mean 521-day follow up [44]. A prospective controlled study comparing dynamic graciloplasty with artificial anal sphincter in 16 patients (8 in each group) showed that both of the two procedures had a high incidence of technical failures and complication requiring reoperation [45]. Chapman et al [46] reported a systematic review article of this procedure, where they searched articles published until November 1999, and found 40 articles met the inclusion criteria. Mortality rates were around 2% for both graciloplasty and colostomy. However, morbidity rates reported for graciloplasty appear to be higher than those for colostomy.

Rongen et al [34] reported an 80% success rate with this procedure in 16 patients with neurogenic fecal incontinence. However, all studies presently available except this report include quite small number of neurogenic patients, and there is no information on the outcome in neurogenic subgroup of patients.

Since dynamic graciloplasty seems to be associated with high complication rates, and outcome appears to correlate to surgeon's experience, this procedure should only be carried out in specialist centres with a reasonably large number of patients, and should be reserved only for carefully selected patients with intractable fecal incontinence where other methods have failed (Grade C). Further studies are needed to determine its role in the neurogenic subpopulation.

IV. ARTIFICIAL ANAL SPHINCTER

Implantation of an artificial anal sphincter was first reported in 1987 [47]. The sphincter used was originally designed for treatment of urinary incontinence, but subsequently the device has been modified. The system consists of an inflatable cuff placed around the upper anal canal, a pressure-regulating balloon to maintain closure of the cuff placed in the subperitoneal space lateral to the bladder and a control pump accessible to the patient to empty the cuff for defaecation placed in the scrotum or labium. The system is left deactivated for 4 to 6 weeks. A multicenter prospective, non-randomized trial in 112 patients with one year follow-up showed 73 revisional operations were required in 51 (46%) , and the infection rate necessitating surgical revision was 25%. Forty-one patients (37%) have had their devices completely explanted [48]. The reported success rates obtaining acceptable continence range were 41% to 90% [48 – 60] (**Table 7**). Explatantion rates in the reported series were 20-40%. One series with long-term follow up (more than 5 years) showed that 7 of 17 patients had the system removed due to infection, malfunction or obstructed defaecation [56]. Technical complications like rupture of the cuff, which occurred frequently with the earlier modifications of the device, are now rare. Emptying problems, without anatomical stenosis, as described for dynamic graciloplasty, have also occurred frequently (13% to 45%) in most series and have in some patients required explantation. Other complications leading to explantation have been erosion of the cuff through the skin or into the anal canal.

As shown in Table 7, most studies have a small number of neurogenic patients or do not indicate the number of neurogenic patients included. In the study reported by Christiansen et al [56], 10 (59%) out of 17 patients had neurological disorders, and the overall success rate was 47%, which seems to be lower than the others. The authors mentioned that the result in neurogenic subgroup was clearly poorer than that in non-neurogenic subgroup.

Implantation of the artificial anal sphincter may be

Table 6. Summary of reported data on dynamic graciloplasty for fecal incontinence

Authors Reference no, year	Level of evidence	No. of patients	No. of neurogenic patients	Median follow up (range)	Success rate (success rate in neurogenic pts.)	Complication rate	Infection rate	Explantation rate	Emptying problem
Rongen et al[34], 2003	Level 3	200	16	>2 yrs.	72% (80%)	69%	12%	12%	16%
Wexner et al[35], 2002	Level 3	129		2 yrs.	56%				
Bresler et al[36], 2002	Level 4	24			79%	92%	25%		
Matzel et al[37], 2001	Level 3	121	0	1.5 yrs.		77%	37%	4%	27%
Baeten et al[38], 2000	Level 3	123	0	1 yr.(1-52 mos.)	74%	74%			
Madoff et al[39], 1999	Level 3	128		2 yrs.	66%		11%		
Sielenzneff et al[40], 1999	Level 4	16	1	20 (6-37) mos.	81%	50%	44%		31%
Christiansen et al[41], 1998	Level 4	13	0	(7-27mos.)	77%		8%		23%
Geerdes et al[42], 1996	Level 4	67	0	2.7 yrs. (14wks.-8.7yrs.)	78%	79%	16%		
Baeten et al[43], 1995	Level 3	52	2	2.1yrs. (12wks.-7.4yrs.)	73% (50%)		13%		

yrs.: years, mons.: months, wks: weeks

Table 7. Summary of reported data on artificial anal sphincter for fecal incontinence

Authors reference no., year	Level of evidence	No. of patients (neurogenic)	Mean age (range)	Median follow up (months) (range)	Success rate (in neurogenic)	Complication rates			
						Explantation	Infection	Revision	Emptying problem
Parker et al[49], 2003	Level 4	45(2)	44(15-72)		51% (50%)	40%	34%	21/13pts	11%
Michot et al[50], 2003	Level 4	37(16)	51(22-73)		79%	30%			37%
Devesa et al[51], 2002	Level 4	53(9)	46(16-76)	26.5(7-55)	65%	19%	13%	26%	22%
Wong et al[48], 2002	Level 3	112(ND)	49(18-81)		53%	37%	25%	46%	
Ortiz et al[52], 2002	Level 4	22(ND)	47(17-72)	26(6-48)	63%	44%			9%
Altomare et al[53], 2001	Level 4	28(4)	58(35-79)	19(7-41)	75%	32%	11%		57%
O'Brien et al[54], 2000	Level 4	13(1)	44(16-71)		77%	23%			
Lehur et al[55], 2000	Level 4	24(4)	44(14-80)	20(6-35)	75%	29%	12%	17%	45%
Christiansen et al[56], 1999	Level 4	17(10)	46(32-65)	7(5-10)years	47%	41%	18%	63%	13%
Vaizey et al[57], 1998	Level 4	6		10(5-13)	83%	16%			
Lehur et al[58], 1998	Level 4	13		30(5-76)	85%				
Lehur et al[59], 1996	Level 4	13(2)		20(4-60)	90% (69%)	23%	15%	15%	
Wong et al[60], 1996	Level 4	12(3)		58	50% (75%)	33%	25%	42%	
Christiansen et al[47], 1987	Level 4	1		3	100%				

ND: not determined

done for the same indications as for dynamic graciloplasty except in patients with previous perianal infections or with a thin and scarred perineum where a muscle transplant is preferable. It should be emphasized that due to the relatively high risk of treatment failure and of complications requiring re-operation patient selection for both procedures should be very strict (Grade C).

V. COLOSTOMY

Spinal cord injury (SCI) has a significant effect on bowel dysfunction, in terms of fecal incontinence, urgency, and toileting methods. This results in a marked impact on quality of life [61 – 62]. Several retrospective studies on the effect of colostomy formation on bowel care and QOL in SCI patients showed a significant decrease in the average time spent on bowel care per week and improvement of QOL [62 – 69]. The early and long-term complication rates reported are 6 to 15%, and 15 to 37.5%, respectively. The commonest long-term complication is mucus discharge per rectum. It should be noted that one of the frequent, persistent, problematic complication is diversion colitis [70 - 71]. Symptoms include hemorrhagic purulent rectal discharge, abdominal pain and tenesmus. This condition is thought to results from a deficiency of luminal short-chain fatty acids [72 – 73]. Steroid enemas, 5-aminosalicylic acid enemas or suppositories, or short-chain fatty acid enemas have been reported to be helpful [73].

Elective colostomy may be an option for some SCI patients with severe uncontrolled fecal incontinence (Grade C).

Conclusions

- **Studies specifically in neurogenic patients on the efficacy and safety of sacral nerve stimulation, dynamic graciloplasty and artificial anal sphincter are limited. However, studies in the general population suggest that sacral nerve stimulation is a minimally invasive procedure, and seems to be an option for fecal incontinence due to functional deficits of the anal sphincter without structural defects when temporary percutaneous nerve evaluation indicates positive effects (Level 4). Studies in large neurogenic populations with long term follow-up are needed to determine its role in the treatment of fecal incontinence associated with neurological lesions.**
- **In contrast to sacral nerve stimulation, both dynamic graciloplasty and artificial anal sphincter have high risk of treatment failure and of complications requiring re-operation (Level 3).**
- **Antegrade continence enema is effective for controlling fecal incontinence and constipation associated with neurogenic bowel dysfunction especially in neuropathic children (Level 4).**
- **Elective colostomy formation has a beneficial effect on bowel care and QOL in SCI patients with intractable fecal incontinence who have failed other therapy (Level 4).**

Recommendations

- **Surgery should be normally reserved for patients who have failed conservative therapy (Grade C).**
- **Sacral nerve stimulation is an option for neurogenic patients with intractable fecal incontinence who have failed conservative therapy, when acute and temporary percutaneous nerve evaluation indicates positive effects (Grade C).**
- **Antegrade continence enema is an option for controlling fecal incontinence and constipation associated with neurogenic bowel dysfunction especially in neuropathic children (Grade C). Patients should be properly selected to determine appropriate motivation.**
- **Since both dynamic graciloplasty and artificial anal sphincter have high risk of treatment failure and of complications requiring re-operation, and some patients developed evacuation difficulties after these procedures, patient selection for both procedures should be very strict (Grade C).**
- **Colostomy may be an option in some selected SCI patients with intractable fecal incontinence who have failed other therapy (Grade C).**

E. SPECIFIC NEUROLOGIC DISEASES

E1. DEMENTIA

I. EPIDEMIOLOGY AND PREVALENCE

Dementia is a poorly understood disease complex involving atrophy and the loss of gray and white matter of the brain, particularly of the frontal lobes. Problems result with memory and the performance of tasks requiring intellectual mentation [1]. Incontinence is traditionally attributed to a patient's mental status and dementia, even though there may be concomitant neurologic bladder dysfunction. The etiopathogenesis of dementia –related incontinence could be multifactorial and caused both by changes within the central nervous system and in the periphery. Looking for the prevalence of dementia associated incontinence one can not easily distinguish dementia caused incontinence from age-related changes of the bladder and from incontinence due to other concomitant diseases. Therefore the true incidence of incontinence caused by dementia is not known. Ouslander et al in a study in 8 proprietary nursing homes in Maryland in newly admitted residents, (LOE 3) found that the development of daytime incontinence was associated with male sex, the diagnosis of dementia, fecal incontinence, and the inability to ambulate or transfer independently [2].

Horimoto et al (LOE 3) found 97% incidence of urinary incontinence amongst patients with Levy body dementia [3]. Toba et al (LOE 3) found amongst geriatric population that the most frequent type of urinary incontinence was functional urinary incontinence in patients who were mentally and/or physically unable to go to the bathroom without aid (21.5%) [4]. Specifically, 38.1% of patients in geriatric hospitals were diagnosed as having functional urinary incontinence, in contrast to only 3.9% of patients in non-geriatric units. In patients with dementia, 88.7% were incontinent; whereas in patients without dementia, the prevalence of urinary incontinence was much lower (51.5%).

Campbell et al (LOE 2) found that patients with dementia were more likely to be incontinent than those with normal mental function [5]. In the majority of those over 80 who were incontinent, the incontinence was associated with either confusion or a combination of factors.

Leung et al (LOE 3) found male to female ratio of dementia related incontinence being 1:15 [6], and Thom et al (LOE 3) found that the risk of hospitalization was 30% higher in women following the diagnosis of incontinence and 50% higher in men after adjustment for age, cohort and co-morbid conditions [7]. The adjusted risk of admission to a nursing facility was 2.0 times greater for incontinent women and 3.2 times greater for incontinent men.

II. PATHOLOGY AND DISEASE SPECIFIC LUT PROBLEMS

Sakakibara et al (LOE 2) found that mainly the medial frontal lobe is responsible for urinary dysfunction in patients after stroke [8]. Griffiths (LOE 2) in his PET studies, shows that cognitive function was slightly more impaired in patients with genuine urge incontinence. But the strongest and most specific association was with impaired temporal orientation [9]. Genuine urge incontinence with reduced bladder filling sensation was associated with global underperfusion of the cerebral cortex and more specifically, with underperfusion of the frontal areas of the brain, especially on the right. Jirovec et al (LOE 3) found that cognitive ability and mobility differ significantly between continent and incontinent patients [10]. When the variables were examined together, mobility emerged as the best predictor of the patient's urine control, followed by cognitive impairment.

In a study by Resnick et al (LOE 2) performed in institutionalized elderly, detailed urodynamic studies in 94 of the 245 incontinent patients showed that detrusor overactivity was the predominant cause in 61 percent, with concomitant impaired detrusor contractility present in half these patients. Other causes among women were stress incontinence (21 %), underactive detrusor (8 %), and outlet obstruction (4 %) [11]. Among the relatively few men in this sample, outlet obstruction accounted for 29 % of the cases. Yoshimura et al (LOE 3) found a 47 % prevalence of detrusor overactivity which correlated with the prevalence of dementia [12].

III. DISEASE SPECIFIC DIAGNOSIS AND TREATMENT

No specific diagnostic tests to evaluate dementia related incontinence were described. Since patients with dementia and incontinence usually have one or more concomitant diseases, the evaluation of the

LUT functions should follow the general rules, bearing in mind that this is the population of frail elderly (see related chapter).

The treatment should start with modification of patient's behaviors and general rehabilitation targeted at making patient more ambulatory, as it was demonstrated that movement limitations are strongly related with incontinence. No other specific treatment in dementia have been described, however certain issues like prompted voiding, anticholinergic drugs and intermittent catheterization have been studied.

In his review of trials where prompted voiding was implemented Eustice et al (LOE 1) found that prompted voiding increased self-initiated voiding and decreased incontinent episodes in the short-term [13]. A single small trial suggested that adding oxybutinin, reduced the number of incontinent episodes in the short-term. In a study by Suzuki et al (LOE 3) the best results were obtained with ambulatory patients with the use of a portable chamber pot and induced urination, while no improvement was seen in bedridden patients treated with anticholinergics [14]. Sugiyama et al (LOE 3) studied the effects of anticholinergics therapy in patients aged 65 years or older with and without dementia. The patients received anticholinergic agents for more than two weeks [15]. Urodynamic studies demonstrated significant increase of maximum bladder capacity in the dementia group and the non-dementia group. There was no significant difference in rate of objective improvement between both groups. On the other hand, rate of subjective improvement was significantly higher in the non-dementia group (40%) than in the dementia group (15%). Improvement of functional bladder parameters was not associated however with improvement of subjective symptoms in the demented patients. In case of emptying failure, like in other bladder diseases intermittent catheterization is a treatment of choice. Lieu et al (LOE 3) found that carer-assisted clean intermittent urethral catheterization is an effective and safe treatment option for persistent urinary retention in elderly female patients with cognitive impairment and other disabilities [16]. With this method of treatment, 54% of the patients were able to void spontaneously and were continent after a median period of 6 weeks with a range of 1 to 40 weeks. Twenty-seven per cent had significant improvement in the symptoms of urinary incontinence and the residual urine volumes became progressively smaller. However, 19% failed this treatment modality. The recovery of spontaneous voiding was found to be significantly influenced by the age of the patient, the carer performing the intermittent catheterization and the development of catheter-related urinary tract infection. Twenty-five per cent of the study patients developed symptomatic urinary tract infection which was associated with a delay in the recovery of spontaneous voiding. Its development was also found to be significantly associated with the presence of pre-existing diabetes mellitus, the person doing the catheterization, the presence of dementia and with more predisposing common medical conditions.

Another interesting issue is the surgical treatment in patients with dementia. Two major groups of surgical procedures could be identified: prostate surgery and incontinence surgery. Yonou et al (LOE 3) studied a group of 13 patients with dementia who underwent TURP procedure [17]. Six patients reported good urination, 3 reported some improvement in urination after surgery, although requiring intermittent catheterization and 1 developed mild incontinence. No specific study addressing the issue of incontinence surgery in woman with dementia was performed; however it seems that the incontinence surgery in patients with dementia should be reserved only for the cases with good ambulation and without concomitant functional disorders of micturition (overactive bladder, hypocontractile detrusor).

IV. GUIDELINES FOR FURTHER RESEARCH

Since dementia is not a homogeneous disease a population study targeted at specific disorder of micturition is urgently needed. Also, a study evaluating different treatment modalities in patients with dementia (especially anticholinergic treatment for overactive bladder and surgical treatment for stress incontinence) is lacking.

Conclusions

- **Dementia associated incontinence occurs in 30-100% of patients with dementia (LOE 3)**
- **The degree of incontinence is strongly associated with patient's general status and ambulation (LOE 3)**
- **There is no one major cause for incontinence in these patients; however overactive bladder is responsible for a significant portion of incontinence (LOE 3)**
- **LUT surgery is not contraindicated in this group of patients (LOE 3-4)**

Recommendations

- **The extensive and aggressive therapy of incontinence in dementia patients should be reserved for patients with good general status and ambulation (Grade C)**
- **In case of ambulatory patients , prompted voiding, rehabilitation and oral anticholinergics seems to be treatment of choice (Grade C)**
- **In case of significant post-void residual, intermittent catheterization is the treatment of choice (Grade B); however in elderly non-ambulatory patients the recovery of LUT functions is not so good (grade C/D)**

E2. MULTIPLE SYSTEM ATROPHY

I. EPIDEMIOLOGY AND PREVALENCE

Multiple system atrophy (MSA) is a rare, adult-onset degenerative disease of the nervous system of unknown origin. Previously described as Shy and Drager syndrome it is characterized by autonomic dysfunction consisting of orthostatic hypotension, anhydrosis, impotence, extrapyramidal symptoms and poor urinary and fecal control. Urinary symptoms of incontinence are caused by neurologic detrusor overactivity and external sphincter weakness [1] (LOE 2).

Kirchhof et al (LOE 2) [2], found that bladder symptoms preceded symptoms of orthostatic hypotension in 76% of patients. Sphincter EMG abnormalities were found in 91% of the patients with MSA.

II. PATHOLOGY AND DISEASE SPECIFIC LUT PROBLEMS

The responsible sites for the urinary dysfunction in MSA seem to be the locus coeruleus (pontine micturition center; PMC).The works of Benarroch (LOE 2) demonstrated, that in MSA there is severe depletion of catecholaminergic neurons of the C1 and A1 areas in the ventrolateral medulla, and this may contribute to orthostatic hypotension and endocrine disturbances in this disorder, respectively. Additionally loss of corticotrophin-releasing factor (CRF) neurons in the pontine micturition area may contribute to neurologic bladder dysfunction [3 – 4].

Sakakibara et al (LOE 2) performed an extensive study of the urological symptoms in MSA patients [5 – 6]. They found the following prevalence of different symptoms: difficulty of voiding in 79%, nocturnal urinary frequency in 74%, sensation of urgency in 63%, urge incontinence in 63%, diurnal urinary frequency in 45%, enuresis in 19% and urinary retention in 8% of the patients. One hundred % of MSA patients presented with some kind of LUT symptoms.

Filling phase abnormalities in videourodynamic studies included detrusor overactivity in 56% of patients with MSA, and uninhibited external sphincter relaxation in 33% of them. Open bladder neck at the start of filling was present in 53% of MSA patients, suggestive of bladder neck denervation. On voiding, detrusor-external sphincter dyssynergia was present in 47% patients. Weak detrusor contraction was present in 71% of women and 63% of men. Post-micturition residuals >100 ml were present in 47%.

It is likely that the urinary dysfunction is more common and often an earlier manifestation than orthostatic hypotension in MSA. Similar results were reported by others showing post-micturition residuals over 30 ml and 100ml in 74% and 52% of patients respectively. Detrusor overactivity was found in 56%, low compliance bladder in 31%, and detrusor acontractility in 5% of patients. Detrusor-sphincter dyssynergia was observed in 45% of patients with MSA. [1, 7, 8].

III. DISEASE SPECIFIC DIAGNOSIS AND TREATMENT

Since LUT functional disturbances precede very often orthostatic hypotension and other autonomic nervous system symptoms in MSA patients, the diagnosis of LUT symptoms is of paramount importance.

Amongst different tests external urethral sphincter EMG is the most sensitive one. Sphincter motor unit potential analysis showed neurologic motor unit potentials in 93% of those with MSA, suggestive of external sphincter denervation [6]. Palace et al (LOE 2) demonstrated abnormal sphincter EMG in 82% of MSA patients [9].

Oertel et al (LOE 2) suggested that reduced genital sensation in females could be pathognomonic for MSA (with equal importance as erectile dysfunction in males [10]. A total of 47% of the MSA patients

and 4% of the control group had reduced genital sensation. Moreover, the appearance of reduced genital sensitivity in female MSA patients showed a close temporal relation to the onset of the disease.

When treatment of the voiding disorders in MSA is concerned, again the general principles of urodynamic based therapy should be used. However it is important to observe that aggressive surgical therapy is not recommended in MSA patients.

Chandiramani et al (LOE 2) found that all MSA patients who underwent TURP due to voiding problems were incontinent postoperatively, most probably due to the progression of the disease [11]. The same observations were done by Beck et al (LOE 2), who evaluated the results of TURP and stress incontinence surgery in MSA patients [1]. They concluded that the results of surgery were unfavorable. Patients benefited from intermittent catheterization, anticholinergic medication and desmopressin spray, which improved continence in 82%.

As nearly half of the MSA patients suffer from voiding difficulties, its management by other means than CIC would be very attractive. Sakakibara et al (LOE 3) compared different non-selective and alpha 1A selective alpha blocking agents (prazosin and moxisylate) in the treatment of LUT dysfunctions in MSA patients [12]. The respective means for reductions in residual urine volume for the prazosin and moxisylyte groups were 38.1% and 35.2% and there was lessening of urinary symptoms. Side effects due to orthostatic hypotension were seen in 23.8% of the prazosin group but in only 10.7% of the moxisylyte group.

IV. GUIDELINES FOR FURTHER RESEARCH

MSA is a slowly progressive disease without any cure. More research is needed to evaluate the effects of long term LUT treatment and to evaluate the effects of different drug treatment modalities.

Conclusions

- **LUT symptoms often precede the clinical manifestation of multiple system atrophy (LOE2)**
- **The most common LUT disturbances are detrusor overactivity, detrusor sphincter dyssynergy, sphincteric relaxation and weak detrusor(LOE 2)**
- **Significant post void residual is observed in about half of the multiple system atrophy patients (LOE 2)**

Recommendations

- **The most sensitive test to detect multiple system atrophy associated LUT abnormalities is sphincter EMG (Grade A)**
- **Due to progressive nature of the disease aggressive treatment and LUT surgery (e.g. TURP) are not recommended (Grade A)**
- **Treatment of choice in case of increased post void residual are CIC and alpha blocking agents (Grade B)**

E3. PARKINSON DISEASE

I. URINARY INCONTINENCE

1. Epidemiology and prevalence

Parkinson's Disease is a movement disorder due to degeneration of dopaminergic neurons in the substantia nigra and a loss of dopamine-containing nerve terminals in the basal ganglia . Degeneration of the nigrostriatal pathway is accompanied by decreases in corresponding biochemical markers, including dopamine, tyrosine hydroxylase, dopamine metabolites, and dopamine transporter. These central nervous system changes have also influence on autonomic functions, including voiding in affected patients.

The most common are gastrointestinal (constipation), perspiratory (hypohidrosis) and urinary systems. Urinary dysfunction in Parkinson's disease has been reported to occur in 37 to 71% of the patients, including urinary urgency, frequency and incontinence in the storage phase [1].

In a study of Hattori et al (LOE 2) 60% of Parkinson patients had urinary symptoms, which could be divided in the following categories: irritative in 28%, obstructive in 11%, and both symptoms in 21%. The frequency of urinary symptoms statistically correlated with severity of the disease, but not with the duration of illness and no sexual difference was noted [2].

2.Pathology and disease specific LUT problems

Sakakibara et al (LOE 2) demonstrated that uptake of a dopamine transporter which reflects striatal presynaptic dopamine level, was significantly reduced in Parkinson disease patients with urinary dysfunction

compared to those without [3]. Therefore urinary dysfunction in Parkinson disease could reflect degeneration of the nigrostriatal dopaminergic cells associated with specific motor disorders.

In a study of Parkinsonian and MSA patients, Sakakibara et al (LOE 2) found urinary symptoms in 72 % of patients. They were mostly attributed to detrusor overactivity (81%) and external sphincter relaxation problems (33%) [4]. During micturition Parkinson patients did not demonstrated detrusor-sphincter dyssynergy, however detrusor hypocontractility was observed in 66% of women and 40% of men.

Similar observations were done by Defreitas et al [5](LOE 2). The urge incontinence prevalence was around 54%, however no statistically significant correlation between the duration or severity of Parkinson's disease and urodynamic parameters was found.

Araki et al [6] (LOE 3) using the International Prostate Symptom Score found a 27% prevalence of voiding dysfunctions among Parkinson's disease patients. However Gray et al (LOE 2) reported that LUT functional disturbances are not disease specific in patients with Parkinson's disease [7].

3. Disease specific diagnosis and treatment

In voiding dysfunctions associated with presumed Parkinson's disease it is important to differentiate between Parkinson's disease and multiple system atrophy. Chandiramani et al (LOE 2), suggested several criteria for distinguishing LUT symptoms caused by MSA from these caused by Parkinson's disease [8]. Presence of the following features: urinary symptoms preceding or presenting with parkinsonism; urinary incontinence; a significant post-void residual urine volume; erectile failure preceding or presenting with parkinsonism, is strongly suggestive of MSA rather than Parkinson's disease.

External urethral sphincter EMG is also helpful to distinguish between these two entities, since detrusor-external sphincter dyssynergia was not seen in patients with Parkinson's disease but was present in 47% of those with MSA [4](LOE 2). This is also confirmed by studies of Palace et al (LOE 2) who demonstrated abnormal sphincter EMG in 82% of MSA patients [9]

In Parkinson's disease treatment of choice is L-dopa, which also affects bladder functions. Aranda et al. (LOE 3) studied the effects of L-dopa with and without apomorphine on bladder functions in parkinsonian patients [10]. They found that patients with detrusor overactivity improved with apomorphine, and to a lesser extent with L-dopa, however these treatments had no effect on patients with hypocontractile detrusor. Raz (LOE 3) found that L-dopa therapy has also an effect on the external urethral sphincter, causing its relaxation and better coordination of pelvic musculature [11].

These observations are in contrast with a study of Uchiyama et al (LOE 3) who studied the effect of a single dose of L-dopa with dopa-decarboxylase inhibitor on micturition function in parkinsonian patients [12]. After administration of a study drug, urinary urgency and urge incontinence were aggravated, whereas voiding difficulty was alleviated in all patients. It also increased detrusor contractility much more than it did urethral obstruction in the voiding phase, producing overall lessening of voiding difficulty and improving voiding efficiency.

Detrusor overactivity should be treated according to the general knowledge of anticholinergic drugs. There are no specific studies on systematic anticholinergic drugs to treat neurologic OAB in Parkinson's disease patients; however since anticholinergics were the first drugs available for the symptomatic treatment of Parkinson's disease and since they are still widely used today there is no reason to believe that they will produce any specific adverse events in these patients. A systematic review of anticholinergic use (centrally acting) to treat Parkinson's disease was recently done by Katzenschlager et al [13](LOE 1).

For emptying failure the treatment of choice remains IC, however no detailed studies on these treatment modalities on Parkinson's disease patients have been performed.

An interesting treatment option was suggested by Finazzi-Agro et al (LOE 3), who implanted subthalamic nucleus electrodes in patients with Parkinson's disease [14]. They observed that during chronic subthalamic nucleus stimulation bladder capacity and reflex volume were increased for and the amplitude of overactive detrusor contractions was decreased (non significantly) in comparison with the studies performed when the stimulator was switched off.

As in MSA a very important issue in Parkinson's disease affected patients is the indication for pelvic surgery. Myers et al (LOE 2) found that women with Parkinson's disease and LUT complaints have a lower maximum cystometric capacity and a higher rate of detrusor overactivity at lower bladder

volumes in comparison with non-neurologic control [15].Therefore surgery for stress incontinence in women with Parkinson's disease should be performed only when no significant detrusor overactivity is present, since it is well known that this type of surgery can evoke or aggravate detrusor overactivity and subsequent urge incontinence.

The issue of selecting the right patient for prostate surgery was described above. Staskin et al (LOE 3) described the results of TURP in MSA rather than in Parkinson's disease patients [16]. Since external urethral sphincter acontractility is extremely rare in true Parkinson's disease prostate surgery should not be contraindicated in this group of patients.

• Guidelines for further research

Despite there is no definite cure for Parkinson's disease, with the current knowledge we can slow down the disease process and bring patients to an almost normal live. Therefore it would be of extreme importance to introduce a validated scheme for LUT dysfunction therapy.

Conclusions

- **LUT symptoms are associated in Parkinson's disease with degeneration of dopaminergic neurotransmission (LOE2)**
- **The most common LUT disturbances are detrusor overactivity, and detrusor hypocontractility (LOE 2)**
- **The effect of L-Dopa on LUT in Parkinson's disease patients remains to be elucidated (LOE 3)**

Recommendations

- **Treatment of choice for bladder overactivity in Parkinson's disease patients is anticholinergics (Grade B)**
- **For voiding failure in case of significant post void residual the treatment of choice remains intermittent catheterization (Grade B)**
- **LUT surgery for patients with Parkinson's symptoms is an option as long as multiple system atrophy is excluded. However stress incontinence surgery should not be offered to patients with significant detrusor overactivity (Grade C)**

II FAECAL INCONTINENCE

Stocchi et al [1] investigated anorectal function in 17 patients with Parkinson Disease. Most patients reported a bowel frequency of less than three evacuations per week and some patients had faecal incontinence. Manometric recordings disclosed an abnormal pattern during straining (a paradoxic contraction or lack of inhibition) in 11 patients. The inhibitory anal reflex and rectal compliance thresholds were within the normal range.

Sakakibara et al [2] studied pelvic organ functions of 115 patients with Parkinson disease (median Hoehn and Yahr stage 3) and compared with 391 local individuals who were undergoing an annual health survey. As compared with the control group, the frequency of dysfunction in the Parkinson group was significantly higher for constipation, difficulty in expulsion, diarrhea.

The QOL index for the Parkinson patients was significantly higher for bladder and bowel but not for sexual dysfunction. In the Parkinson patients, fecal incontinence was associated with urinary incontinence. Bladder and bowel dysfunction increased with the Hoehn and Yahr stage.

Regarding bowel management [3], *psyllium*, a soluble fibre aimed at absorbing water and increasing bulk to encourage normal peristalsis and bowel motility, was associated with increased stool frequency in Parkinson but did not alter colonic transit time.

Conclusions(LOE3)

- **Patients with Parkinson's disease have often abnormal anorectal function.**
- **Bowel dysfunction such as constipation is common and has significant impact on quality of life of Parkinson's patients.**

Recommendation

- **More studies on neurologic bowel dysfunction and management in Parkinson disease are needed before giving any recommendation.**

E4. ALZHEIMER DISEASE

I. EPIDEMIOLOGY AND PREVALENCE

Alzheimer's disease affects mostly elderly people. It is the principal cause of dementia in the elderly, The symptoms include worsening of memory, impairment of language and other cognitive functions (analytical thinking, abstract reasoning). Ultimately, there is loss of self-hygiene, eating, dressing, and ambulatory abilities, and incontinence and motor dysfunction [1].

The onset of incontinence usually correlates with the disease progression (LOE 3) [1].

The prevalence of incontinence is reported to be between 23% and 48% (LOE 3) [2–3]

II. PATHOLOGY AND DISEASE SPECIFIC LUT PROBLEMS

Yokoyama et al (LOE 3) suggested a suprapontine origin of voiding disorders in both Parkinson's and Alzheimer's diseases. They report published arguments that bladder overactivity in Alzheimer's patients is mediated by down regulation of M1 muscarinic inhibitory mechanisms [4]. MRI studies performed by Bennett et al (LOE 3) demonstrated that subcortical white matter lesions were associated with gait disturbance and incontinence [5].

In a study by Del Ser et al (LOE 3) urinary incontinence was associated with severe cognitive decline in pure Alzheimer's disease but usually preceded severe mental failure in patient with dementia due to diffuse Lewy body disease [6]. Nobili et al (LOE 3) performed quantitative EEG in Alzheimer' s patients, finding that incontinence was predicted by alpha power in the right side [7].

In another study by Nobili et al (LOE 3) the value of regional cerebral blood flow from a posterior temporal-inferior parietal area in each hemisphere predicted development of incontinence [8]. Brain computer tomography study done by Sugiyama et al (LOE 3) in Alzheimer's disease patients showed that the degree of brain atrophy was more severe in those with detrusor overactivity than those without it [9].

Detrusor overactivity was found in 61% of their patients. Haddad et al (LOE 3) described two patients with vesicoureteral reflux, one of them showing buccosalivary, gastroesophageal, vesicoureteral, urethroprostatic and urethrovesicular reflux as a consequence of the neurologic dysfunction [10].

There is no systematic review of type and grade of LUT dysfunctions in Alzheimer's disease, nor a study about progression of these dysfunctions as the disease progresses.

III. DISEASE SPECIFIC DIAGNOSIS AND TREATMENT

As mentioned above EEG and regional cerebral blood flow might predict when and if incontinence will occur during the course of the disease [7 – 8].

Franssen et al (LOE 2) examined the occurrence of following developmental reflexes: the tactile suck reflex, the palmar and plantar grasp reflexes, and the plantar extensor reflex in healthy elderly, cognitively and functionally mildly impaired patients, and patients with Alzheimer's disease [11]. Prevalence of all five reflexes was more than 6 times higher for those categories that comprised only permanently doubly incontinent patients as compared to those categories that comprised only continent individuals. It is interesting that the frequency of developmental reflexes rose sharply with the onset of progressive incontinence, suggesting its cortical origin. As demonstrated above, the development of incontinence in Alzheimer's disease patients is associated with cognitive impairment and brain degeneration, suggesting its central nervous system origin. Therefore behavioral therapy, toilet training and prompted voiding would be most useful treatment modalities for this type of incontinence.

Hutchinson et al (LOE 3) suggested that caregivers of patients with Alzheimer's disease should study the toileting behaviors. This would permit them to provide physical and cognitive assistance while attempting to avoid accidents and catastrophic events [12]. Tariot (LOE 4) stressed the necessity for taking into account different factors (like mobility, cognitive functions, general medical conditions), when planning treatment (also for incontinence) in Alzheimer disease patients [13].

Again the general guidelines should apply for choosing the best management of incontinence in Alzheimer's disease patients. The treatment should be however tailored to individual patient needs and disease status.

IV. GUIDELINES FOR FURTHER RESEARCH

There is still no cure for Alzheimer's disease, which is progressive and a type of dementia associated disease. We are still lacking studies evaluating LUT disorders in Alzheimer's disease. No systematic review has been performed regarding the possibilities of medical management (both pharmacological and behavioral) of incontinence.

An open issue also remains the question of aggressive surgery for LUT problems in these patients. Should we offer a surgical therapy for incontinence in female patients with stress incontinence and progressive Alzheimer's disease? This is a question so far unanswered.

Conclusions

- **Bladder overactivity seems to be the most common cause of incontinence in Alzheimer's disease patients (LOE 3)**
- **The degree of incontinence is associated with cognitive impairment and brain degeneration (LOE 3)**
- **EEG studies, occurrence of developmental reflexes and regional blood flow studies can predict the development of incontinence in Alzheimer's disease patients (LOE 3)**

Recommendations

- **The extensive and aggressive therapy of incontinence in Alzheimer 's disease patients should be reserved for those with good general status and ambulation (Grade C)**
- **In case of ambulatory patients , prompted voiding, behavioral therapy and oral anticholinergics seem to be the treatment of choice (Grade C)**

E5. CEREBRAL LESIONS, CEREBRO VASCULAR ACCIDENTS

I. URINARY INCONTINENCE

1. Cerebro-vascular accident (CVA)

a) Epidemiology and prevalence

Cerebro-vascular accidents are the third most frequent cause of death in industrialised countries after myocardial infarction and malignancies. Based on age-dependence of cerebro-vascular accidents (CVA) and the increase of the elderly in our population the importance of this disease enhances: currently one out of 200 inhabitants will suffer from a CVA, 80 to 90 % of them above the age of 65. The 5-year-survival rate is 56 % in men and 64 % in women.

An analysis of the symptoms of 532 patients seen within 7 days of their stroke found that the presence of urinary incontinence appeared to be a more powerful prognostic indicator for poor survival and eventual functional dependence than a depressed level of consciousness in this period [1 – 2]. It was suggested either incontinence was the result of a severe general rather than specific loss of function or that those who were incontinent were less motivated to recover from both continence and more general function. Outcome was so much better in those who remained or became dry that it seems possible that recovery of continence may promote moral and self-esteem which can actually hasten overall recovery. Without proper treatment six months after the CVA 20 % - 30 % [3] still suffer from urinary incontinence.

b) Pathology and disease specific LUT problems

Prior to the findings of PET-scan studies [4] all that was known about the cortical control of the bladder was based on clinical studies of patients with brain lesions. The most influential study was that by Andrew and Nathan, 1964 [5].

The typical clinical picture of frontal lobe incontinence they described was of a patient with severe urgency and frequency of micturition and urge incontinence, without dementia, the patient being socially aware and embarrassed by the incontinence. Micturition was normally co-ordinated, indicating that the disturbance was in the higher control of these processes. Nathan concludes his translation notes to the paper with a comment "this paper was written because people did not believe that there was such a thing as cerebral disturbance of the bladder".

There have been a number of urodynamic studies of groups of patients who have had CVA's and subsequently developed urinary symptoms. The conclusions drawn from these groups of patients with disparate cortical lesions are that, in general, voiding is normally co-ordinated as no patients showed evidence of detrusor sphincter dyssynergia, and that the commonest cystometric finding is detrusor overactivity [6 – 9].

In 1996 Sakakibara et al [10] reported on the bladder symptoms of 72 patients who had been admitted with an acute hemispheric stroke. When assessed at 3 months, 53 % were found to have significant urinary complaints. The commonest clinical problem was nocturia which occured in 36 %, while urge incontinence affected 29 % and difficulty in voiding 25 %. Urinary retention was seen in the acute phase of illness in 6 %. A significant positive correlation was found between the occurence of a urinary disturbance and hemiparesis. Brain imaging techniques confirmed a more anterior location of brain lesions in these groups. Urodynamic studies on 22 symptomatic patients showed detrusor overactivity in 68 %, detrusor-sphincter dyssynergia in 14 % and uninhibited sphincter relaxation in 36 %.

If this was really a detrusor-sphincter-dyssynergia, which should not occur in suprapontine lesions, or a hold-on manoevre to prevent urinary leakage, can not be clarified from the paper. There was some indication that lesion size was related to the occurrence of urinary symptoms. In contrast to the findings of Maurice-Williams [11] and Kuroiwa et al [8], who found a correlation of urinary incontinence with lesions of the right brain hemisphere, Sakakibara et al [10] could not find a preponderance of right sided lesions for incontinence. Their findings suggest that the damage to the anterio-medial frontal lobe, its descending pathway and to the basal ganglia is mainly responsible for micturition dysfunction in stroke patients.

Another paper by Mochizuki and Saito [12], looking at patients with frontal lobe lesions (tumors) concluded the damage to the right superior bifrontal region was associated with temporary incontinence, whereas permanent incontinence was associated with bilateral damage.

Urinary retention has also been described in patients with brain lesions: Three case histories of elderly females with various forms of right frontal lobe pathology were described as urinary retention. In two, one with an abscess and the other with a haematoma, successful treatment brought recovery of bladder function [13 – 14].

An experimental model for studying the effect of forebrain lesions and voiding dysfunction was recently developed in the rat by occluding the middle cerebral artery under pentobarbital or halothane anesthesia. At thirty minutes after recovery from anesthesia bladder capacity in animals with cerebral infarct was markedly decreased indicating an overactive bladder. The decreasing bladder capacity continued as long as four months after artery occlusion. Based on the effects of two different types of receptors antagonists on OAB induced by left middle cerebral artery occlusion, the authors Yokoyama et al [15] conclude that the NMDA receptor (N-methyl-D-aspartate) has an essential role in the development of OAB after CVA. Therefore, a glutamate receptor antagonist can be expected to be beneficial for treating overactivity caused by cerebrovascular disease, as the induced potentiation of bladder reflexes seems to depend on NMDA glutamate transmission (LOE 4).

2. Brainstem lesions

Already in 1926 Holman [16] noted that voiding difficulty could be a sign of tumors in the posterior fossa. In a series of patients with brain tumors Ueki et al [17] reported voiding difficulty to occur in 46/152 (30 %) of patients with tumours in the posterior fossa, while urinary incontinence occured only in 3 (1.9 %).

Renier and Gabreels [18] found urinary retention in 12/17 children with pontine glioma. There are a number of case histories published presenting difficulties with micturition in the presence of various brain stem pathologies [19 – 21].

Sakakibara et al [22] reported the urinary symptoms of 39 patients who had brainstem strokes. Almost half the patients had urinary symptoms, nocturia and voiding difficulty in 28 %, urinary retention in 21 % and urinary incontinence in 8 %. The problems were more common following haemorrhage, probably because the damage was usually bilateral. Urinary symptoms did not occur in those with lesions of the midbrain, but they did in 35 % of those with pontine lesions and in 18 % of those with medullary stroke. Urodynamic studies in 11 symptomatic patients showed detrusor overactivity in 8/11, low compliance in 1/11 and detrusor acontractility in 3/11 three months, six months and 3 years after the occurence respectively. A non-relaxing sphincter on voiding was found in 5/11 and uninhibited sphincter relaxation in 3/11 (LOE 3).

a) Disease specific diagnosis

Basic diagnosis comprises a targeted history and clinical investigation, urine analysis, postvoid residual urine and a bladder diary. In patients with significant residual urine of over 100 cc or more than 50 % of bladder capacity an urodynamic investigation is

recommended to differentiate between detrusor weakness and functional or morphological outflow obstruction.

b) Disease specific treatment

Immediately after the stroke accident in the Stroke Unit, an indwelling transurethral catheter allows controll of the urinary output. Once the stroke situation is stabilised the catheter should be removed and the patient put on intermittent catheterisation if voiding is unbalanced. In the early stage after the stroke, urinary incontinence can be managed by a condom catheter or by pads. Further treatment comprises, as the two main stays of management, behavioural therapy, initially toileting, later on micturition training and anticholinergic therapy, if the voided volumes are below 250 cc. The patient's ability to squeeze voluntarely the anal sphincter is a good prognostic sign to achieve continence further on. In the early phase, especially during catheter drainage, special care must be taken to avoid urinary tract infections with secondary complications. In diabetic patients low dose infection prophylaxis is recommended (LOE 4).

3. Guidelines for further research

There is a need for further epidemiologic studies of the true incidence of LUT symptoms incl. incontinence after cerebro-vascular accidents in long term. In regards to therapy controlled studies comparing behavioural therapy and anticholinergic medication alone and in combination should show which treatment regime is best.

Conclusions

- **Incontinence after CVA is not only a distressing symptom but also a powerful prognostic indicator for survival and eventually functional dependence. LOE 2**
- **The commonest urological problems after stroke are nocturia (36 %), urge incontinence (29 %) and difficulty in voiding (25 %). LOE 2/3**
- **There is a positive correlation between the occurence of urinary dysfunction and hemiparesis. LOE 2/3**
- **Urodynamic studies revealed detrusor overactivity in 68 %, sphincter relaxation problems in 36 % LOE 4.**
- **Damage to the antero-medial frontal lobe and its descending pathway and the basal ganglia are mainly responsible for voiding dysfunction in stroke patients. With brainstem pathology symptoms of impaired voiding (urinary retention) predominate. LOE 3**

Recommendations

- **As the urological symptoms, especially incontinence are very distressing, urological care is mandatory for these patients (Grade B)**
- **Prevention of early urinary tract infection, especially when during the acute phase an indwelling (Foley-) catheter is used. Thereafter management with toileting, later micturition training, combined with anticholinergic therapy are the main stays (Grade C)**
- **Rarely intermittent catheterisation is necessary due to unbalanced voiding mostly in men with preexisting infravesical obstruction till general recovery allows surgical measures to relieve obstruction, if alpha-blockers and 5-alpha reductase inhibitors are not effective (Grade C).**

II. FAECAL INCONTINENCE

1. Epidemiology – (LOE 3)

Brocklehurst et al [1] observed that 14% of stroke patients with faecal incontinence became so beyond 8 weeks after the acute event, leading to speculation that constipation, immobility and dependence may be primary underlying causes. The incidence of incontinence was 51% (urine) and 23% (faeces) within one year. Faecal incontinence at onset is associated with measures of severity of stroke and of immobility.

In the Copenhagen Stroke Study, Nakayama et al [2] did a survey of urinary and faecal incontinence using subscores of the Barthel Index during the hospital stay and at 6-month follow-up in 935 acute stroke patients. In the acute state, almost half of an unselected stroke population had urinary and/or faecal incontinence (40%). The proportion declined to one fifth for urinary incontinence and one tenth (9%) for faecal incontinence of the surviving patients at 6 months. By multivariate analysis, significant risk factors for both incontinences were age, severity of stroke, diabetes, and comorbidity of other disabling diseases.

According to Harari et al [3], prevalence of poststro-

ke faecal incontinence was 30% (7 to 10 days), 11% (3 months), 11% (1 year), and 15% (3 years). New-onset faecal incontinence during acute stage was associated with urinary incontinence (Odds ratio-OR, 19.96; 95% confidence interval -CI, 8.8 to 36.8), Glasgow Coma Score < 15 (OR, 2.84; 95% CI, 1.6 to 5.0), visual field defect (OR, 2.69; 95% CI, 1.6 to 4.6), dysphagia (OR, 2.16; 95% CI, 1.2 to 3.8) and age 65 years and over (OR, 2.16; 95% CI, 1.0 to 4.8). One third of patients with faecal incontinence at 3 months were continent by 1 year (suggesting the presence of a reversible underlying cause); conversely, 63% incontinent at 1 year had been continent at 3 months. *Urinary incontinence* (OR, 87.6; 95% CI, 41.6 to 184.4)*, anticholinergic drug use* (including antipsychotics, tricyclic antidepressants, oxybutynin, or antiemetics) (OR, 3.1; 95% CI, 1.1 to 10.2) and *needing help with toilet use* (OR, 3.5; 95% CI, 1.4 to 17.3) were significantly associated with faecal incontinence in stroke survivors at 3 months. Faecal incontinence at 3 months increased the risk of long-term placement (28% vs 6%) and death within 1 year (20% vs 8%). Modifiable risk factors for faecal incontinence 3 months after stroke are constipating drug use and difficulty with toilet access.

2. Conservative bowel management (LOE 3)

Venn et al [4] performed a trial in persons with stroke and compared 4 bowel programmes based on the use of suppositories and scheduled bowel care. 85% of participants successfully achieved effective bowel training within a month. Those assigned to morning suppository schedules were more likely to establish a successful bowel regime than those assigned to evening schedules (P<0.01).

Munchiando and Kendall [5] compared the effectiveness of two bowel training programs for patients with CVA and determined the length of time required to establish a regulated program. The sample of 48 CVA patients included 23 in the control group who had *every-other-day digital stimulation* and 25 in the experimental group who had *daily digital stimulation*. Demographic data showed no significant differences between the two groups. More subjects in the experimental group established regularity. However, the subjects in the control group who did achieve regularity took less time to do it. Subjects with right-side hemiplegia and less mobility required more time to become established. The routine protocol for bowel training in their rehabilitation unit was then changed to include daily digital stimulation.

Conclusion (LOE2/3)

- **Faecal incontinence after stroke is prevalent but declines over time.**
- **Faecal incontinence is associated with age, severity of stroke, urinary incontinence, comorbidity, using constipating drugs and functional difficulties.**
- **Suppository and digital stimulation may assist in regulating bowel evacuation.**

Recommendation (Grade B)

- **Modifiable/treatable causes of faecal incontinence should be evaluated and corrected.**

E6. MULTIPLE SCLEROSIS

I. URINARY INCONTINENCE

1. Epidemiology and prevalence

In Western countries multiple sclerosis is a common neurological disease of the central nervous system affecting mostly young adults with a prevalence of 50 to 100 per 100.000 individuals. It affects the function of various neural tracts. Bladder and urethral dysfunction often occurs in patients with multiple sclerosis and severely disturb patient quality of life. It is part of the initial symptom complex in 1-15 % of patients [1 – 4].

In a recent survey in Austria amongst 1000 patients with multiple sclerosis, symptoms of LUT dysfunction were the third most embarassing symptom complex after tiredness and muscle weakness [5].

The reported incidence of voiding dysfunction in multiple sclerosis is 33 % to 52 % in patients sampled consecutively regardless of urinary symptoms and its incidence is related to the disability status [6]. Giannantoni et al [7] detected urodynamic abnormalities in 104/116 patients with MS symptoms. According to DasGupta & Fowler [8] there is almost a 100 % chance of having LUT dysfunction once these patients experience difficulties with walking.

In contrast to white individuals, multiple sclerosis is a much less common disease in Asian individuals. In addition, Asian-type multiple sclerosis is characterized by a high rate of optic nerve and spinal cord involvement [9 – 10]. Araki et al [11] found that in regards to LUT symptoms in multiple sclerosis the

prevalence of emptying symptoms is equal to or even higher than that of filling symptoms in Japan , whereas filling symptoms are predominant in Western countries (LOE 3). Therefore, the numbers given from studies in Western countries may be different from those found in Asian people.

2. Disease specific LUT dysfunction patterns

The most frequent urodynamic finding is detrusor overactivity, which was found in 44 % by Araki et al[11], in 51 % by Kim et al [12] and in 58 % by Ukkonen et al [13]. Detrusor overactivity is combined with detrusor-sphincter-dyssynergia (overactive sphincter) in over 90 % in the study by Araki et al [11], with impaired detrusor contractility (below 40 cm H2O) in 13 % by Araki et al [11], and in 12,2 % by Kim et al [12]. Terminology used in these publications to define detrusor-underactivity is not consistent: Kim et al [12] found "Detrusor hyporeflexia"in 15,6 % and detrusor areflexia in 14,4 %, Araki et al [11] described "hyporeflexia or areflexia" in 38 %. They defined "detrusor hyporeflexia" as a condition with low maximum detrusor pressure during voiding, large post void residual urine and with a high maximum cystometric capacity without giving further details, especially without differentiating between decreased contractility and acontractility of the detrusor.

Hinson and Boone compiled data from 15 series of 2,076 total patients and found detrusor overactivity in 52 to 99 %, detrusor-sphincter-dyssynergia in 6 to 66 %, detrusor underactivity/acontractility in 0 to 40 % and normal urodynamics in 1 to 25 % (14, LOE2). No abnormality with urodynamics was found in 6.7 % of MS patients by Kim et al [12] (LOE 3).

a) Change of urodynamic patterns over time

A significant proportion of patients with MS with and without new urinary symptoms will develop changes in their underlying urodynamic pattern and in detrusor compliance. According to Ciancio et al 55 % (12/22) of patients experienced a change in the urodynamic patterns and/or in compliance during a mean follow-up intervall of 42+/- 45 months between the urodynamic studies [15]. Most patients initially had urodynamic patterns showing detrusor overactivity, detrusor-sphincter dyssynergia or detrusor hypocontractility. Sixty four % of the patients studied had the same or worsening of the same symptoms, 36 % had a new urological symptom. Forty three % (6/14) with no new symptoms and 75 % (6/8) with new symptoms had significant changes found with follow-up urodynamic testing. The authors therefore conclude that urodynamic evaluation should be repeated at regular intervals in symptomatic patients to optimise clinical management, to reduce complications and better enable these patients to manage their neurologic bladder dysfunction. However, in respect to these data Alan Wein in an editorial comment states that if medication was instituted at the time of the first evaluation and not discontinued before the second evaluation (not mentioned in the article) it may well be that any difference in urodynamic pattern has resulted from the treatment and not from the disease and if a urodynamic study does not reproduce the clinical symptoms it is not an optimal study. If in someone, who complains of frequency, urge and urge incontinence, urodynamics show only "hypocontractility" it may well be that under other circumstances the urodynamic study could have revealed quite different findings. The primary purpose in urodynamic evaluations should be to assess the presence of risk factors that would prompt a change in therapy rather than to notice a change in urodynamic patterns in a laboratory urodynamic study. Without being able to rely on symptoms to evaluate and treat vesicourethral dysfunction in these patients, it is clinically prudent to repeat urodynamic evaluations in symptomatic patients, even in patients who have persistent but not necessarily new symptoms (LOE 3).

b) Is there a need for urodynamic studies in MS patients?

The need for urodynamic studies in these patients is a matter of debate. A pragmatic approach to the problem is that a medical strategy can be somewhat predicted on the basis of the patient's symptoms and incomplete emptying measurements [8]. On the other hand several authors, urologists and neurologists see a major role for an urodynamic investigation in the management of these patients: according to Ukkonen et al [13] urodynamic investigations are needed for specific definition of micturition dysfunction and should be undertaken before therapeutic decisions. Also Kim et al [12] suggest that multiple sclerosis patients with voiding symptoms should undergo urodynamic evaluation independent of current neurological evaluation. This is true for an academic setting. For daily practice however urine examination and post void residual urine (PVR) and echography of the kidneys may be sufficient if there are no urinary tract infections.

c) Do urodynamic patterns correlate with MRI findings? Relationship of bladder dysfunction to lesion site in multiple sclerosis

Mainly three publications [12, 16 – 17] deal with this topic and the results are controversial.

Araki et al found overactive detrusor with hypocontractility as indicative of pontine lesions and detrusor-sphincter dyssyergia as a sign for cervical spinal cord lesions. Therefore they conclude that the lesion site in the central nervous system may be a major determinant for the type of bladder and urethral sphincter dysfunction [16]. In contrast Kim et al [12] found no correlation between urodynamic category, presence of impaired compliance or presence of detrusor-sphincter dyssynergia and any of the MRI findings of atrophy or enhancing lesions, total number of lesions or size of the largest lesion. Their conclusion is that cranial MRI findings can predict neither urodynamic findings nor the presence of voiding symptoms, and they suggest that multiple sclerosis patients with voiding symptoms should undergo urodynamic evaluation.

One reason for the discrepancy might be that Araki et al evaluated not only the brain (incl. cerebellum, brain stem) but also the cervical spinal cord, whereas Kim et al evaluated brain MRI only. The findings of Kim et al. are also in contrast with the latest results of Charil et al [17]: In the introduction the authors state that in multiple sclerosis the correlation between disability and volume of white matter lesions on MRI is usually weak. This may be so because lesion location is also important as this influences the extent and type of functional disability. They therefore applied an automatic lesion-detection algorithm to 452 MRI scans of patients with relapsing-/remitting MS to identify the regions preferentially responsible for different types of clinical deficits: bowel and bladder scores correlated with lesions in the medial frontal lobes, cerebellum, insula, dorsal brain and pons, areas known to be involved in the control of micturition. The statistical peaks in the dorsal midbrain are close to the periaqueductal grey and pontine micturition center, which serve as the interface between afferent and efferent connections with the bladder [18], and are activated during micturition [19 – 21]. There were also many statistical peaks in bilateral frontal lobes as well as adjacent to prefrontal, premotor and supplementary motor cortex. Most of these peaks were in the white matter tracts connecting to medial frontal regions, which have been implicated in the control of micturition by lesion [18] and PET studies [19 – 21]. The correlated areas were mostly located in the right hemisphere, consistent with previous PET and lesion studies [22] showing right hemisphere dominance in the control of human micturition.

The white matter near the right insula and its cerebellum were also identified as sites where the presence of lesions correlated with bowel and bladder dysfunction. The insula is activated during withholding of urine [20], and several PET studies of micturition have shown simultaneous cerebellar activation [19, 21]. Both sites have been implicated in processing sensory information from the bladder during storage. The study by Charil et al is the first which demonstrates a relationship between the site of lesions and the type of disability in a large scale MRI data set in MS (LOE 3). These findings correlate with the fact, that centres located in the dorsal pons and midbrain control the emptying and storage function of the bladder. Lesions of the cervical spinal cord are thought to be the predominant cause of incontinence in MS [23]. However, the results suggest that lesions affecting the brainstem and the cerebral hemispheres also play a role. A strong association between bladder symptoms and the presence of clinical spinal cord involvement including paraparesis and upper motor neuron signs on examination of the lower limb was found [23]. Both clinical studies and more recently MRI studies have shown that ~75 % of those with a diagnosis of multiple sclerosis have spinal cord involvement [24].

Clinically impaired bladder control is a common symptom in MS patients. It is often regarded as one of the major distressing aspects in the early period of the disease. The most frequent symptoms, urgency, frequency and urge incontinence reflect underlying detrusor overactivity. Hesitancy, interrupted stream and incomplete emptying reflect dyssynergic voiding. Neurologic bladder and urethral dysfunction secondary to MS appear to be unpredictable and dynamic. MS itself can behave in a similarily unpredictable manner, yet no correlation was found between changes in the urodynamic and in the underlying neurological patterns.

3. Disease specific therapeutic aspects

As the neurological condition progresses lower urinary dysfunction may become more difficult to treat. This is because of worsening detrusor overactivity, decreasingly efficient emptying in the context of worsening paraparesis and increased detrusor-sphinc-

ter dyssynergia, recurrent urinary infections, spasticity, general immobility and possibly also cognitive impairment. However, unlike the bladder dysfunction that follows spinal cord injury, progressive neurological diseases very rarely cause upper urinary tract damage [25]. This is even the case when long standing MS has already resulted in severe disability and spasticity. The reason for this is not known but means that in such diseases, the emphasis of management needs to be on symptomatic relief and should be as conservative as possible. (LOE 3; Grade B)

4. Recommendations for research

We suggest a study comparing the lesion location based on MRI studies of the brain and the spinal cord (cervical, sacral), possibly using an automotic lesion-detection algorithm [17] and the urodynamic pattern of vesico-urethral dysfunction.

Studies so far either correlate the MRI finding of brain and spinal cord with clinical symptoms of LUT dysfunction or only MRI's of the brain were undertaken.

Moreover a prospective study evaluating urodynamic pattern changes in multiple sclerosis is suggested, correlating these findings also with the neurological symptomatology. The results of such a study would be helpful in deciding whether and to what extent urodynamic follow-up studies are indicated, also considering that damage to the upper urinary tract rarely occurs in these patients.

Conclusions

- **Several studies have reported that approximately 75 % of all patients with MS will develop urinary symptoms. These are urgency, frequency and urge incontinence due to detrusor overactivity which is the most common cystometric finding. LOE 2/3**
- **There is an association between the occurence of bladder symptoms and pyramidal dysfunction in the lower limbs. LOE 2/3**
- **As the neurological condition progresses also the severity of the urinary symptoms increases and treatment becomes increasingly difficult. LOE 2/3**
- **The upper urinary tract is rarely involved. The reason for this remains unclear, however treatment should therefore be primarily focused at providing symptomatic relief. LOE 3**
- **Management of neurologic urinary incontinence in MS patients comprises measurement and follow up of postvoid residual urine if this is found to be above 100 cc**
- **Bladder relaxing therapy (drugs/botulinum toxin) is the therapy of choice, if postvoid residual is above 100 cc. It has to be combined with intermittent (self-) catheterisation.**
- **There are no good data on the change of urodynamic patterns over time.**
- **The need for urodynamic studies in MS patients is controversial. In patients with only irritative symptoms and without significant postvoid residual urine detrusor overactivity can be assumed and anticholinergic therapy be started without urodynamics. In patients with significant postvoid residual urine urodynamic studies are recommended to define the cause though the therapy remains the same.**
- **The question whether urodynamic patterns correlate with MRI findings is still controversial due to different designs of studies.**
- **As upper urinary tract deterioration occurs rarely in MS patients even when longstanding MS has already resulted in severe disability and spasticity, the emphasis of management needs to be on symptomatic relief and should be as conservative as possible. (LOE 3)**

Recommendations

- **Management needs to focus on symptomatic relief and should be as conservative as possible. (Grade B)**

II. FAECAL INCONTINENCE

1. Pathophysiology (LOE 3)

Caruana et al [1] measured anorectal sensory and motor function in 11 patients with MS and faecal incontinence, 11 continent patients with MS, and 12 healthy control subjects. The threshold volume at which patients with MS and faecal incontinence experienced rectal sensation was higher than that in healthy controls (42.7 +/- 6.2 ml vs. 13.3 +/- 2.8 ml; $P<0.01$). Those with MS also showed increased thresholds of phasic external sphincter contraction compared with controls ($P<0.05$). Those with faecal

incontinence showed only decreased maximal voluntary anal sphincter pressures (P<0.01 vs. controls) and also required smaller volumes of rectal distention to inhibit internal sphincter tone compared with controls (P<0.01). Decreased maximal voluntary squeeze pressures were less severe in continent patients than in incontinent patients.

2. Conservative bowel management – (LOE 3)

According to Stolp-Smith et al [2], decreased gastrointestinal motility and difficulties with evacuation are the principal problems for patients with MS. Preventing impaction and avoiding faecal incontinence are the goals of a regular, well-controlled bowel program. Sacral reflexes responsible for rectal control are generally not impaired by MS. Thus, traditional enemas should be avoided because they can destroy these reflexes by overdistending the rectum and are necessary only if impaction occurs. Additionally, a well-controlled bowel program decreases spasticity as a result of diminished visceral related nociception.

Conclusions (LOE 3)

- **Impaired function of the external anal sphincter and decreased volumes of rectal distention required to inhibit the internal anal sphincter or both may contribute to faecal incontinence in multiple sclerosis (LOE 3).**
- **Increased thresholds of conscious rectal sensation in some incontinent patients may contribute to faecal incontinence by impairing the recognition of impending defecation (LOE 3).**

Recommendations(Grade B)

- **A regular bowel programme should be implemented to prevent constipation, rectal overdistension and faecal incontinence.**

E7. SPINAL CORD LESION

I. URINARY INCONTINENCE

1. Epidemiology and prevalence

Spinal cord injury is the damage of the spinal cord that occurs as a result of an injury to the vertebral column. It produces damage to the nerve fibers that run within the spinal cord (partial or total), which results, in alterations in the functions of different organs that are innervated by these damaged nerves and neurologic centers.

Spinal cord injury can be caused by different injuries to the vertebral column

e.g. motor vehicle accidents, falls, sports injuries (particularly diving into shallow water), industrial accidents, gunshot wounds, assault, and others. The occurrence of traumatic SCI is estimated to be at the level of 1.5 to 4 per 100 000 population in the developed countries. Males are affected four to five times as often as females, and in the US, african-americans have twice the rates of caucasians. Half the cases are due to motor vehicle accidents, 1/4 to falls, and 1/10 to sports injuries. Maximal ages at risk are 15 to 34; only for cord damage due to falls does this risk differ, and here elderly are the more prone [1- 6]. The survival after SCI improved dramatically in recent years, and nowadays more than 4 of 5 traumatic SCI patients will survive ten years with an average of almost 18 years. Median survival may be almost 14 years for complete quadriplegia, 17 for complete paraplegia, 19 for incomplete quadriplegia, 20 for incomplete paraplegia and 28 for cauda equina lesions [1]. The most critical time for survival is the 3 months period after the injury, after which paraplegic and quadriplegic patients reach ten-year survival rates of 86% and 80%, respectively [7].The prevalence figures of SCI in US vary from 177,000 persons to over 200,000 [8 – 9]. Total direct costs for all causes of SCI in the United States are $7.736 billion [10].

It must be stressed that despite our growing knowledge of the pathomechanisms involved in the incontinence development after SCI we still are lacking the data on the occurrence and natural history of the LUT dysfunctions following SCI. No good epidemiological studies exist (even retrospective ones) on the occurence and long-term follow-up of bladder dysfunctions in SCI patients. The Italian Epidemiological Study Group (LOE 3) reported that 61% of SCI patients had bladder and bowel autonomy on discharge [3].

2.Pathology and disease specific LUT problems

The injury to the spinal cord produces total or partial decentralisation or denervation. Additionally a reorganization of reflexes and a pronounced plasticity

within the peripheral nervous system occurs. Recent electrophysiological and histological studies in rats have revealed that chronic SCI induces various phenotypic changes in bladder afferent neurons such as: somal hypertrophy along with increased expression of neurofilament protein; and increased excitability due to the plasticity of Na+ and K+ ion channels. It is also suggested that the changes in bladder reflex pathways following SCI are influenced by neural-target organ interactions probably mediated by neurotrophic signals originating in the hypertrophied bladder [11]. All these changes cause an alteration in the functioning of the LUT. Yoshiyama et al (LOE 4) observed that in rats after SCI 55% of the animals exhibited uninhibited bladder contractions before voiding. Compared with control rats, SCI rats had larger volume thresholds and voided volumes. Although SCI rats had larger micturition pressures, residual volumes were increased and voiding efficiency was decreased [12]. This study allows extrapolating the results to humans;, however, of course it does not represent a long-term longitudinal study.

Studies describing the various dysfunctional patterns of the LUT functions following SCI have been done. Kaplan et al [13] (LOE 3) studied the relationship between the clinical neurological level, bladder and sphincter behaviour on video-urodynamic studies in 489 patients with spinal cord lesions due to a variety of causes. They conclude that the clinical neurological examination alone is not an adequate barometer to predict neurourological dysfunction and that video-urodynamic evaluation provides a more precise diagnosis for each patient. Wyndaele [14] (LOE 3)compared, in 92 patients with spinal cord lesion out of spinal shock, the data from a clinical neurological examination of the lumbosacral area with the data from a full urodynamic investigation. He concluded that clinical neurological examination gives useful information which acceptably corresponds with the LUT function. However to decide on a detailed individual diagnosis, clinical examination was insufficient. Urodynamic tests were found necessary for a profound evaluation of the function of different parts of the lower urinary tract and their interaction. Perlow et al (LOE 3), described the results of combined cystometry and perineal EMG in 75 consecutive, traumatic SCI patients [15]. In patients with spinal injuries at vertebral level T7 or above a reflex neurologic (overactive) bladder eventually developed. In those with vertebral level injuries T11 or below a lower motor neuron bladder dysfunction developed. Injuries at the vertebral levels T8, T9, and T10 represent a gray zone; and, depending on adjacent soft tissue injury, in these patients an upper or lower motor neuron bladder dysfunction developed. They found that detrusor sphincter dyssynergy was present in 68% of the patients with upper motor neuron lesion. In a study by Weld et al (LOE 3) a retrospective analysis of 316 patients was performed [16]. It was found that 94.9% of patients with suprasacral injuries demonstrated overactivity and/or detrusor sphincter dyssynergia, 41.8% had low bladder compliance 40.3% had high detrusor leak point pressures. On the other hand 85.7% of patients with sacral injuries manifested areflexia, 78.6% had low compliance, and 85.7% had high leak point pressures. For combined suprasacral/sacral injuries 67.7% had detrusor overactivity and/or detrusor sphincter dyssynergia, 27.3% areflexia and 57.6% low compliance, high leak point pressure was observed in 60.7% of these patients. O'Flynn (LOE 2/3) presented an analysis of a large group (562) SCI patients, and found the prevalence of outflow obstruction to be 30%, with a correlation with completeness and thoracic localisation of the lesion [17]. The factor of paramount importance is the occurrence of upper urinary tract changes, secondary to the LUT dysfunction, as it is an important prognostic factor for survival of these patients. Ruutu et al (LOE 3) found upper urinary tract changes in 30% of patients after SCI [18]; death rate due to renal failure was however very low (0.5%). In another paper by this author (Ruutu et al) 42% of patients had some degree of upper tract pathological changes on excretory urograms, and 40% of these patients had at least one febrile urinary tract infection per year [19]. Gerridzen et al (LOE 3) evaluated 140 patients after SCI (8 years post injury on the average) [20]. Two patient groups were identified. In group 1 patients with an areflexic bladder, 17.5% had significant upper tract deterioration. Maximum detrusor pressure during urine storage in group 1 with abnormal upper tracts was significantly higher than in those with normal kidneys. Group 2 included patients with an overactive bladder. Sixteen % of them had documented upper tract deterioration. Maximum detrusor contraction pressure during voiding in group 2 was significantly higher in those with abnormal upper tracts secondary to neurologic outflow obstruction.

3. Treatment

Treatment does not differ from that in other neurologic dysfunctions and aims at keeping the pressure in the bladder low, the capacity of the bladder suffi-

cient, the bladder emptying as complete as possible and preventing occurrence of urinary tract infection. Continence can usually be obtained. The choice of treatment should be made on full urodynamic investigation with video and/ or EMG if available (LOE 2).

4. Recommendations for future research

Studies on the true prevalence of LUT neurologic dysfunction in SCI patients should be performed.

II. FAECAL INCONTINENCE

1. Pathophysiology (LOE 3)

Regarding anorectal physiology following SCI, the colon in patients with a complete SCI of the thoracic region demonstrated an abnormal stretch response similar to that described in the bladder [1]. Rectal compliance and basal resting sphincter pressures were lower than normal values; anorectal manometry demonstrated a pattern of sphincter activity similar to that recorded in the patients' cystometrograms, however there was no definite relationship to bowel dysfunction. In addition, the anorectal dysfunction in those with high SCI seems to be due to increased rectal contraction and anal relaxation in response to low distending volumes, reduced rectal sensation and loss of conscious external anal sphincter control; whereas those with low SCI lesions produced lower increase in sphincter pressure with Valsalva and squeezing, increased rectal compliance in response to rectal distention and reduced rectal sensation. This reduced sphincter response may contribute to the higher incidence of faecal incontinence reported by these patients [2].

2. Epidemiology (LOE 3)

In long term SCI, annual incidence of gastrointestinal problems increased from 5.3% in those < 30 years old and 9.0% in those 40-49, to 15.3% in those > 60 years old. It also showed a slight increase in frequency between the 10^{th} and 30^{th} year post injury [3]. Faecal incontinence was significantly more prevalent in the tetraplegia group (p=0.003), while constipation was significantly more frequent in the paraplegia group (p=0.001). According to the self-reports, bowel accident occurred in 38.5% of those using abdominal pressure, in 36.4% of those using chemical stimulation, in 26.1% of those using digital stimulation and in 18% of those having nearly normal bowel emptying. Physicians diagnosed faecal incontinence much less [overall 6.3%, with digital stimulation 8.5%, with chemical stimulation 3.0%, with abdominal pressure 7.7%, and nearly normal 0%] [4].

Han et al investigated chronic gastrointestinal problems and bowel dysfunction in 72 traumatic SCI patients. Constipation was the commonest problem, affecting 43% of patients, while difficulty with evacuation (33%) and post-prandial discomfort (33%) were the next most frequent. Fourteen % had faecal incontinence due to urgency [5]. However, bowel dysfunction was not related to age, duration or the neurological level of injury.

In the study of Krogh et al [6], questionnaires were sent out to 589 patients with spinal cord lesion. Seventy two % responded. Eighty one % of the patients lacked a normal desire to defecate, and 75% experienced faecal incontinence, though most only had a few episodes of faecal incontinence.

3. Quality of life –QoL (LOE 3)

The most common gastro-intestinal problems that impair the quality of life (QoL), as found in 34/127 patients with spinal cord lesion and gastro-intestinal problems, were poorly localized abdominal pain (14%) and difficulty with bowel evacuation (20%). Hemorrhoids (74%), abdominal distention (43%), and autonomic dysreflexia arising from the gastrointestinal tract (43%) were also common, but had a lesser impact on lifestyle [7].

Chronic GI problems had an extensive impact on ADL such as restricted diet (80%), restricted outdoor ambulation (64%) and unhappiness with bowel care (62%). Patients in the study by Han et al performed bowel care once per 3 days and needed an average of 42 minutes to do this [5]. In another study, 48% needed more than 15 minutes for defecation, while 80% of male paraplegics and 46% of male tetraplegics ranked bladder and bowel problems as their greatest functional losses after loss of mobility [8]. In the study of Krogh et al [6], 30% regarded colorectal complaints to be worse than both bladder and sexual dysfunction.

According to the controlled and comparative, questionnaire based study of Lynch et al [9], faecal urgency and time spent at the toilet were also significantly higher for the SCI group: 92.3% of controls were never affected by faecal incontinence, compared with only 43.9% of SCI patients (p<0.0001). 8.1% of SCI patients had their everyday live affected

by incontinence, compared with 0.4% of controls. Those with complete injuries were more likely to have incontinence affect their life than those with incomplete injuries.

Byrne et al [10] used the Direct Questioning of Objectives QoL measure in 118 patients with neurologic FI. The most frequent QoL problem concerned the ability to get out of home, to socialize outside of home, to go shopping, and not to have to worry about the location of the nearest toilet while out of home (34%). At least one of these four objectives was stated by 72% of patients. Only 31% of patients nominated an objective related to the physical act of soiling. The ability to travel (29%), exercise including walking (25%), performing home duties (19%), family and relationships (22%), and job (13%) were less frequently cited by patients.

4. Conservative bowel management (LOE 3)

In the study of Han et al [5] 43% of the patients took oral medication, and 36% controlled their diet. Usual methods of bowel care were anal massage (35%), finger enema (18%), rectal suppository (15%) and unaided self-defaecation with/without oral medication and abdominal massage (29%). Krogh et al [6] found that 65% of SCI patients also used digital evacuation or stimulation.

Kirschblum et al [11] retrospectively studied bowel care practices in 100 chronic SCI patients. Eighty percent of the patients performed digital stimulation, 72% reported use of suppositories, 56% used oral medications, and Colace and senokot were usually used in combination. Only 13% of the patients used dietary modifications to regulate their bowel program. Forty-six percent reported performing their bowel program on alternate days and 24% performed a daily program. 77% were able to perform their program in less than 45 minutes. Patients had only minimal constipation and diarrhea, and few had difficulty with evacuation.

According to Lynch et al [9], 43.2% of SCI patients (n = 467) and 23.2% of controls from the general community (n = 668) took extra fibre with no change in fibre use with time since injury, or incontinence. Laxatives were used by 39% of SCI patients, compared with 4% of controls (P<0.0001). The use became more frequent with increasing time since injury (p=0.005), but not with age (p=0.95), or incontinence score (P=0.10). Enemas were used by 10.9%, with approximately twice as many patients with complete injuries using them compared to those with incomplete injuries (p<0.0001). Regular manual evacuation was more frequent among those with complete SCI (67%) compared to those with incomplete (25.4%). In addition, 62.7% of SCI patients used digital stimulation, 15% used suppositories and 82.3% of those with higher injuries required assistance, compared with 14.3% of those with complete lumbosacral lesions.

Regarding the level of lesion, patients with LMN tend to suffer more difficulties in the management of their neurologic bowel than those with UMN. It has been suggested that more intensive and aggressive bowel care programs should be provided for SCI patients with LMN lesions [12].

Conclusions (LOE 3)

- **Neurologic bowel dysfunction and bowel problems including faecal incontinence and constipation, are prevalent among SCI persons.**
- **Faecal incontinence and methods of bowel care affect the QoL and social activities of SCI persons.**
- **Bowel care and bowel management used among SCI persons vary.**

Recommendation : Grade B/C

- **Colorectal problems deserve more attention in the treatment of SCI patients.**
- **Impact on QoL, especially in bowel care and social activities, should be included in the assessment of colorectal dysfunction and faecal incontinence in SCI patients.**
- **Goals of bowel management should be person-centred and aimed at social bowel continence and prevention of gastrointestinal complications.**
- **Appropriate bowel programme/management should be properly designed to each person and adequate training should be provided.**

E8. SPINAL STENOSIS

I. EPIDEMIOLOGY AND PREVALENCE

Data on prevalence are scarse. In 1976 Sharr et al [1] reported a series of 34 patients with lumbar spondylosis and spinal stenosis associated with chronic bladder symptoms including incontinence.

II. PATHOLOGY AND DISEASE SPECIFIC LUT PROBLEMS

Lumbar spondylosis comprises the degenerative hypertrophy of the ligamentous, cartilaginous and osseous structures of the lumbar spine. In its more advanced forms, this disorder often causes chronic and progressive symptoms which generally evolve slowly over months to years. Patients typically seek medical help when intractable leg pain develops, yet when questioned, about 50 % of patients report symptoms of bladder dysfunction including incontinence, urinary hesitancy, nocturia or frequent urinary tract infections. In some patients, these symptoms may be overlooked or attributed to primary urological disorders such as benign prostatic obstruction.

These urological symptoms may indicate the presence of significant cauda equina dysfunction. When intractable leg pain develops lumbar decompressive laminectomy is the treatment of choice. The goal of surgery is relief of leg pain and paresthesias. Some patients also have reported improvement in bladder function [2].

Sharr et al [1] reported that after lumbar decompressive laminectomy 75 % of their patients experienced some improvement in bladder function. Interesting enough urodynamics were of limited value and the diagnosis of neurologic bladder depended as much on the medical history as on the results of the urological and neurological investigation.

Experimental studies in this field are scarse. Delamarer et al [3] studied urological function in dogs after experimental cauda equina compression. They reported that an acute 75 % constriction of the thecal sac led to severe changes on cystometrography with detrusor acontractility, increased bladder capacity and clinical urinary incontinence. Urodynamics revealed an acontractile neurologic bladder in animals subjected to an acute 75 % constriction of the cauda equina, but urodynamics were basically normal in animals subjected to lesser degrees (25 % and 50 %) of cauda equina constriction.

Only recently Inui et al [4] evaluated prospectively the relationship between the degree of cauda equina compression and the prevalence of neurologic bladder in patients with lumbar spinal stenosis and lumbar disc herniation. Thirty-four consecutive patients admitted for treatment for lumbar spinal stenosis or lumbar disc herniation underwent urodynamic studies, and CT-scans after myelography were obtained to determine the degree of cauda equina compression. The cross-sectional area and the anteroposterior diameter of the dural sac were measured at their smallest transverse area. Twenty (58,8 %) of the 34 patients were diagnosed with a positive neurologic bladder. There was no significant difference in the cross-sectional area of dural sac between the patients with or without neurologic bladder; however the dural sac anteroposterior diameter in patients with neurologic bladder was significantly shorter than in patients with negative neurologic bladder. A critical size for dural sac of patients with neurologic bladder was revealed as 8 mm in this study.Therefore the authors conclude that the dural sac anteroposterior diameter might be an important factor predicting neurologic LUT dysfunction in these patients (LOE 3).

III. DISEASE SPECIFIC DIAGNOSIS

In a prospective study of Deen et al [2] patients with lumbar stenosis and LUT dysfunction had a broad spectrum of symptoms. Of the 20 patients evaluated 16 complained of nocturia, 10 of incontinence, 6 had a feeling of incomplete or the need for double voiding, 5 reported urinary frequency, 3 urinary hesitancy, 2 urinary urgency and 1 had frequent urinary tract infection.

Kawaguchi et al [5] found urinary incontinence as the most characteristic symptom in patients with lumbar spinal stenosis and neurologic bladder. These authors also stated that patients with a neurologic LUT dysfunction had a more severe neurologic disturbance compared with those without symptoms indicative for LUT dysfunction.

Hellstrom et al [6] evaluated voiding dysfunction and urodynamic findings in 18 consecutive patients (12 men and 6 women, mean age 55) with clinically

and radiologically lumbar spinal stenosis: 16 underwent urodynamic examinations before decompressive laminectomy and 15 afterwards. Twelve of the patients had symptoms of voiding dysfunction preoperatively but urodynamic findings were normal in most cases; only one patient showed detrusor overactivity and one an obstruction.

Deen et al [7] investigated prospectively elderly patients with lumbar spinal stenosis to determine whether laminectomy had any effect on urological function. Ten were men and 10 women (average age 70,9 years). All patients had severe lumbar stenosis affecting between 2 and 4 spinal segments and all reported some degree of bladder dysfunction. After laminectomy bladder function was subjectively improved in 60 % of patients and unchanged in 40 %. No patient reported deterioration in bladder function.

When improvement occured it was prompt and was noticeable at the 2-month postoperative follow-up review. There was no correlation of the urological outcome with patient's age, sex, extent of laminectomy or degree of BPH in men. Postvoiding residual (PVR) urine volume was the urodynamic factor most likely to be improved by laminectomy: in 9 patients (45 %), baseline PVR urine volume was above 100 cc, in eight of them it was normal after surgery. In a woman with a cystocele a preoperative PVR of 480 ml decreased to 300 ml after the operation. In the remaining 55 % of patients the PVR urine volume was normal pre- and postoperatively. Moreover men with abnormal baseline maximum flow rates (below 12 ml/sec.) had a significant improvement after the operation.

Kawaguchi et al [5] also found that residual volume was reduced after surgery. Postoperative urodynamics carried out in nine patients showed a normal pattern in 6 patients. However, in three patients the detrusor remained underactive. Furthermore, four patients still required intermittent self-catheterization after surgery. In the study of Hellstrom et al [6] 12 of 18 consecutive patients with clinically and radiologically verified lumbar spinal stenosis had symptoms of voiding dysfunction preoperatively. Postoperatively three reported an improvement, three showed obstructive voiding, one of them undergoing TURP with a good outcome. One patient developed detrusor acontractility after the neurosurgical operation with difficulties in bladder emptying. The only statistically significant changes in urodynamic parameters were rises in the maximum urethral closure pressure. According to the authors the effect of decompressive laminectomy on bladder and urethral function remains controversial and unexpected, and they recommend electrophysiological investigations for more detailed analysis.

Clinchot et al [8] presented an 80 year old man who developed lumbar spinal stenosis with a progressive neurologic deficit that caused severe leg pain, affected bladder function and gait. Bladder dysfunction and gait returned after spinal surgery to normal and this patient's pain was greatly reduced, illustrating that also patients over 80 can have a successful outcome with surgery for lumbar spinal stenosis.

IV. GUIDELINES FOR FURTHER RESEARCH

There is a need for experimental studies in order to correlate the degree of cauda equina compression, duration of compression, recovery and permanent damage. Moreover prospective studies are needed to confirm the results of Inui et al [4] that the dural sac anterioposterior diameter might be an important factor predicting neurologic LUT dysfunction. We also need more prospective studies to determine the effect of laminectomy on preoperatively disturbed LUT function in patients with spinal stenosis not only based on clinical findings and urodynamics, but also on electrophysiological investigations.

Conclusions

- **About 50 % of the patients seeking help for intractable leg pain due to spinal stenosis report symptoms of bladder dysfunction such as sense of incomplete bladder emptying, urinary hesitancy, incontinence, nocturia or urinary tract infections. These symptoms may be overlooked or attributed to primary urological disorders.(LOE 3)**
- **The prevalence of neurologic bladder is more significantly associated with dural sac anteroposterior diameter than with the cross-sectional area of dural sac. Therefore, the dural sac anteroposterior diameter might be an important factor predicting LUT dysfunction.(LOE 3)**
- **The most sensitive indicators of bladder dysfunction and its response to typical decompressive laminectomy were patient's symptoms, the results of PVR urine volume and in men maximum urinary flow rates (LOE 3).**

Thus the improvement of PVR urine volume and of urinary flow rate may be considered as evidence of improved bladder function. Other urodynamic procedures were of limited value (LOE 3).

Recommendations

- **Based on the fact that 50 % of patients with spinal stenosis seeking medical help when intractable leg pain develops, report symptoms of bladder dysfunction, a careful neuro-urological evaluation is mandatory.(Grade C).**
- **The most significant urodynamic signs of bladder dysfunction in patients with lumbar stenosis are PVR urine volume and reduced flow rate. Vice versa patients with such findings should be asked whether leg or back pains are present; if yes ,further neurological and neurosurgical investigations should be carried out (Grade C).**
- **The urological symptoms may indicate the presence of significant cauda equina dysfunction (Grade C).**
- **Prospective studies have shown that bladder function was improved subjectively and objectively in up to 60 % of patients, especially in regards to the amount of post voiding residual urine and max. flow rate in men . Therefore neurosurgical treatment is mandatory. Only occasionally do the neurosurgical procedures cause a further deterioration of detrusor dysfunction (Grade C).**

E9. GUILLAIN BARRÉ

I. EPIDEMIOLOGY AND PREVALENCE

Guillain-Barré Syndrome (GBS) is an acute inflammatory demyelinating disorder that affects the peripheral nerves, cranial nerves, sympathetic and parasympathetic nerves. GBS is characterized by weakness and areflexia or severe hyporeflexia.

The following stages are observed: progression or acute phase, plateau phase and recovery phase. Mortality is about 3%, complete recovery occurs in up to 80% of patients. In up to 80% of patients with GB syndrome there are signs and symptoms of autonomic dysfunction and among these symptoms are voiding problems. Due to the nature of the disease (acute phase and resolution phase with return of almost all functions being possible) the true prevalence of micturition problems is highly dependent on the evaluation time-frame. The prevalence of micturition disorders varies from 25% to over 80% of patients with GB syndrome [1 – 2]. The true incidence is uncertain due to the fact that during the acute phase patients are usually managed by indwelling catheter.

II. PATHOLOGY AND DISEASE SPECIFIC LUT PROBLEMS

There is a lack of good systemic studies on micturition disorders in GBS during both acute and chronic phase. No information exists about the fate of these patients. The most extensive study was performed by Sakakibara et al [2] (LOE 3) during the acute phase. They found that 25% of the patients with GBS showed micturitional disturbance. Voiding difficulties were presented by 86%, urinary retention by 43%, nocturnal urinary frequency by 43%, and urge incontinence by 28% of patients suffering from micturition problems.

Urodynamic studies demonstrated disturbed bladder sensation in one patient, bladder areflexia in one, and absence of the bulbocavernosus reflex in one. Cystometry showed decreased bladder volume in two and bladder overactivity in two, one of whom had urge urinary incontinence and the other urinary retention.Grbavac et al [1] (LOE 3/4) studied urodynamically four patients in the acute stage of this neurological disease. All of them had complete urinary retention. They described in this group both detrusor areflexia and detrusor overactivity, as well as detrusor-sphincter dyssynergy. One patient was followed also during the chronic stage of the disease showing detrusor overactivity.

Urodynamic symptoms in GBS appear during the neurological manifestation of the syndrome (weakness) and gradually improve over time. That is in line with the observation that dysautonomic abnormalities are at their maximum during the peak period of paralysis and improve gradually along with the neurological signs.

III. DISEASE SPECIFIC DIAGNOSIS AND TREATMENTI

An impression of the extent of damage to the spinal cord might be obtained by MRI studies of the spinal cord, as suggested by Crino et al [3].

Since GBS is an acute condition during which an abrupt deterioration of the LUT function is observed, after which a subsequent resolution occurs, it is suggested to manage these patients expectantly. Usually during the acute phase a permanent catheter is installed. During the acute phase different forms of storage and emptying disorders were described (areflexia, overactivity, dyssynergy), which probably reflects different levels of spinal cord involvement. The value of urodynamic tests in the acute phase should therefore be questioned, as only rarely they would carry any prognosis for the final outcome of LUT functional disorders. It is worthwhile however to concentrate on functional diagnostics of the LUT during the paralysis recovery phase. Again no general treatment, due to a variety of symptoms, can be recommended, and the only solution is to treat these patients according to the urodynamic study results.

IV. GUIDELINES FOR FURTHER RESEARCH

There is only one study about the prevalence of LUT problems in GBS, which is however concentrated on the acute phase of the disease. Therefore a long-term follow-up of these patients is strongly needed. We still don't know what are the long-term consequences of this disease for the LUT and what is the true prevalence of incontinence in this group of patients.

Conclusions

- **In the acute phase of GB syndrome about 25% of patients demonstrate LUT functional problems (LOE3)**
- **Both storage and voiding symptoms are observed in GB syndrome (LOE 3)**
- **Recovery of the LUT functions might take months and sometimes a full recovery is not possible (LOE 3)**

Recommendations

- **Patients in the acute phase of the GB syndrome should be managed expectantly, the indwelling catheter being the treatment of choice (Grade C)**
- **No extensive diagnostics of the bladder/urethral functions are needed during the acute phase (Grade C)**
- **During and after the recovery of the paralysis a detailed functional evaluation of the LUT in symptomatic patients is needed in order to optimize the therapy (Grade C)**

E10. AIDS

I. EPIDEMIOLOGY AND PREVALENCE

HIV virus belongs to the family of retroviruses. This family of viruses is known for latency, persistent viremia, infection of the nervous system, and weak host immune responses. HIV has high affinity for CD4 T lymphocytes and monocytes. HIV binds to CD4 cells and becomes internalized. The virus replicates itself by generating a DNA copy by reverse transcriptase. Viral DNA becomes incorporated into the host DNA, enabling further replication. HIV enters the nervous system early, at the time of initial infection, and may immediately cause symptoms, or may cause symptoms any time during the person's life.

All parts of the nervous system may be involved. Neurological disorders could be HIV-related, secondary to secondary infections, malignancy, metabolic or nutritional problems and to therapy.

It is estimated that without anti-retroviral treatment, up to 80% of patients are symptomatic in terms of nervous system and for 30% neurological symptoms are the initial clinical problem.

Neurological syndromes may be the sole clinical problem or cause of death. The following brain symptoms were described: meningitis, dementia, stroke, seizures, degenerative disorders. For spinal cord both transverse myelitis and progressive myelopathy were observed. Taking all this information together it is evident that nervous system involvement in HIV infection should be reflected to a various degree in the LUT [1]. Shin et al [2] (LOE

3) described a higher prevalence of incontinence in HIV-positive patients in nursing homes as compared to HIV-negative. Gyrtrup et al [3] (LOE 3) found voiding problems in 12% of HIV-infected patients, mostly in an advanced stage of the disease.

II. PATHOLOGY AND DISEASE SPECIFIC LUT PROBLEMS

As already described virtually all parts of the LUT innervation can be involved in AIDS patients, either as the primary location of HIV infection or secondary to HIV-related complications. Among these different manifestations particular attention should be paid to the primary locations as they develop early in the stage of the disease.

HTLV-I associated myelopathy (HAM) affects up to 3% of HIV positive patients and is manifested by slowly progressive spastic paraparesis, including deterioration of bladder problems [4] (LOE 2). Another primary demonstration of HIV infection is lumbosacral polyradiculopathy, described by Matsumoto et al (LOE 3) [5]. In this case report voiding difficulties and lower limb paresis were the primary manifestation of HIV infection.

Also Mahieux et al [6](LOE 3) described a case of acute myeloradiculitis due to cytomegalovirus as the initial manifestation of the terminal stage.

Begara et al [7] (LOE 3) performed urodynamic studies in 10 patients with AIDS and voiding disorders and found that the most common symptom was urge incontinence and the most common urodynamic finding was detrusor-external sphincter dyssynergia. In 3 patients they found demonstrable functional disorders of the LUT (2 patients had detrusor overactivity: one of them had a history of encephalopathy from HIV and the other patient had polyneuritis; the third patient had myelitis and a urodynamically diagnosed sympathetic decentralization). Detrusor areflexia was described in 2 HIV-positive patients by Menendez et al [8](LOE 3). One of them had an ascending myelitis of probable herpetic origin; the other had a cerebral abscess caused by Toxoplasma gondii.

III. DISEASE SPECIFIC DIAGNOSIS AND TREATMENT

Since during the course of the disease all parts of the nervous system can be involved, either as the primary location or secondary to AIDS-related complications, no disease specific diagnosis or treatment can be proposed. It is important to observe that sometimes functional disorders of the LUT can be the first manifestation of the HIV infection.

When managing the patient with HIV infection one must bear in mind that both storage and voiding problems can occur and that both should be treated according to the results of urodynamic studies.

IV. GUIDELINES FOR FURTHER RESEARCH

All rapports about HIV and voiding problems are rather anecdotal, and no good prospective studies exist. The need for such studies is particularly important, when realizing that it takes up to 20-30 years from HIV infection to AIDS full manifestation and that new antiviral treatment modalities could prolong the life of a patient with HIV significantly. Particular attention should be paid to primary nervous system involvement by HIV and to related voiding dysfunction.

Conclusions

- **HIV can influence the nervous system and the LUT functions in two ways: as primary infection or secondary to AIDS related complications (LOE 3)**
- **Nervous system manifestation of HIV infection can by the only sign, and it is therefore important to take the possibility of HIV infection into consideration when facing unusual signs and symptoms from the LUT without any other obvious cause (LOE 3)**
- **AIDS is a progressive disease, and dynamic changes to the LUT functions can occur during the evolution of the disease (LOE 3)**

Recommendations

- **Patients with HIV related nervous system pathological signs and symptoms should be evaluated for functional LUT problems (Grade C)**
- **Due to the variety of LUT functional damage in AIDS patients urodynamic study is essential for tailoring the optimal therapy (Grade C)**

E11. LUMBAR DISC PROLAPSE

I. EPIDEMIOLOGY AND PREVALENCE

Usually disc prolapse is in a posterolateral direction which does not affect the majority of the cauda equina. Bartolin et al [1] reported normal detrusor activity in 83/114 patients with lumbar disc protrusion. Cauda equina syndrome due to central lumbar disc prolapse has been reported to be relatively rare, the incidence being from 1 to 5% of all prolapsed lumbar discs [2 – 9].

II. PATHOPHYSIOLOGY AND DISEASE SPECIFIC LUT PROBLEMS

Central lumbar disc prolapse can compress sacral nerve fibers to and from the bladder, the large bowel, the anal and urethral sphincters, and pelvic floor. Clinical features of the cauda equina syndrome include low-back pain, bilateral sciatica, saddle anesthesia, and urinary retention, loss of urethral sensation as well as constipation and erectile dysfunction [5, 8, 10, 11] (LOE 3). Those patients with cauda equina syndrome usually have some sensory disturbance in the sacral dermatomes [5, 11] (LOE 3). Disturbed afferent activity from the bladder can be present.

III. DISEASE SPECIFIC DIAGNOSIS AND LUT DYSFUNCTION PATTERNS

The most common urinary symptom associated with lumbar disc prolapse is acute urinary retention [12] (LOE 3). At the onset, acontractile detrusor with impaired bladder sensation is a typical urodynamic finding [5, 11, 12] (LOE 3). Severe denervation of pelvic floor [12] and external urethral sphincter [11] is also frequently demonstrated. Detrusor overactivity may occur, presumably through the irritation of the sacral nerve root [12]. Urinary disorders usually follow or accompany more obvious neurologic symptoms, such as lumbar pain and perineal sensory disturbances, which lead to a proper diagnosis.

However, sometimes voiding disturbances may be the only or the first symptom of this condition, which makes it more difficult to diagnose this disease [4, 10] (LOE3).

IV. DISEASE SPECIFIC THERAPY

Emergency surgical decompression has been reported to be important to increase the chance of satisfactory neurological recovery in patients with cauda equina syndrome due to central lumbar disc prolapse [5, 13 – 15](LOE3). In a meta-analysis of surgical outcomes, Ahn et al [8] reported that a significant improvement in sensory and motor deficits as well as urinary and rectal function occurred in patients who underwent the surgery within 48 hours compared with those who had the surgery more than 48 hours after the onset of the cauda equina syndrome. Also other reports support the concept that decompression performed within 48 hours of onset of this syndrome resulted in improved functional outcomes [4, 9, 16] (LOE 3). However, acontractile detrusor is usually irreversible even after immediate decompression [10, 1, 17] (LOE 3). Although most patients can empty their bladder postoperatively, it is only by straining or changing their voiding postures [11, 17]. In contrast to bladder dysfunction, urethral function shows a better recovery after surgery [11 – 12] (LOE 3).

Conclusions

- **Cauda equina syndrome due to central lumbar disc prolapse is rare (LOE 3).**
- **The most common urinary symptom is acute urinary retention (LOE 3)**
- **Voiding disturbances may be the only or the first symptom (LOE3).**
- **Emergency surgical decompression is mandatory but acontractile detrusor is often irreversible (LOE 3)**

E12. MENINGOMYELOCOELE AND SPINA BIFIDA

Please refer to the chapter on children. We reviewed only the scarce literature on adult patients.

I. EPIDEMIOLOGY AND PREVALENCE

Myelomeningocele (spina bifida) is one of the most common birth defects of the spine and brain. It occurs in 1-2 births per 1000, involving all levels of the spinal column (lumbar 26%, lumbosacral 47%,

sacral 20%, thoracic 5% and cervical spine 2%). Associated Arnold- Chiari malformation is seen in 85% of children, often requiring ventriculo-peritoneal shunting of cerebrospinal fluid. Ingestion of folic acid prior to conception and during the first trimester of pregnancy has significantly reduced the incidence of this problem and other associated neural tube defects. The neurologic defect produced is quite variable and cannot be totally predicted by the vertebral level of the lesion. Additionally the fibrosis associated with myomeningocele closure, may tether the cord. Subsequent growth of the infant or child will produce further neurologic problems, manifesting as changes in bladder, bowel and lower extremity function.

The incidence of urethrovesical dysfunction in myelomeningocele is not absolutely known, but most studies suggest it is very high (>90%). Similarly, anorectal dysfuction is very common, but its exact incidence has not been reported. Congenital neurologic bladder dysfunction with spina bifida and sacral dysgenesis that manifested itself only at middle age in a 48-year-old male is reported by Kaneoya et al [1](LOE4). Yamamura et al [2] reviewed the literature of tethered cord of adult onset and found 56 cases published (LOE 3).

II. PATHOLOGY AND DISEASE SPECIFIC LUT PROBLEMS

The two major consequences of the vesicourethral dysfunction are urinary incontinence and hydroureteronephrosis which can occur early or later in life [3]. There are many studies documenting the urodynamic characteristics of the vesicourethral unit in myelomeningocele patients but most in children. The findings do not correlate with the clinical neurologic findings or the level of the lesion [4]. In the past much attention has been directed at the significance of dyssynergia between the external sphincter and the bladder, and the associated deterioration of the upper renal tracts in these patients. With the increasing reliance on clean intermittent catheterization in the management of these patients, more emphasis has been placed on the pressure the bladder is generating prior to leaking as a prognostic factor in predicting upper tract deterioration.

III. DISEASE SPECIFIC DIAGNOSIS AND TREATMENT

Urodynamics is the cornerstone in the diagnosis and management of vesicourethral dysfunction in myelomeningocele. Clinical examination has been shown to have no diagnostic power (see section diagnosis neurogenic LUT in this chapter). As previously stated, urodynamic findings may predict the patients at risk of upper tract deterioration. Controversy continues as when to initiate these studies, either as soon as possible after back closure, at the first sign of upper tract changes or before considering management of incontinence. Studies supporting each position have been reported, although the preponderence of evidence suggests earlier diagnosis of hostile factors is advisable. Lumbosacral abnormalities can be unsuspected. Taskinen et al [4] examined 30 patients with anorectal anomalies mainly because of fecal or urinary incontinence. All patients underwent spinal magnetic resonance imaging and urodynamic investigation. Major lumbosacral abnormalities were detected in 57% of patients, including 13, 4 and 3 with a tethered cord, syringomyelia and caudal regression, respectively. Significant dysfunction of the LUT in 57% of the cases involved an overactive detrusor in 11, detrusor-sphincter dyssynergia in 4, distended bladder in 4 and lazy bladder in 1. When the spinal cord was normal, 54% of the patients had abnormal urodynamic findings but when the spinal cord was abnormal, 59% had abnormal urodynamics. When the bony spine was normal, 33% of the patients had an abnormal spinal cord but when the bony spine was abnormal, 69% had an abnormal spinal cord. (LOE 3).

As hydronephrosis and vesico-ureteric reflux are a consequence of detrusor dysfunction, synchronous fluoroscopic evaluation of the urinary tract is advisable at the time of urodynamics. Similarly, renal ultrasound has become an invaluable routine serial evaluation in these patients, assessing renal growth, development of scarring and, most importantly, hydroureteronephrosis. Studies suggest a role for repeat urodynamics and ultrasound in this patient population, however, the timing and frequency of these studies still needs to be elucidated.

Although, renal scans are routinely used, especially in the myelomeningocele patient with hydronephrosis, the exact role of this study in these patients is not clear.

Urologic treatment depends on the age of the patient and the nature of the vesico urethral dysfunction as characterized by urodynamics.

In a retrospective study, urinary sepsis accounted for the majority of admissions (62%), while 38 of 62 patients required 60 surgical procedures [6]. Targe-

ting the primary urological abnormality (the dysfunctional and usually poorly compliant bladder) allowed implementation of effective treatments, including regular intermittent bladder catherisation (52%) in order to preserve upper renal tract function. Associated postural abnormalities complicated both conservative and interventional therapies.

The mainstay of treatment is clean intermittent catheterization and antimuscarinic medication. As continence is not at issue in the neonate and infant, treatment may be postponed, unless upper tract changes are present. Some evidence exists pointing to the fact that early initiation of treatment may prevent subsequent deleterious bladder changes.

Management of incontinence and or upper tract deterioration mirrors the treatment of neurologic bladder. Variations in this algorithm include the use of vesicostomy in the younger child who has failed conservative measures and has evidence of deteriorating upper tracts. External sphincterotomy has no place in the management of these patients and the use of the appendico vesicostomy in continent LUT reconstruction (Mitrofanoff) has become very popular. Most studies on surgical management of the myelomeningocele bladder are descriptive (LOE 4) at best.

Data from adult and paediatric surveys show renal damage to be the single most prevalent cause of morbidity and mortality; even in children, 30-40% exhibit evidence of renal damage. Additional factors such as chronic infection and stone formation will then render the kidney more vulnerable to progressive loss of renal mass and subsequent chronic renal failure. Renal transplantation is now considered the optimal treatment for end-stage renal disease in all age groups. Although more prone to complications, recent data on patients with meningomyelocele or severely abnormal LUTs demonstrate excellent patient and graft outcomes [7] (LOE 3).

IV. GUIDELINES FOR FURTHER RESEARCH

Further clarification of the role of fetal surgery to repair the neural tube defect is required. Similarly the role of early intervention, conservative or surgical is required. The timing of surgical intervention needs further study as well as better quality of life assessments and risk/ benefit analyses of LUT reconstructive procedures. The development of a tissue-engineered substitute for cystoplasy is being studied. Finally, the fate of the adult myelomeningocele patient, especially those who have undergone reconstruction needs to be documented.

Conclusions

- **Meningomyelocoele is one of the commonest birth defects**
- **Incidence decreased by folate ingestion (LOE 2)**
- **Most have bladder dysfunction leading to incontinence and / or upper tract deterioration (LOE 3)**
- **Majority will derive significant benefit from conservative measures (LOE 3)**
- **Spinal defects can be unsuspected and should be looked for in the presence of unexplained symptoms (LOE 3)**

Recommendations

- **Regular surveillance, from infancy, with urodynamics and renal ultrasound is needed (Grade B)**
- **Early initiation of conservative measures such as clean intermittent catheterization, anti muscarinic medication is recommended (Grade B)**
- **Surgery should be reserved for failed conservative treatment (Grade B)**

E13. DIABETES MELLITUS

I. URINARY INCONTINENCE

1. Epidemiology and prevalence

Diabetes is one of the commonest causes of polyneuropathy. Amongst different types of polyneuropathies in diabetic patients “diabetic cystopathy” occurs in 43% to 87% of insulin-dependent diabetics, with no sex or age differences. It is also described in about 25% of diabetic patients on oral hypoglycemic treatment. A Scandinavian study showed that in patients who have had diabetes for 10 years, the prevalence of diabetic cystopathy in those who were insulin-dependent was 2 to 4 per 1000 and in those on oral hypoglycemic agents was 1 to 3 per 1000. The correlation between diabetic cystopathy and peripheral neuropathy ranged from 75% to 100%. Nephropathy was seen in 30% to 40% of cases [1].

2. Pathology and disease specific LUT problems

Van Poppel et al [2] had neuropathological examination of bladder biopsies done on 14 patients with severe insulin-dependent adult-onset diabetes and compared these with the acetylcholinesterase and S100 staining of 38 control specimens. A decrease in acetylcholinesterase activity, due to axonal degeneration, was found in all cases. An increase in S100 positivity was found in the majority and is due to Schwann cell proliferation as a regeneration attempt after demyelination or axonal degeneration. When acetylcholinesterase activity decreases and an S100 density increase is found in a patient with diabetes, this combination is highly suggestive of thorough diabetic cystopathy amenable to early symptomatic treatment .

Since the peripheral nerves are involved, the clinical manifestation of diabetic cystopathy might vary. Usually there is reduced sensation of bladder fullness, and decreased frequency of voiding. This is followed by slowing of the urinary stream and difficulty in voiding due to impaired detrusor contraction. Post-voiding dribbling may also occur. The impaired bladder emptying and urinary retention predispose to urinary tract infections. No prospective studies referring specifically to the problem of functional disturbances of the LUT in diabetic patients were performed.

Recent articles have suggested that the classic cystopathy may not be the only form of LUT dysfunction in diabetes patients. Involuntary detrusor contractions have been demonstrated in 55%-61% [3 – 4]. Chancellor and Blaivas [5] showed in 43 patients that 33% had involuntary bladder contractions with normal contractility and 23% had involuntary contraction with impaired contractility. Ueda et al [6] also found DOA in 25 % of diabetes patients but noted that all of these had a history of cerebrovascular accident. Whether DOA in patients with diabetes cystopathy can be related to another cause and in how many needs to be further clarified.

3. Disease specific diagnosis and treatment

Since diabetic polyneuropathy occurs in most patients after prolonged insulin-treatment and in about a quarter of patients treated with oral hypoglycemic drugs, it would be interesting to know the patients who are at risk of developing diabetic cystopathy without performing extensive functional tests of the LUT.

Ishigooka et al (LOE 3) described the results of the ice-water test in diabetic patients with and without cystopathy [7]. 12.5% patients without cystopathy and 25% of patients with cystopathy did not feel the ice water sensation. Ueda et al (LOE 2) performed studies evaluating sympathetic skin response in correlation with cystometry [6]. They found that patients without sympathetic skin responses had increased residual urine and decreased detrusor contraction pressure, while patients with lower amplitude of sympathetic skin response and more prolonged latency than controls had a significant decrease in detrusor contraction pressure. The changes within the bladder functions were observed as early as within one year from the diagnosis of diabetes.

Beylot et al (LOE 3) found that the presence of residual urine in diabetic patients, after exclusion of co morbidities, was strongly associated with peripheral neuropathy [8].

No specific treatment has been described in regards to the population of patients with diabetic cystopathy. Therefore general rules as for the other bladder conditions with impaired (absent) detrusor contractions should be followed.

4. Guidelines for further research

No good epidemiological studies of the true incidence of diabetes related functional disorders of micturition were performed. The same is true for the treatment of diabetic “neurologic bladder”. There are no studies referring to the theoretically effective prompted voiding, and intravesical electrostimulation

Conclusions

- **Diabetic cystopathy occurs in up to 80% of insulin dependent diabetes mellitus (LOE3)**
- **Patients with diabetic cystopathy have impaired detrusor contractions and increased post-void residual (LOE ?)**
- **Detrusor overactivity has been described in a high % of diabetic patients. If this is a consequence of the diabetes or is caused by another pathology needs to be further clarified (LOE 3)**
- **Recurrent urinary tract infections might be a long term problem (LOE ?)**

Recommendations

- **Post void residual and urine dipstick (optional culture) in all patients with insulin dependent diabetes mellitus should be performed yearly (Grade C)**
- **Treatment of choice for acontractile bladder in this group remains intermittent catheterization (Grade B/C)**

II. FAECAL INCONTINENCE

Caruana et al [1] found that DM patients with faecal incontinence showed increased thresholds of phasic external sphincter contraction compared with controls ($P<0.05$) and had reduced resting and maximal voluntary anal sphincter pressures compared with controls ($P< 0.05$). Increased thresholds of conscious rectal sensation in some incontinent patients with DM may contribute to faecal incontinence by impairing the recognition of impending defecation. Nakayama et al [2] found that age and DM have an independent negative influence on faecal incontinence after stroke. It could be due to an abnormal internal-anal-sphincter function [3].

Talley et al [4] studied GI symptoms and found frequent abdominal pain, bowel-related abdominal pain, reflux, dyspepsia, constipation, diarrhea, and faecal incontinence in DM patients. There was a clinically significant decrease in QoL scores in diabetics compared with population norms across all subscales. The impact on QoL in diabetes was predominantly observed in type 2 diabetics. For all the Short Form-36 subscales, GI symptom groups were significantly (all $p < 0.0001$) associated with poorer QoL in diabetes, independent of age, gender, smoking, alcohol use, and type of diabetes.

Conclusions (LOE3)

- **Faecal incontinence in DM patients may be due to impaired anorectal sensation and control functions.**
- **GI symptoms impact negatively on health-related QoL in diabetes mellitus.**

Recommendations

- **More studies on neurologic bowel dysfunction and management in diabetes are needed before giving any recommendation.**

E 14. PERIPHERAL NEUROPATHY DUE TO IATROGENIC LESION (FOCAL NEUROPATHY)

I. EPIDEMIOLOGY AND PREVALENCE

LUT dysfunctions can occur from damage to the nerves innervating the pelvic organs, anywhere in the course of these nerves through the cauda equina, the spinal nerve roots, the sacral plexus, or to the various individual nerves that arise from the plexus.

Most injuries to these nerves are iatrogenic. Extensive pelvic surgery as abdomino-perineal resection for rectal cancer, radical hysterectomy, and aortoiliac surgery are all likely to damage the pelvic parasympathetic nerves to the bladder and genitalia. A variety of types of voiding dysfunction and erectile dysfunction can result.

Two major groups of patients can be identified: female patients after hysterectomy (simple or radical) and patients of both sexes after colo-rectal surgery.

Parys et al (LOE 3) studied 126 women after simple hysterectomy [1]. Their results show that 47 % had detrusor overactivity, 36.7% had urethral obstruction, and 24.8% stress incontinence. Sekido et al (LOE 3) described 9 women treated with radical hysterectomy more than 10 years before the study [2]. Obstructive voiding symptoms and/or urinary incontinence were observed in 7 patients. Cystometry revealed impaired bladder sensation, detrusor acontractility, straining on voiding, and impaired relaxation of the sphincter in all assessable patients. In addition, decreased bladder compliance was observed in 5 patients.

Retrospective analysis of 52 patients after abdominoperineal resection was performed by Eickenberg et al (LOE 3) [3]. Neurologic bladder dysfunction of various degrees was found in 50 per cent of all patients, but represented a long-term problem in only 10 per cent.

Baumgarner et al (LOE 3) studied 86 consecutive cases of abdominoperineal resection and described 11 cases of various functional problems of micturition [4]. All these studies however are lacking specific tests of LUT function and are not prospective.

However curative total mesorectal excision with autonomic nerve preservation can be done with high rates of preservation of such function: Pocard et al

[5] investigated 20 patients, 13 men and 7 women following curative total mesorectal excision with autonomic nerve preservation for rectal cancer. There was no difference in preoperative and postoperative LUT function, International Prostatic Symptom Score or urodynamic results, or in the results of the quality of urinary function questionnaire. Also sexual activity and potency were unchanged in these men. Therefore the authors conclude that autonomic nerve preservation is possible and does not impair urinary and sexual function. Also Kim et al [6] showed relative safety in preserving sexual and voiding function with total mesorectal excision with pelvic autonomic nerve preservation. Evaluation was based on uroflowmetry, voided volumes and residual volume; symptoms were evaluated with the IPSS: There were significant differences in maximum. urinary flow rate and voided volume before and after surgery, however no differences in residual volume before and after surgery were apparent. The IPPS however increased after surgery from 6.2 +/- 5,8 to 9.8 +/- 5,9 (= < 0,05).

Similar results are reported by Turoldo et al [7] evaluating incidence and pathogenesis of LUT dysfunction after surgical treatment of rectal cancer in a series of 219 patients with normal urinary function preoperatively: in the immediate follow-up only 17 patients with dysfunction were observed, 14 stage II, 2 at stage III and 1 at stage IV according to Astler-Koller classification; six months later only 8 patients had claimed urinary dysfunction and 1 required catheterisation. However no urodynamic studies were performed. There was no correlation of those with LUT dysfunction with staging, radiotherapy, size of tumor, surgical technique. However the worst functional results were observed in patients who underwent abdomino-perineal resection.

II. PATHOLOGY AND DISEASE SPECIFIC LUT PROBLEMS

The focal injury to the bladder and/or sphincter peripheral innervation results in denervation of the above mentioned organs. Therefore detrusor hypocontractility (acontractility) and/or sphincteric deficiency will be the result of such damage. This in turn will result in impaired bladder emptying and/or stress incontinence. No prospective studies referring specifically to the problem of functional disturbances of the LUT in focal iatrogenic neuronal injury in patients after hysterectomy or colorectal surgery have been performed.

III. DISEASE SPECIFIC DIAGNOSIS AND TREATMENT

The only specific test in this patient population was described by Nordling et al [8](LOE 3). In patients after radical hysterectomy, those who had a completely denervated bladder had a greater rise in maximum urethral pressure during noradrenaline infusion (exceeding 20 cm H2O) than normal subjects (1 to 15 cm H2O). Therefore authors concluded that urethral supersensitivity to noradrenaline may be a promising test in diagnosing damage of the sympathetic nervous innervation of the LUT. The test has not found a large application.

Since the major cause of focal neuropathy is surgical intervention, the best prevention is to avoid peripheral neuronal injury during surgery. A detailed knowledge of pelvis neuroanatomy and meticulous dissection of the structures adjacent to the possibly affected nerves was shown to be the best technique [9 – 13]. An interesting method of intraoperative identification of the vesical branches of the pelvic nerves during radical hysterectomy, was described by Kuwabara et al (LOE 3) [14]. They used during the intervention electrical stimulation on the outer surface of the posterior sheath of the vesicouterine ligament and controlled for increase of intravesical pressure. Postoperative compliance of the detrusor in cases where this method was implemented demonstrated less decrement from preoperative values than in cases with the conventional method. These patients required also significantly fewer days to achieve residual urine volumes less than 50 ml after surgery.

If, however, injury to the nerves innervating the bladder/urethra complex occurs, the treatment should be based on general principles described elsewhere and on the results of functional examination of the LUT. Zanolla et al (LOE 3) suggested that early implementation of rehabilitative treatment (prompted voiding) allows satisfactory functional recovery of the bladder activity in 91% of the symptomatic patients after radical hysterectomy [15]. Another interesting issue is the indication for the treatment of stress incontinence with an artificial urinary sphincter in patients after colorectal surgery, hysterectomy and/or radiotherapy. Only one case of abdominoperineal resection with adjuvant radiation was identified in a larger series of 81 men who had undergone different types of pelvic surgery with or without radiation (LOE 3) [16]. The authors concluded that the implant

of an artificial sphincter is a method of choice also in such cases but that there is a significantly greater risk of revision (38% versus 22% in the literature for low risk groups).

IV. GUIDELINES FOR FURTHER RESEARCH

No good epidemiological, prospective studies of the true incidence of peripheral injury related functional disorders of micturition were performed. Neither the descriptive studies of the disorders were performed. No specific, injury related therapy was described.

Conclusions

- **Injury to the bladder/sphincter innervation occurs in 30-50% of patients after extensive pelvic surgery (LOE3) but this figure may be improved with specific nerve sparing techniques**
- **Focal injury results in impaired detrusor contractions and external urethral sphincter deficiency or detrusor/sphincter dyssynergy (LOE 3)**
- **The key issue in avoiding these complications is meticulous anatomical preparation of the structures containing nerves to the bladder/urethra (LOE 3)**

Recommendations

- **Patients after extensive pelvic surgery demonstrating functional disorders of micturition should be properly evaluated due to a variety of possible disorders (Grade C)**
- **Early rehabilitation of the LUT might improve voiding in a majority of patients (Grade C)**
- **Treatment of choice for acontractile bladder in this group remains intermittent catheterization (Grade B/C)**
- **Surgeons should aim for autonomic nerve preservation when performing surgery for rectal cancer. Post-operative post-void residual urine measurements as well as a targeted history of micturition before and after are mandatory in order to avoid secondary myogenic damage of the detrusor by chronic urinary retention.(Grade C)**

E 15. SYSTEMIC LUPUS ERYTHEMATOSUS

I. EPIDEMIOLOGY AND PREVALENCE

Nervous system involvement occurs in about half of patients with systemic lupus erythematosus (SLE). Seizures and psychiatric disorders are most common manifestations; spinal cord lesions are uncommon. Symptoms of LUT dysfunction can occur, however data on prevalence are not available.

II. PATHOPHYSIOLOGY

Neurological manifestations of systemic lupus erythematosus are subacute encephalomyelopathy, subacute myelopathy (rarely) and chronic encephalomyelopathy. Sakakibara et al [1] published the findings of 6 women and 2 men, mean age 23 years, suffering from SLE for 2-25 years under immunosuppressant therapy. All 8 patients had urodynamic abnormalities, 5/8 showed decreased urinary flow, 3/8 increased post-void residual urine, 2/8 increased max. urethral closure pressure, 5/8 showed detrusor overactivity, and 5/8 impaired detrusor contractility; furthermore detrusor-sphincter dyssynergia was found in 4/8, and neurologic motor unit potentials of the external sphincter in two of four patient studied. They found detrusor overactivity more common in patients with brisk deep tendon reflex (80 %) than in those without (33 %).

Repeated studies during a follow-up period between 2 months and 8 years showed deterioration in 3/8 including loss of bladder sensation, development of a low compliance bladder and decreased bladder capacity (LOE 4).

Conclusions

- **Half of patients with systemic lupus erythematosis show nervous system involvement. In 30 % of them subacute and chronic encephalomyelopathy may cause LUT dysfunction with variable patterns including detrusor overactivity, impaired detrusor contractility, pathologic voiding pattern and increased post-void residual urine. Incontinence may result from bladder overfilling**

Recommendations

- **The dysfunction pattern may change over time, therefore urological follow-up is recommended. (Grade C)**
- **Urodynamics are necessary to define the underlying pathophysiology of the urinary symptoms (Grade C).**

E16. HERPES ZOSTER

I. EPIDEMIOLOGY AND PREVALENCE

The incidence of LUT dysfunction is as high as 28 % if only lumbosacral dermatome-involved patients are considered. The overall incidence is 4 % [1].

II. PATHOPHYSIOLOGY

Herpes zoster in the lumbosacral dermatomes may manifest according to Chen et al [1], based on 17 patients, as cystitis-associated (12/17), neuritis-associated (4/12) and myelitis-associated (1/17).

III. DISEASE SPECIFIC DIAGNOSIS AND THERAPY

No data are available on urodynamics.

Herpes zoster associated voiding dysfunction is a transient phenomenon and is not uncommon in patients with lumbosacral dermatome involvement. As long as voiding is unbalanced the treatment with intermittent catheterisation or indwelling catheter placement is recommended in order to avoid secondary damage to the LUT due to infection or chronic urinary retention. The disease usually is of a benign clinical course and almost every patient will either regain normal voiding or, at least balanced bladder function. Incontinence could follow if urine drainage is not done.

Conclusions

- **28 % of patients with Herpes zoster in the lumbosacral dermatoms show LUT dysfunction with impaired voiding as the most common symptom.(LOE 3- 4)**
- **Voiding dysfunction has a transient course and almost every patient will either regain normal voiding or at least balanced bladder function.(LOE 3-4)**

Recommendations

- **Till functional recovery takes place treatment with intermittent catheterisation or indwelling catheter is recommended (Grade C).**

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D. NEUROLOGIC FAECAL INCONTINENCE

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D2. DIAGNOSTICS

General principles

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