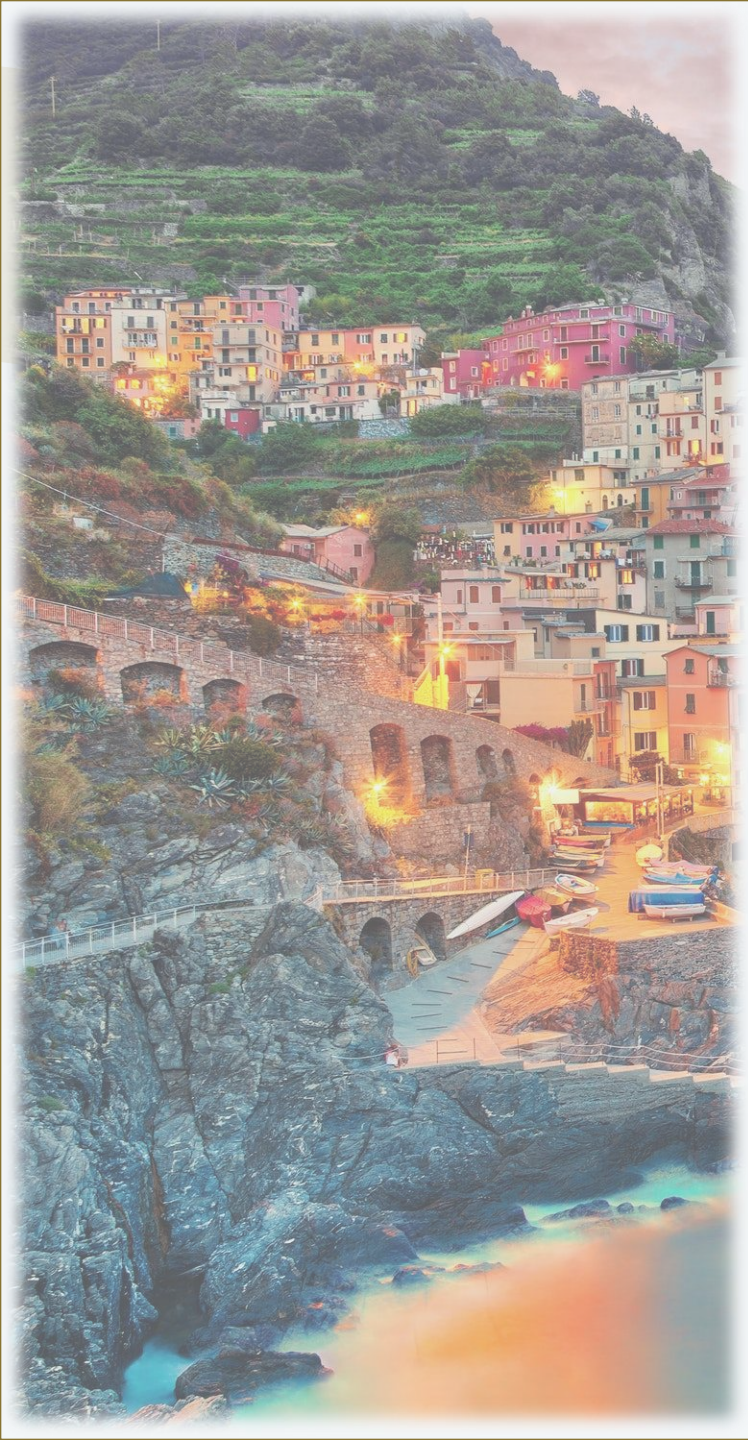


A scenic landscape featuring a dirt road winding through a valley. The foreground is filled with green grass and shrubs. The middle ground is dominated by tall, dark evergreen trees. In the background, rolling hills and mountains are visible, with a bright sun shining from the upper right, creating a warm, golden glow and lens flare effects. The overall atmosphere is peaceful and natural.

Undescended testes

BY R2 PEERAWIT SONGSIRI MD.



Contents

- Definition
- Embryology
- Classification
- Incidence
- Diagnosis
- Complication
- Treatment

Definition



Definitions

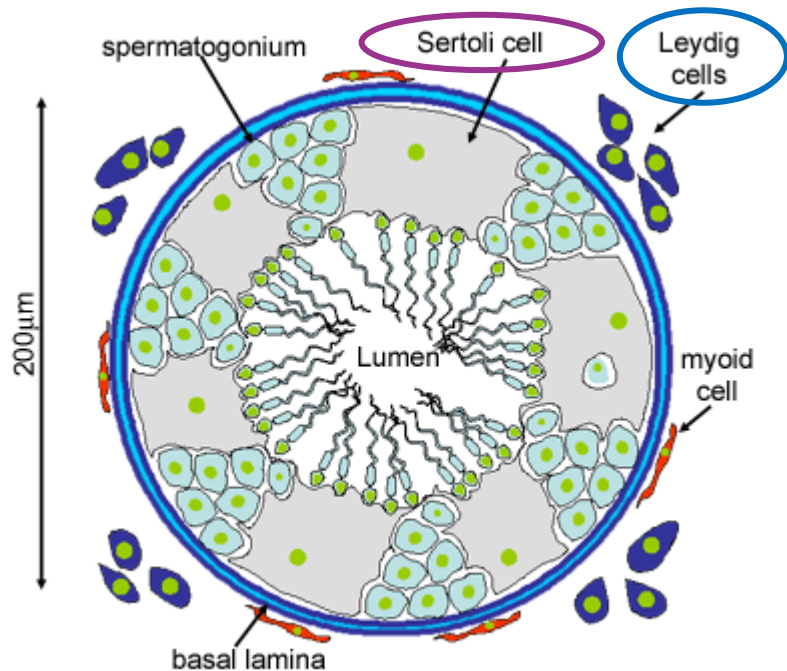
- Normal scrotal position
 - Position of the midpoint of the testis at or below the midscrotum
- Undescended testis or Cryptorchidism
 - Testis that can't be manipulated to the bottom of scrotum without undue tension on the spermatic cord
- Ectopic testis
 - Condition caused by abnormally implanted gubernaculum , testis settled in suprapubic area, thigh, perineum
- Orchidopexy (orchiopexy)
 - Surgical fixation of testis in scrotum



Embryology

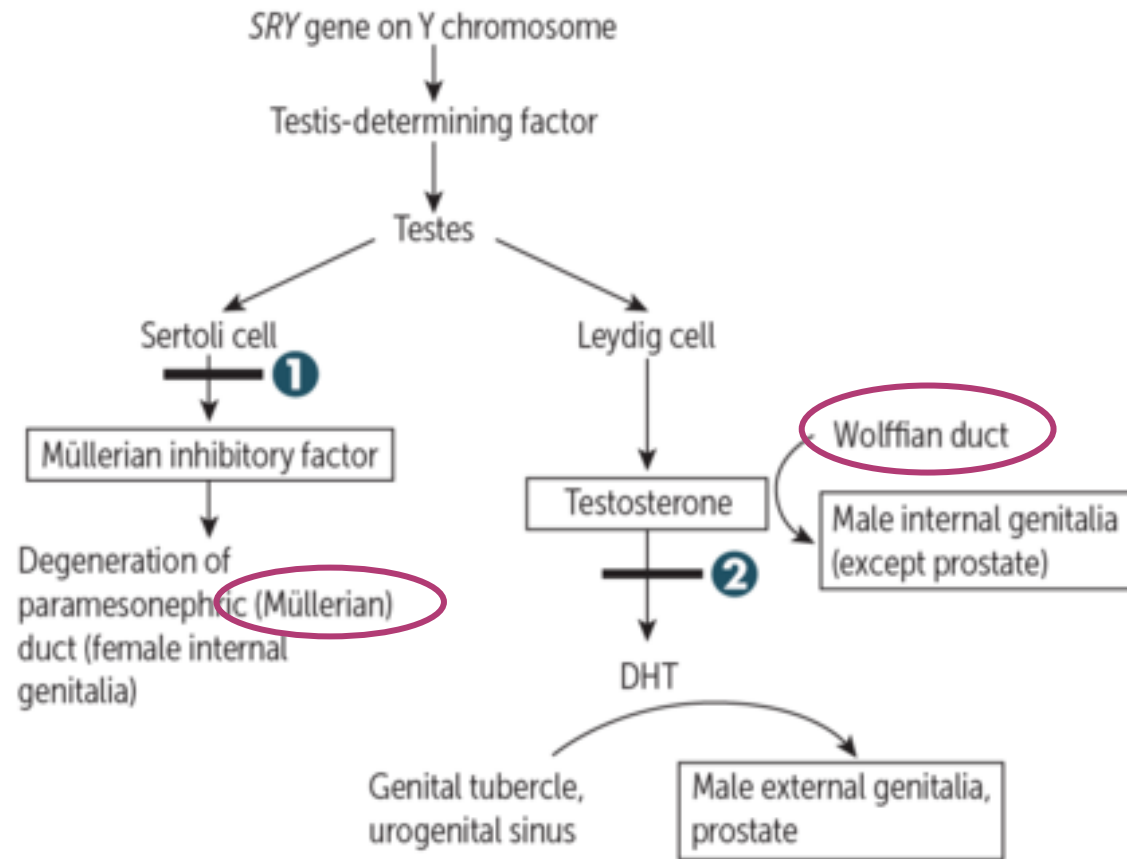
Embryology

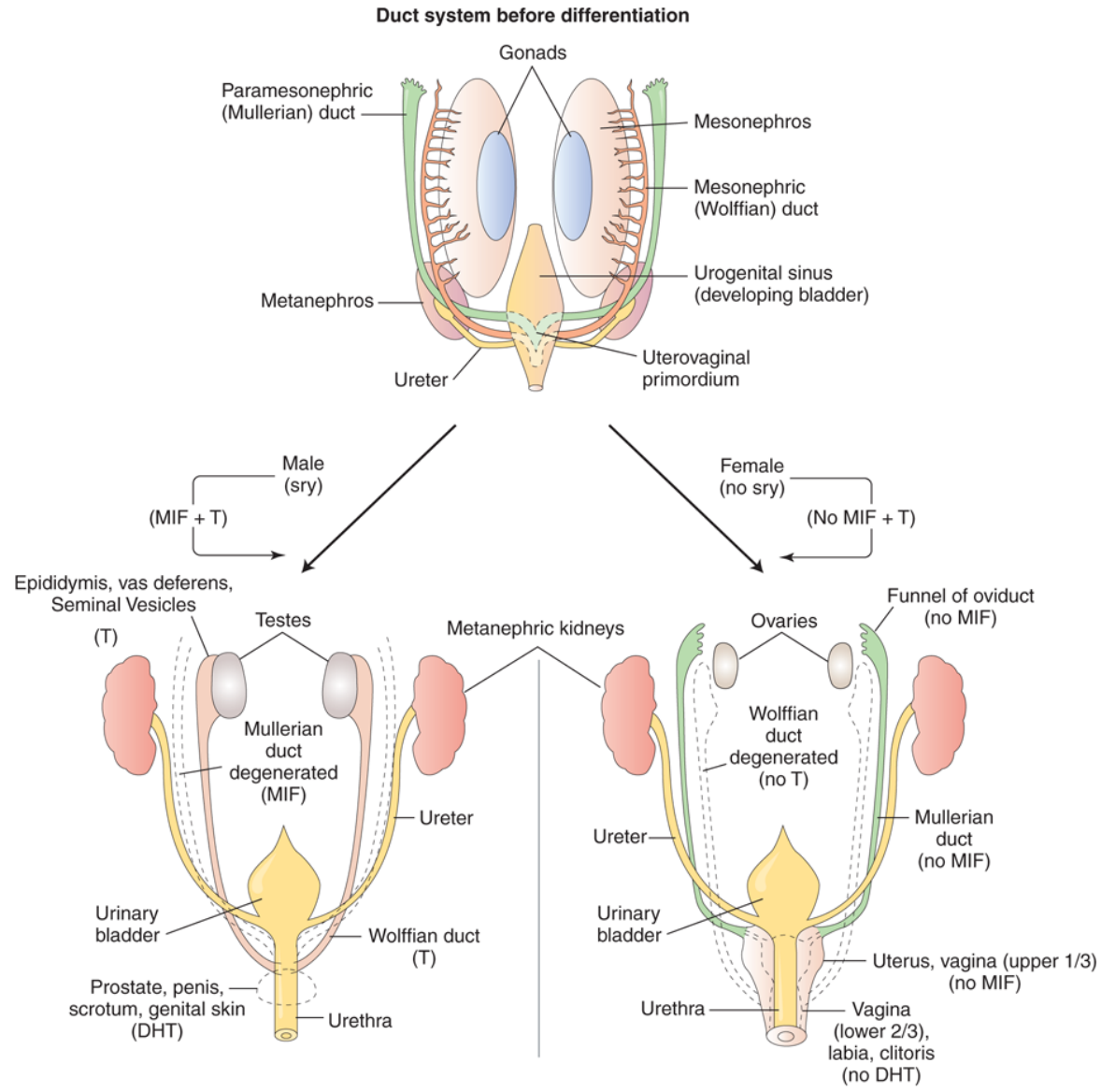
- Biopotential gonadal tissue located on embryo's genital ridge begin differentiation into testis during 6-7 week by effect of **SRY gene** on chromosome Y



- **Sertoli cell** -> Mullerian inhibitory factor (MIF) -> regression of most Mullerian duct structure except remnant appendix testis and prostatic utricle
- **Leydig cell** -> testosterone (GA 9th) -> wolffian duct structure development
- Testis resides in abdomen near internal ring then descent through inguinal into scrotum at seven to eight month (third trimester)

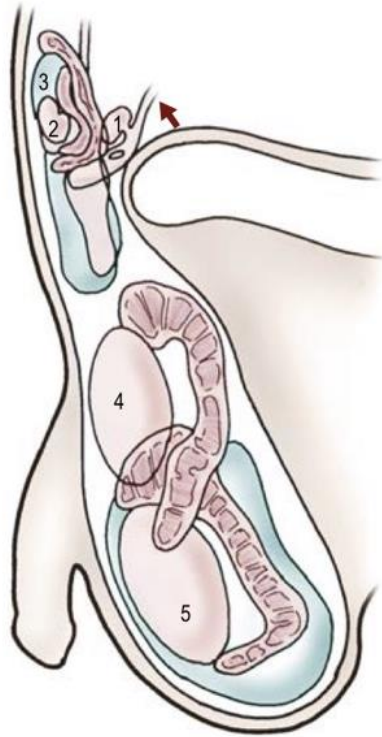
Embryology





Source: Lee W. Janson, Marc E. Tischler: *The Big Picture: Medical Biochemistry*. Copyright © McGraw-Hill Education. All rights reserved.

Embryology



- Testis resides in abdomen near internal ring then descent through inguinal into scrotum at seven to eight month (third trimester)

Fig. 51.1 Testicular descent in males: 1, 90 mm crown–rump length (CRL) (12–24 weeks of gestational age); 2, 125 mm CRL (15–17 weeks); 3, 230 mm CRL (24–26 weeks); 4, 280 mm CRL (28–30 weeks); 5, at term. The convoluted structure is the epididymis. (Adapted from Hadziselimovic F. Embryology of testicular descent and maldescent. In: Hadziselimovic F, editor. Cryptorchidism: Management and Implications. New York: Springer-Verlag; 1983. p. 23.)

Embryology : Important factors

- Hormones : Testis secrete
 - Insulin like factor3 (INSL3)
 - Testosterone

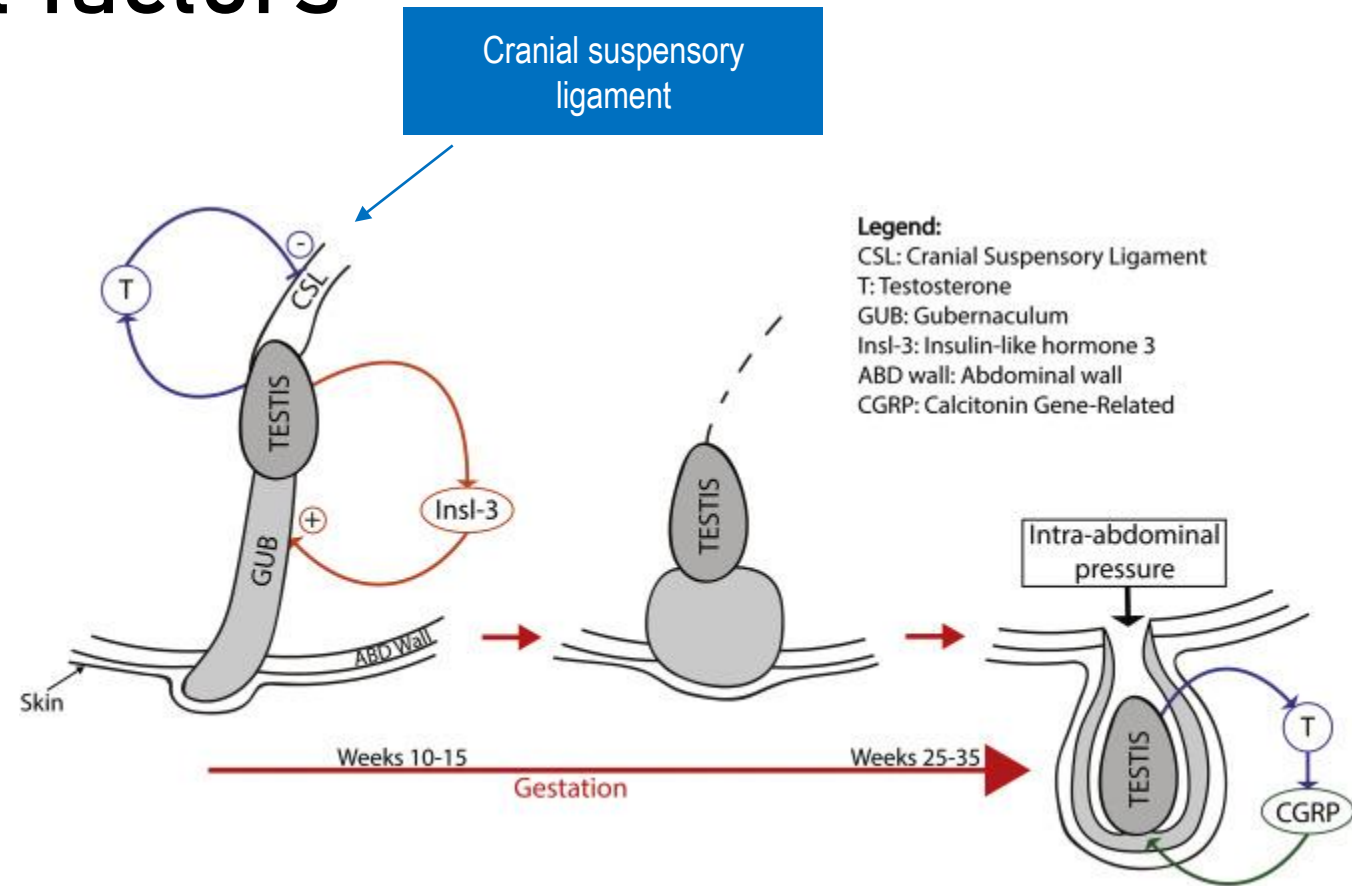
- Anatomical structure

1. **Gubernaculum testis**

- mucofibrous structure attached to the testis and scrotum
- guide the descent of the testis into scrotum
- help anchor the testis near internal ring

2. **Cranial suspensory ligament (CSL)**

- Androgen prompt involution -> downward migration of testis

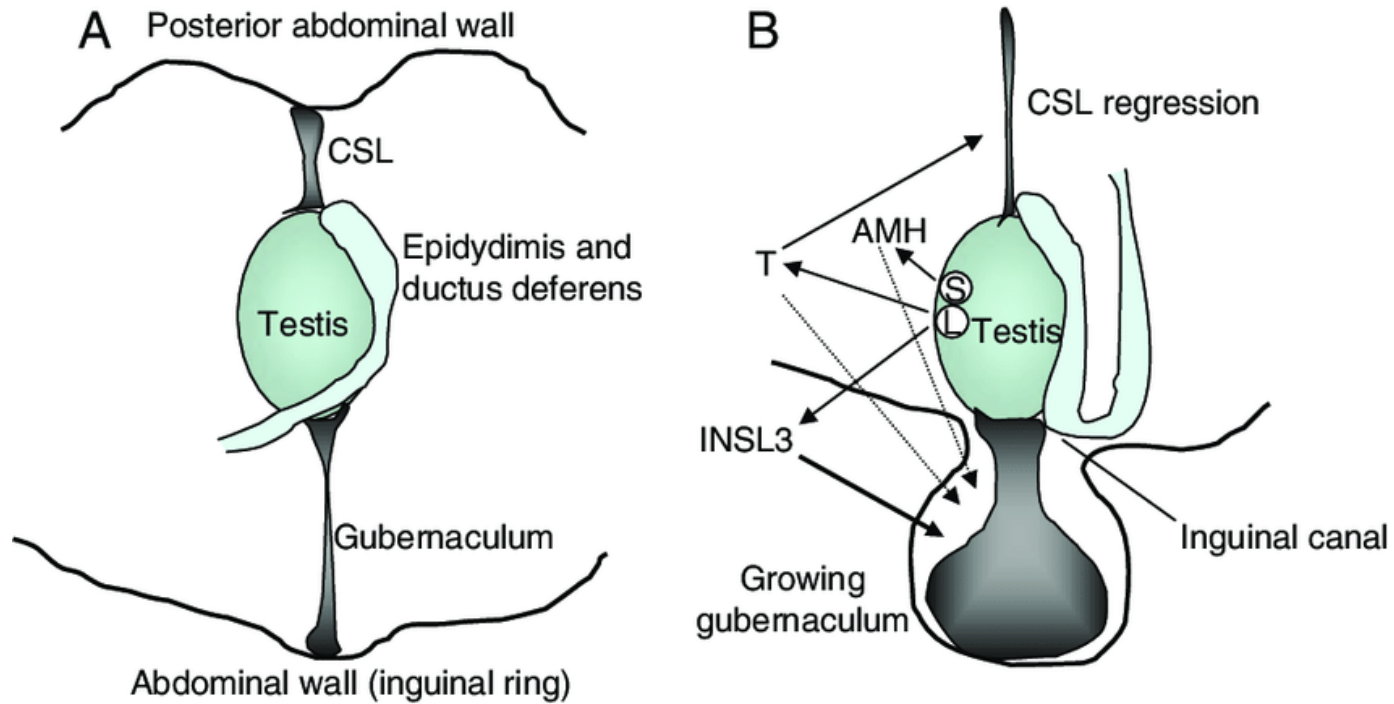


Cranial suspensory ligament

Genitofemoral nerve

Embryology : Hutson biphasic model

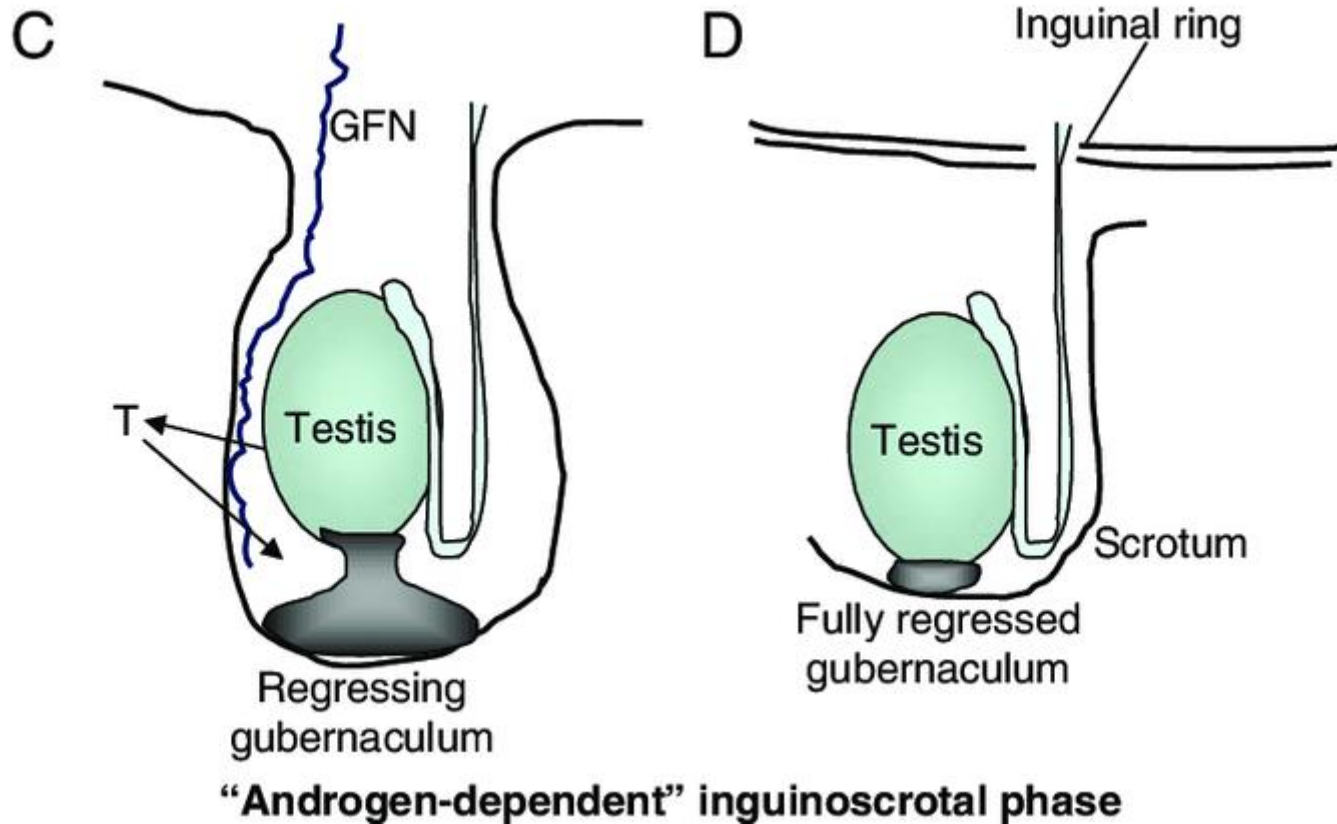
- Under influence of INSL3



“INSL3-dependent” transabdominal phase

1. Transabdominal / Outgrowth phase
 - Testis move from posterior abdominal wall to internal ring
 - Rapid swelling of gubernaculum -> dilate inguinal canal create pathway for descend

Embryology : Hutson biphasic model



2. Inguinoscrotal / Regression phase

- Testis move from internal ring to scrotum
- Gubernaculum remodeling -> fibrous structure
- Indirectly mediated by calcitonin gene related peptide (CGRP)
- Intra-abdominal pressure cause protrusion of processus vaginalis through internal ring -> transmit pressure to gubernaculum -> testicular descend

Transit through inguinal ring is rapid : start week 22 end week 27

Factor of UDT

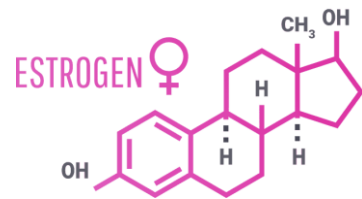
- Increased in boys with disease that effect androgen secretion or function



Anti androgen



- Rat of UDT in male offspring is 50%



- Associated with cryptorchidism

Embryology : Other mediators

- Mullerian inhibitor factor (MIF)
 - Resorption of Mullerian structure
- Calcitonin gene related peptide (CGRP)
 - Rhythmic contraction of cremasteric muscle
 - Subsequent gubernacular and testicular descend
- Epidermal growth factor
 - Placenta to enhance gonadotropin release -> secretion of descendin (growth factor for gubernaculum development)



Classification

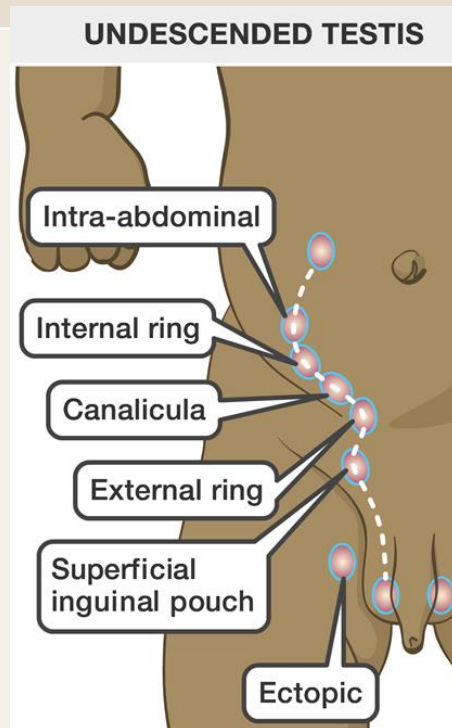
Classification

1. Palpable
 2. Nonpalpable
 - Simple intra-abdominal
 - Truly vanished due to intrauterine or perinatal torsion ->"monorchia", "anorchia"
-
- Retractable testis -> Not undescended testis
 - Normal descended testis that retract into inguinal canal due to cremasteric contraction
 - 1/3 become ascending UDT
 - Link between rate of height growth and ascended testis suggested significant growth spurt may be factor of retractile testis become undescended testis

Classification

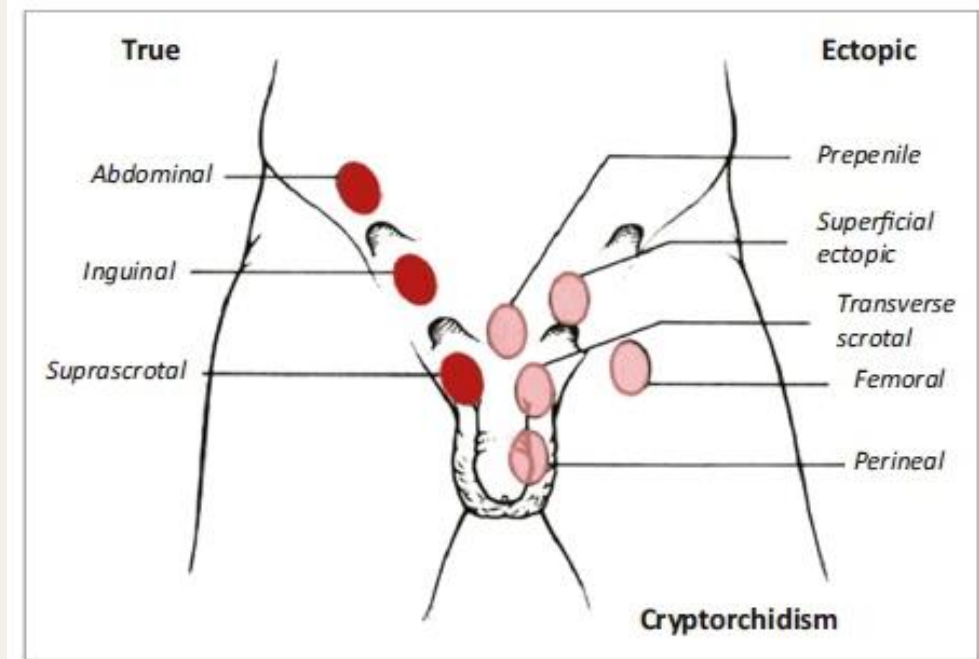
True UDT

Halted somewhere along normal path



Ectopic testis

- Located away from normal pathway can be found in, perineum, femoral canal, penopubic area, contralateral hemiscrotum
- Rare 0.1%



Classification

- Ascending/ acquired undescended testes

- Testis that was previously descended on examination, but cannot be brought down into scrotum at a later time
- Cause
 - Significant growth spurt may be a factor for retractile testis become ascending testis
 - Iatrogenic when descended testis trapped in scar tissue after inguinal surgery

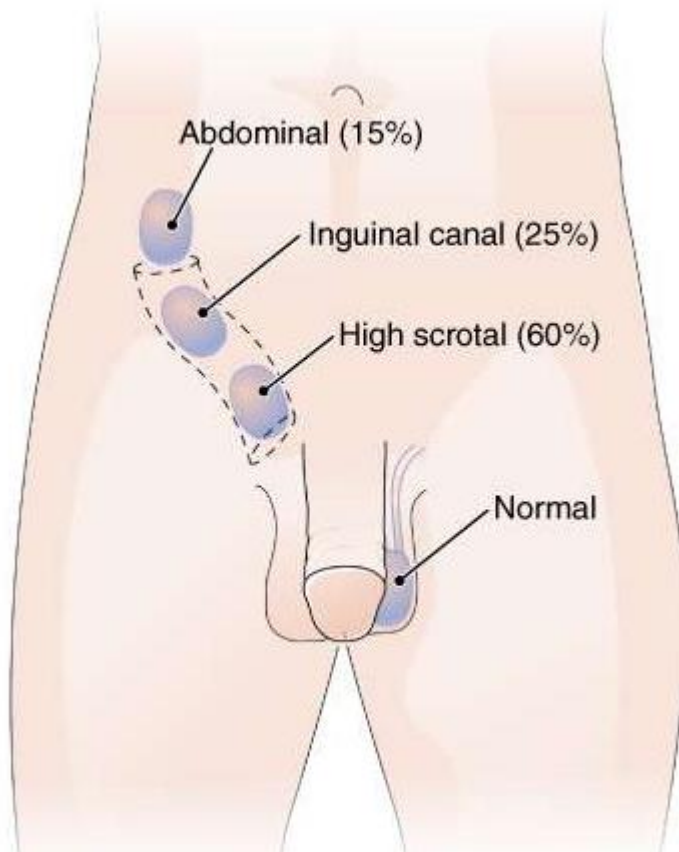
- Vanishing testes

- Result of a vascular or other insult to developing gonad
- Presence of vas deferens and vessels lying side by side in inguinal canal strongly suggested that a testis once existed and subsequently vanished
- Inguinal exploration should be done

Incidence



Incidence



- Approximately 3% of term male infants ,
- 33-45% of premature and/or low birth weight (< 2.5 kg)
- Testis usually descend within first 6-12 months , at 1 year incidence is down to 1%
- 2/3 to 3/4 of cases are palpable
- Location mostly within inguinal canal or distal to the external ring

Incidence

TABLE 62-2

Anatomical Position of 3064 Cryptorchid Testes in 2509 Boys Treated at Our Lady's Hospital for Sick Children, Dublin, Ireland (1969–1995)

Site	Number
Superficial inguinal pouch	2369 (77.3%)
Canalicular or abdominal	547 (17.8%)
Vanishing testis	105 (3.4%)
Absent testis	39 (1.3%)
Ectopic	4 (0.1%)

Association disorder

TABLE 62-1 Cryptorchidism in Congenital Malformation Syndromes

I Malformation syndromes with endocrine dysfunction

1. Syndromes with gonadotropin deficiency
 - Kalliman–De Morsier syndrome
 - Prader–Willi syndrome
 - Laurence Moon and Bardet–Beild syndromes
 - LEOPARD syndrome
 - Optiz syndrome
2. Syndromes with primary testicular failure
 - Noonans syndrome
 - Seckel syndrome
 - Enzyme disorders of testosterone synthesis
3. Persistence of Müllerian duct derivative syndrome

II Syndromes with cerebral and/or neuromuscular disorders

- Pena Schokeir syndrome
- Multiple Pterygium syndrome
- Distal Arthrogyriposis syndrome
- Miller–Dicker syndrome

III Syndromes with abnormalities of the anterior abdominal wall

- Prune belly syndrome
- Exomphalos
- Gastroschisis

IV Chromosomal Syndromes

- Syndromes involving chromosomes 4, 8, 9, 10, 13, 15, 18, 21, and 22

Associated anomalies

- Patent processus vaginalis
- Epididymal abnormalities
- Specific syndrome with higher rates of UDT
 - Prune-belly syndrome
 - Gastroschisis
 - Bladder extrophy
 - Prader-Willi
 - Kallman
 - Noonan
 - Testicular dysgenesis
 - Androgen insensitivity syndrome

Diagnosis



Diagnosis

- Aim to identify **presence** or **absence** of a palpable gonad
- Determine lowest position without tension
- Time : at birth, 3 month, 6 month of age

Diagnosis : Physical examination



nu118010 www.fotosearch.com

- In warm room ,supine and frog-legged position
- Observed hypoplasia, presence of either testis
- Monorchia -> compensatory hypertrophy
- Walk finger from iliac crest along inguinal canal towards scrotum
- Pushing subcutaneous structure toward scrotum
- Up to 20% of nonpalpable testis can be palpated under anesthesia

Diagnosis : Physical examination

- Observe whether testis can reside in the scrotum spontaneously

	Physical exam	Ipsilateral hemiscrotum
Retractile testis	<ul style="list-style-type: none">- Remain in place until displaced by cremasteric reflex- Normal size testis- History of testis resides spontaneously in scrotum	<ul style="list-style-type: none">- Fully developed
Low UDT	<ul style="list-style-type: none">- Retract back to its abnormal location once released	<ul style="list-style-type: none">- Underdeveloped

Diagnosis

Palpate but not in scrotum



Reexamined at 3 months of age



Descended within 12 weeks



Close observation

Diagnosis

Cannot palpate in
usual position



Ectopic testis should
be examined

Diagnosis

Neither testis
is palpable

Bilateral nonpalpable UDT

Anorchia

Androgen insensitivity
syndrome

Chromosomal abnormality

Masculinized 46,XX with
congenital adrenal
hyperplasia (CAH)

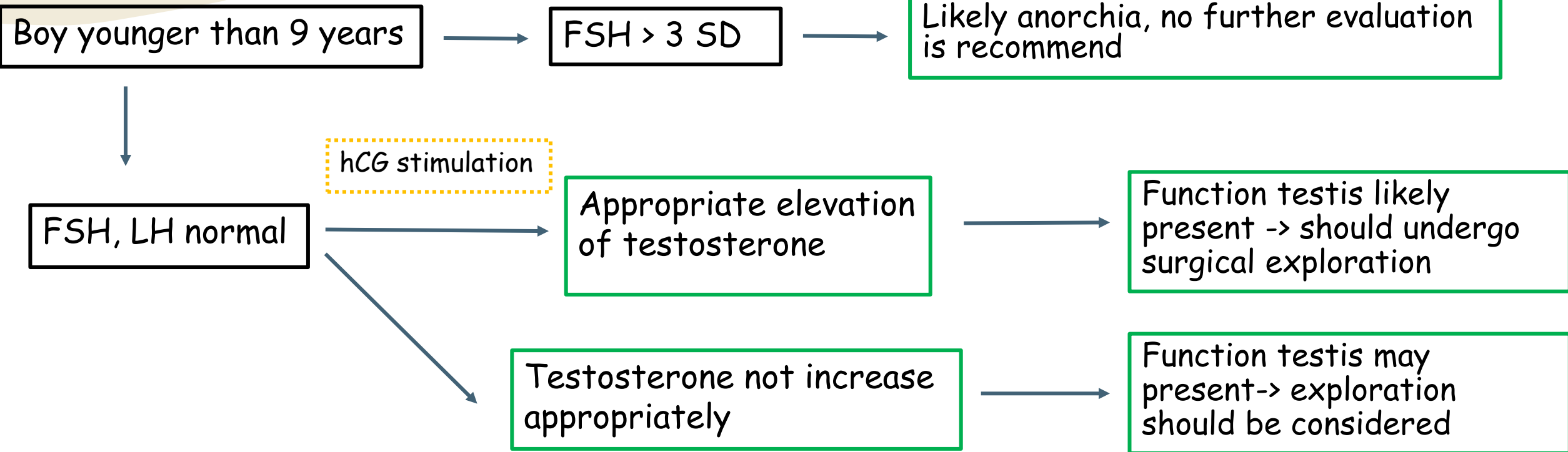
Salt wasting -> severe
electrolyte imbalance and
cardiovascular compromise

Diagnosis : Investigation

- In 46XY with anorchia to avoid unnecessary surgical exploration studies to determine **presence of viable testicular tissue**
 - Serum MIF
 - Inhibin B
 - Follicle-stimulating hormone (FSH)
 - Luteinizing hormone (LH)
 - Testosterone

Child <9-12 months absence of viable testis -> MIS and inhibin B should be undetectable

Diagnosis : Investigation



Diagnosis : Imaging

- Rarely helpful in determine the presence or location of an UDT
- May delay for surgical treatment
- Routine use is not recommended
- Bilateral nonpalpable testis -> MRI with gadolinium useful for detecting abdominal testis (bright on MRI)
- Ultrasonography
 - Low accuracy sensitivity 45% specificity 78%
 - Useful in locating extra inguinal testis in obese boys

Guideline Statement 6.

Providers should not perform ultrasound (US) or other imaging modalities in the evaluation of boys with cryptorchidism prior to referral, as these studies rarely assist in decision making. (Standard; Evidence Strength: Grade B)

Complication

- Temperature effect
- Endocrine effect
- Fertility
- Germ cell development
- Malignancy

Temperature effects

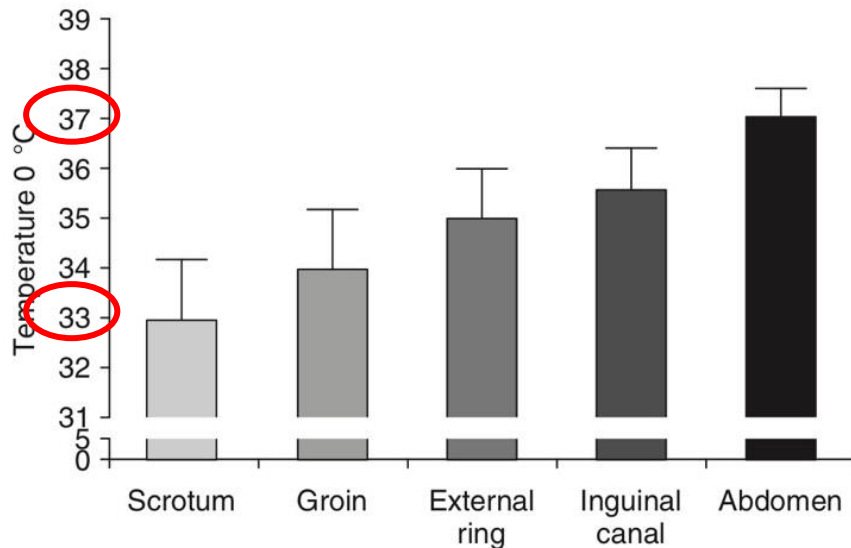


FIGURE 77-3 The temperature (mean \pm standard deviation) of the testis at different levels. (From Hutson JM, Beasley SW: Descent of the Testis. London, Edward Arnold, 1992.)

- Scrotal testis resides in low-temperature
- Regulate by temperature-sensitive muscles e.g. cremasteric and dartos muscle
- Immaturity of Sertoli cells in monkeys
- Undescended testis undergoes progressive alteration due to increased of temperature

Endocrine effect

- In rat testes : no gross abnormalities if surgical fixation before puberty

	Undescended	Normal
Post natal rise of LH	lower	
Post natal rise of testosterone	lower	
Mullerian-inhibiting substance	Not elevate	elevate

Germ cell development

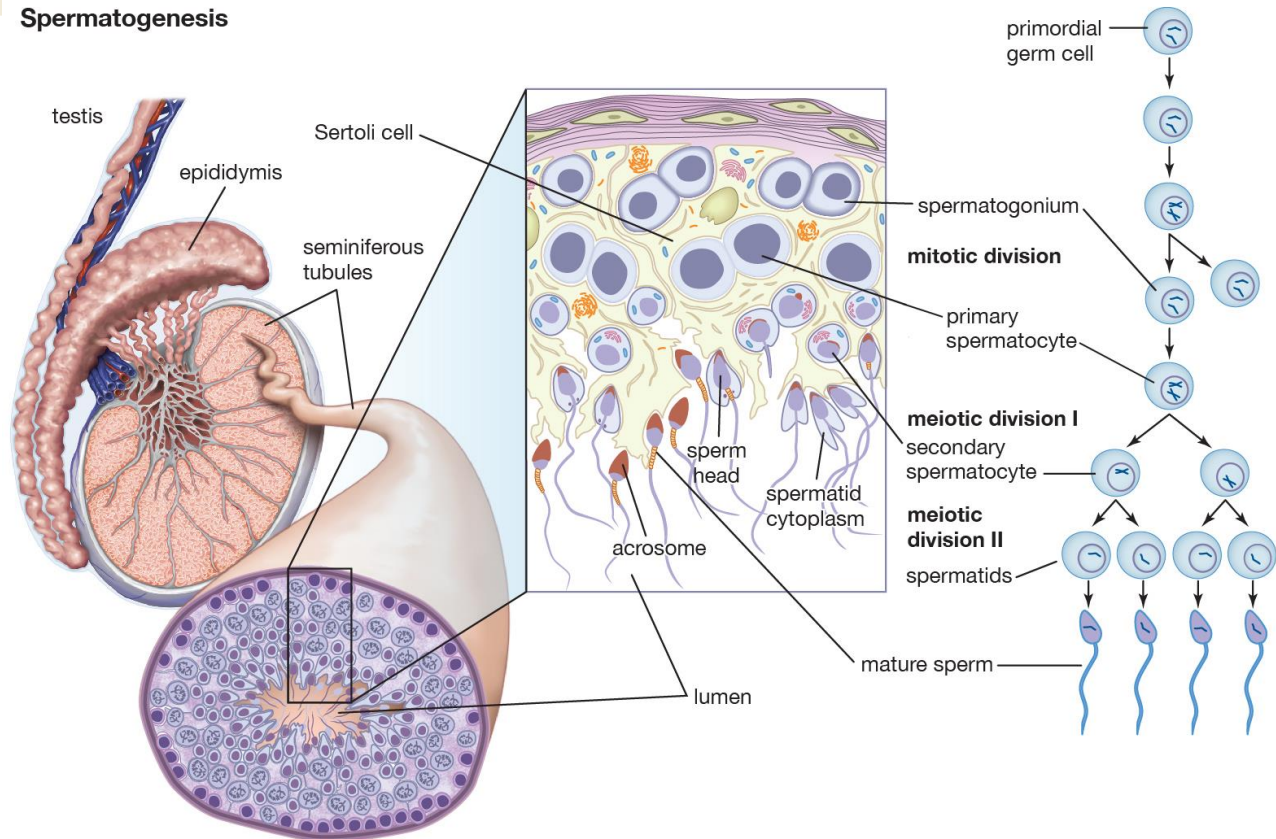
- Leydig cell development is impaired
- Sertoli and germ cell were normal
- Well established that cryptorchidism children impair of transformation of neonatal gonocytes to type A spermatogonia

Fertility

- Biopsies show abnormal histology in UDT
- Patient with history of UDT has subnormal semen analysis
- Fertility related to position of UDT
 - Abdominal or canalicular testis lower fertility than inguinal testis (83.3 % vs 90%)
- However infertility rate of unilateral testis is equivalent to normal population (10%)
- Bilateral UDT has paternity rate 50-60% even corrected early

Fertility

Spermatogenesis



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- Mechanism

- Associated with effect on Sertoli and Leydig cell
- Inhibit transport of already insufficient sperm

Fertility : Timing of orchiopexy

- Experimental in rat model
 - Preservation of germ cell number and spermatogenesis in early orchiopexy VS apoptosis in untreated
- Delay orchiopexy 3 years vs 9 months resulted in impaired testicular catch up

Fertility : Neoadjuvant hormone therapy

- Clinical trial Neoadjuvant LH-releasing hormone (LHRH) prior to orchiopexy improve fertility index (spermatogonia/tubule) still need confirmation
- Prospective RCT on neoadjuvant gonadotropin-releasing hormone prior to orchiopexy improve in mean fertility index
- The long-term outcome remains **largely unknown**
- It is not commonly practiced in many setting

Malignancy

- Associated 2-8 fold increased risk of malignancy
- Factor
 - Gonad's location : 1% inguinal , 5% abdominal testis
- Usually occur at the same age of normally descended testis (20-40 years)
- Most common cancer of abdominal testis is seminoma (74%)
- Most common cancer after successful orchiopexy is non-seminomas (63%)
- In testicular tumor patient 10% have history of UDT

Risk of malignancy : Theories

1. "Position" theory
2. "Common cause" or "Testicular dysgenesis" theory

1. Position theories

- Implicate the **carcinogenic potential** of the altered micro and macroenvironment of the UDT
- **Timing of correction** could lessen development of malignancy
- **Meta-analysis**
 - Orchiopexy after 10 years of age compared with before age of 10 was associated 6 times risk of malignancy
- Association between age need further verification
- Placing testis in accessible location help with early cancer detection

Position theories

Age at Surgery for Undescended Testis and Risk of Testicular Cancer

Andreas Pettersson, M.D., Lorenzo Richiardi, M.D., Ph.D.,
Agneta Nordenskjold, M.D., Ph.D., Magnus Kaijser, M.D., Ph.D.,
and Olof Akre, M.D., Ph.D.

- Cohort studies of 16,983 Swedish men of surgically treated UDT
- Results : 56 cases of testicular cancer
- Having orchiopexy before age 13 years had 2.23 relative risk of testicular cancer compared with the Swedish general population
- For those treated at 13 years of age or older, the relative risk was 5.40
- Conclusion : Treatment for undescended testis before puberty decreases the risk of testicular cancer

2. “Common cause”/ “testicular dysgenesis”

- Malignancy risk may be due to an **underlying genetic** or **hormonal etiology**
- 15-20% UDT, testicular tumor arise from normally contralateral testis
- Normally descended testis in UDT still carries increased relative risk of malignancy 1.7
- Carcinoma in situ (CIS)
 - 2-4% in men with cryptorchism VS < 1 % in non-affected men
 - Postpubertal male, CIS progress to invasive germ cell in 50% of cases within 5 years
 - Repeat biopsy after puberty still unclear for benefit of cancer prevention



Treatment

Management

Guidelines (AAP 1996 and EAU 2012)

- Orchiopexy should be performed **by 12-18 month** of age
- Gonad is unlikely to descend after 6-12 months of age , no benefit from waiting

AUA 2014

- Referred by 6 months
- Orchiopexy performed by 18 months

- If symptomatic hernia is present , can earlier repaired
- Risk of general anesthesia after 6 month is acceptably low with pediatric anesthesiologists

Management

- Advantages of early scrotal placement
 - Reduce risk of malignancy
 - Infertility
 - Reduce risk of torsion
 - Facilitates testicular examination
 - Improves endocrine function of testis
 - Creates normal-appearing scrotum

Hormonal treatment

- Still controversial
- Some center in Europe use **Buserelin (LHRH agonist)** : highest success rate in case testis is at or distal to the external ring -> **now has not been approved by U.S Food and Drug administration**
- Other recommend low-dose hCG therapy to restore normal endocrine milieu and enhance germ cell maturation
- Combination of hCG and buserelin yield success rate 60% , still required orchiopexy 40%

AUA 2014 does not recommend use of hormonal therapy to induce testicular descent

Surgical treatment : Orchiopexy

- Operative approach UDT depends on whether testis is palpable
- 18% of nonpalpable testis became palpable under anesthesia
- Routine biopsy **is not recommended**, but may provide prognostic information of fertility

Orchiopexy vs orchiectomy

- Unilateral palpable UDT after puberty
 - Orchiopexy
 - Orchiectomy - due to frequent lack of spermatogenesis

Candidate for orchiectomy

- Orchiopexy is difficult and normal contralateral testis is present
- UDT is abnormally soft and small
- Post-pubertal
- Unilateral intra-abdominal UDT

- Laparoscopic orchiectomy is ideal in this setting
- In postpubertal males with significant anesthetic risk or older than 50 -> observation is acceptable

Diagram of treatment

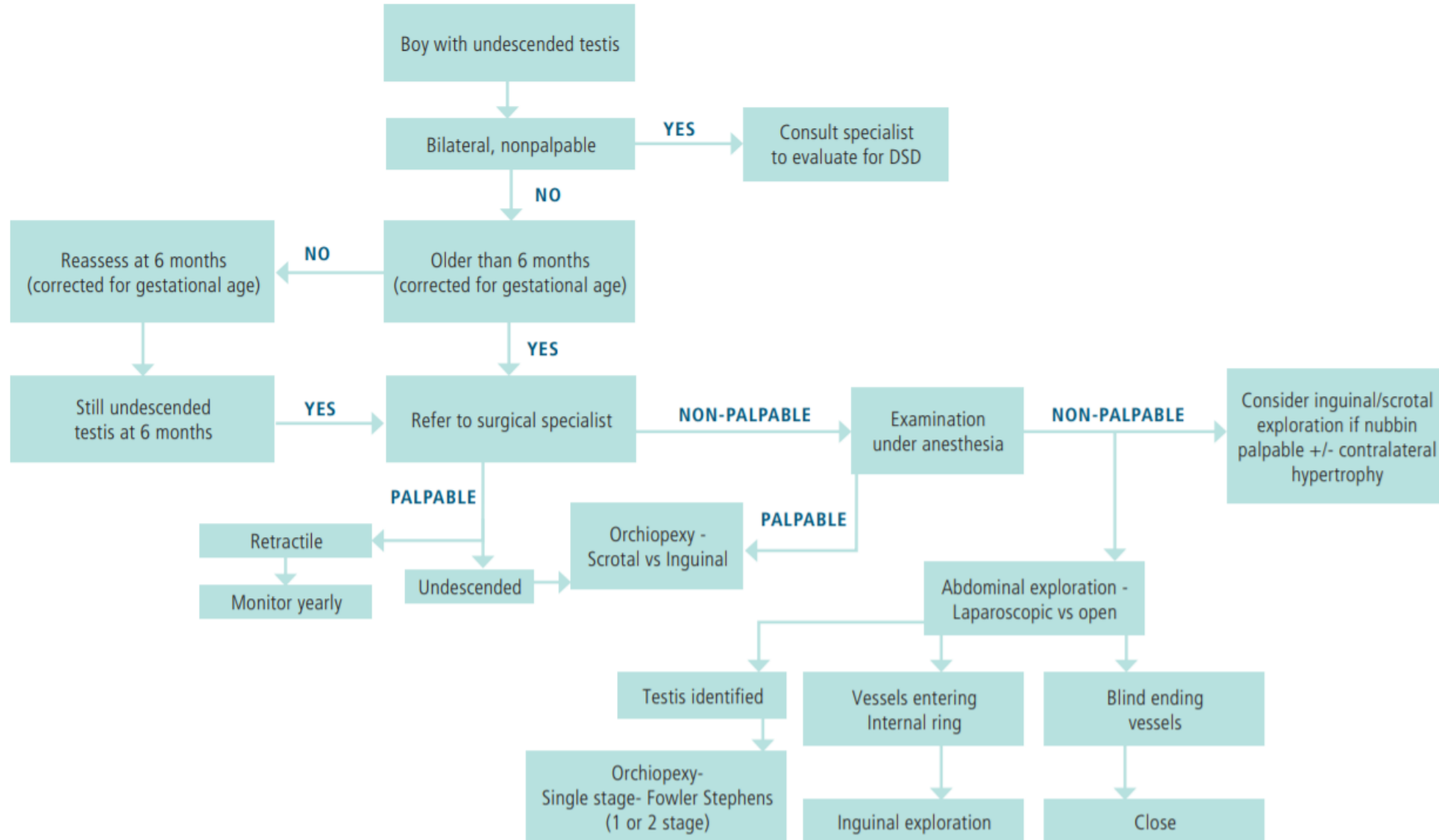
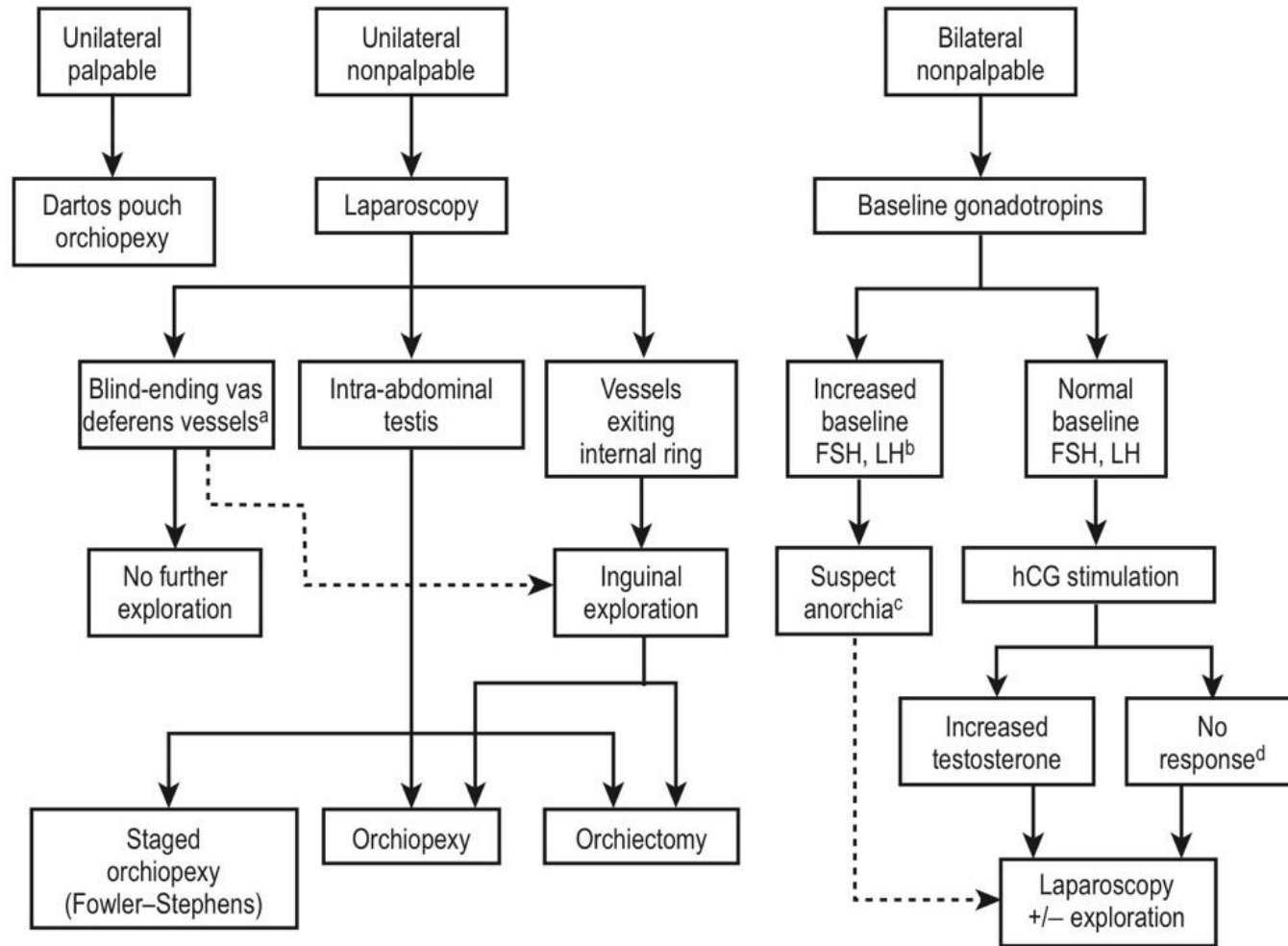
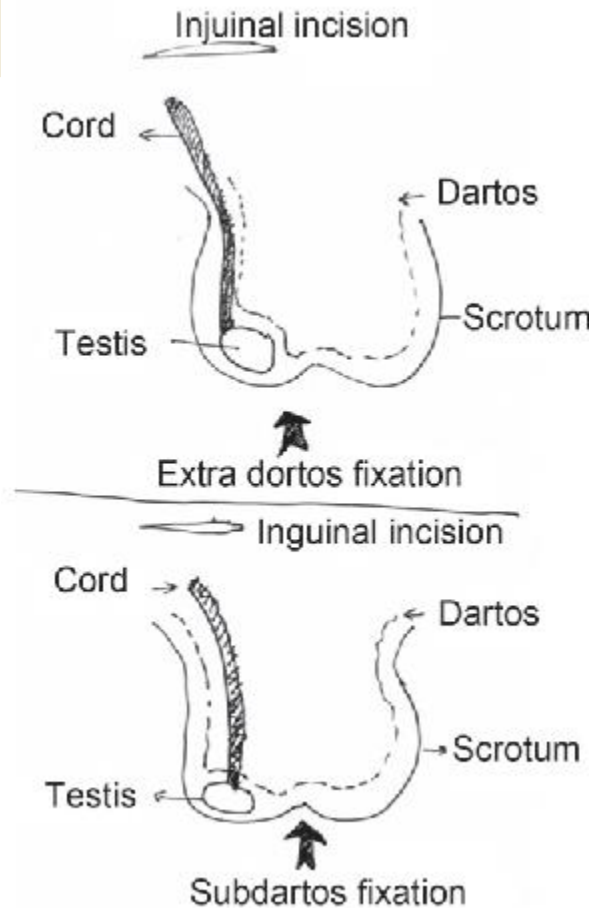


Diagram of treatment



FSH,LH elevated if > 3 SD

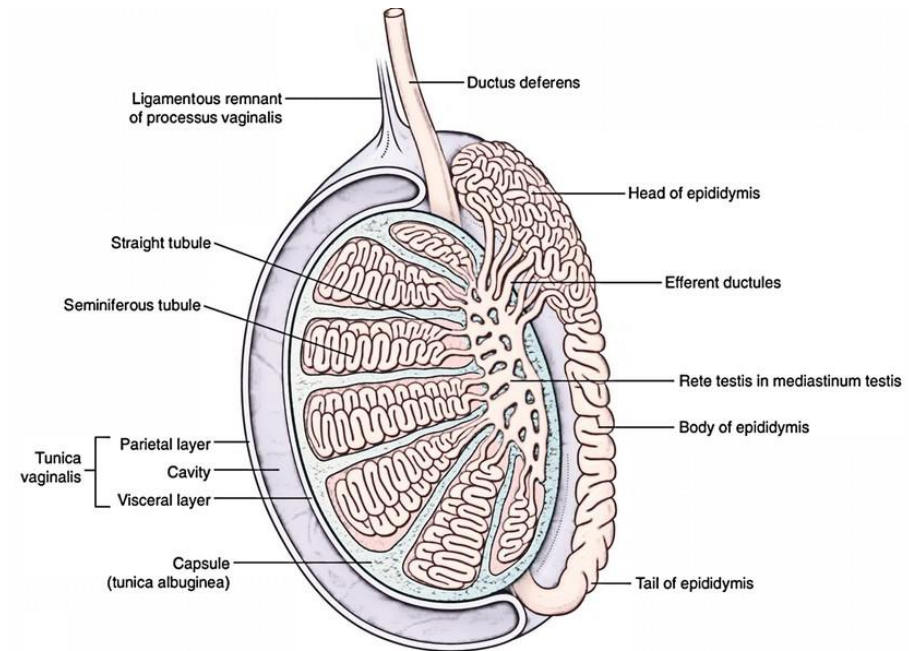
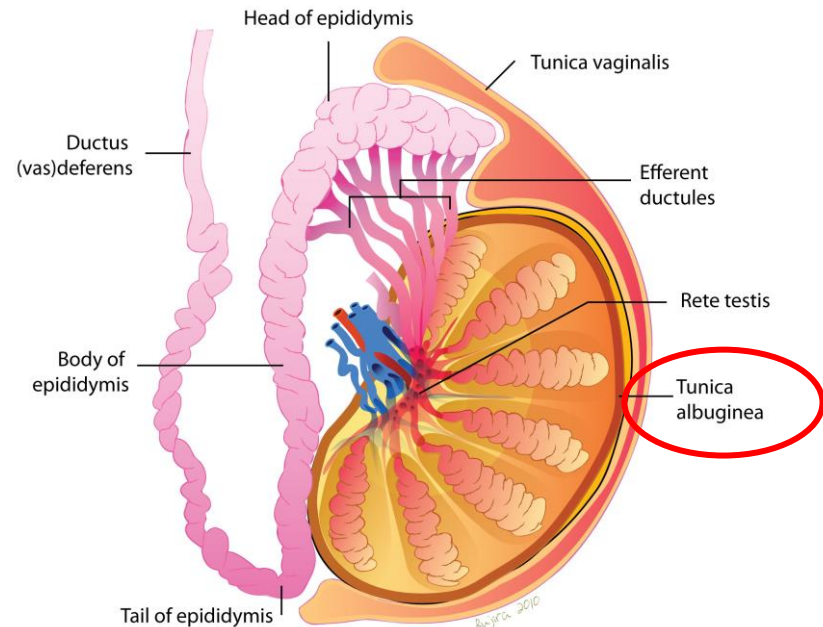
Palpable undescended testes : Unilateral or bilateral



- Mainstay is orchiopexy with creation of subdartos pouch
- Incision
 - Standard two-incision (inguinal and scrotal) -> success rate 95%
 - single-incision high scrotal approach
- Scrotal fixation is achieved by scarring of the everted tunica vaginalis to the surrounding tissue

Palpable undescended testes : Unilateral or bilateral

- Fixation in tunica albuginea is debated due to potential for causing testicular inflammation -> increased infertility risk, damage intratesticular vessel
- Finding of open processus vaginalis or hernia should be repaired



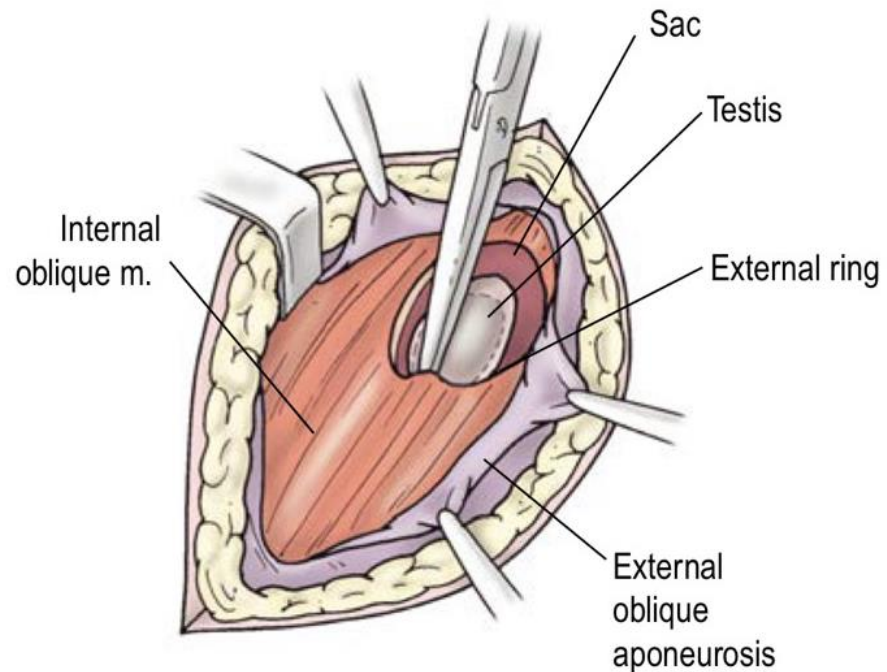
Operative technique

- Position - supine
- Intraoperative ilioinguinal nerve block with bupivacaine
- Incision - along one of the Langer lines over internal ring

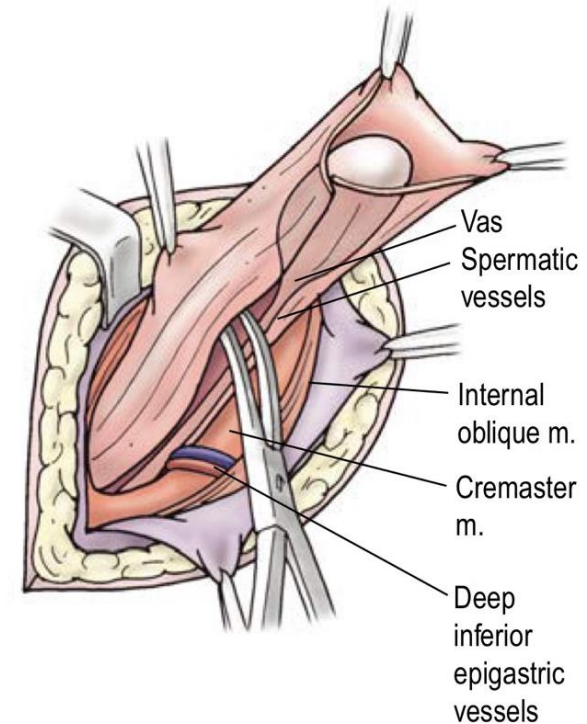


Operative technique

- External oblique aponeurosis is incised in same direction of fiber, aware of ilioinguinal nerve

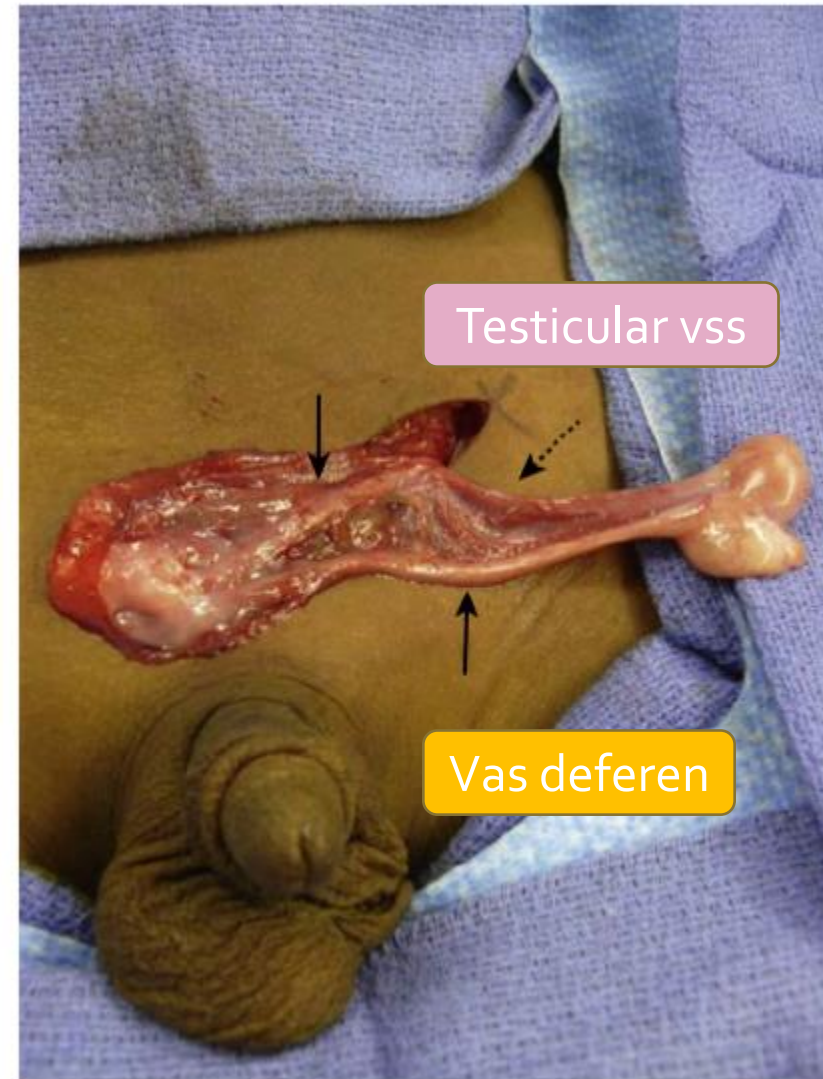


- Testis and spermatic cord are freed from canal, cremasteric and ectopic gubernacular attachment
- Testis is delivered, patent processus vaginalis is opened distally near testis

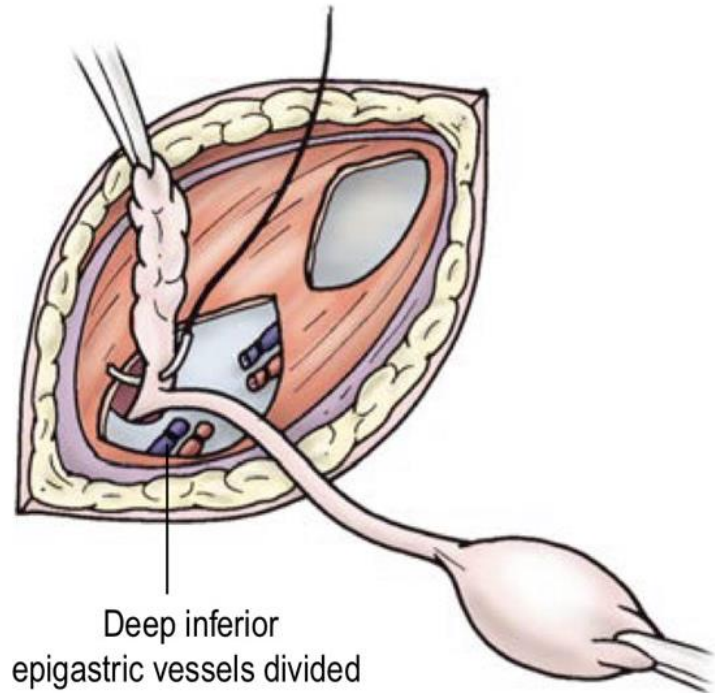


Operative technique

- Long-looping vas can hinder mobilization and difficult to locate testis in the mid to lower scrotum

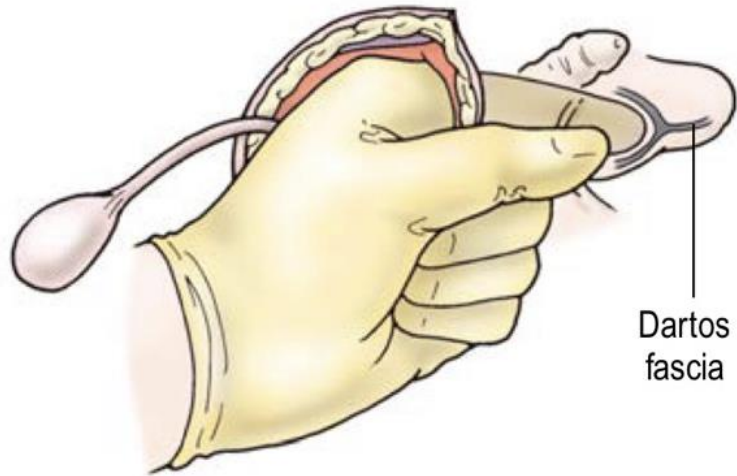


Operative technique



- Processus vaginalis is separated from cord structure, suture ligated and amputated
- If additional length is required
 - Inferior epigastric vessel may be ligated (Prentiss maneuver)
 - Retroperitoneal resection through internal ring

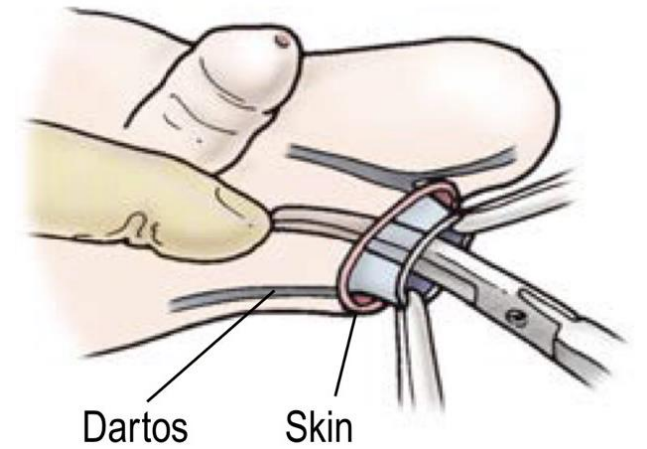
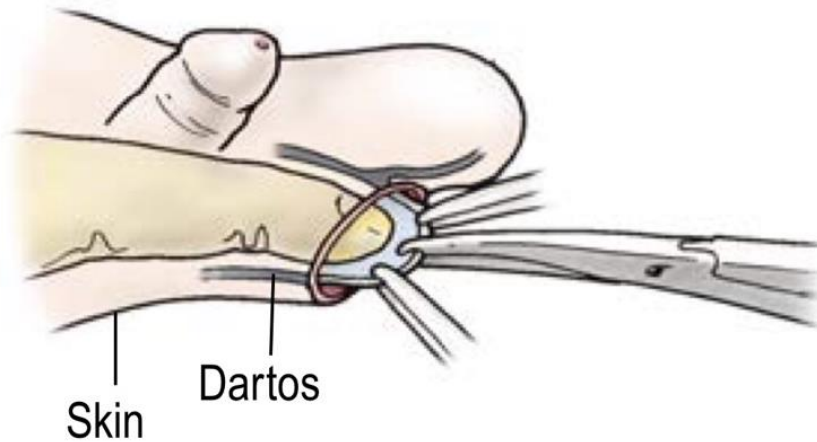
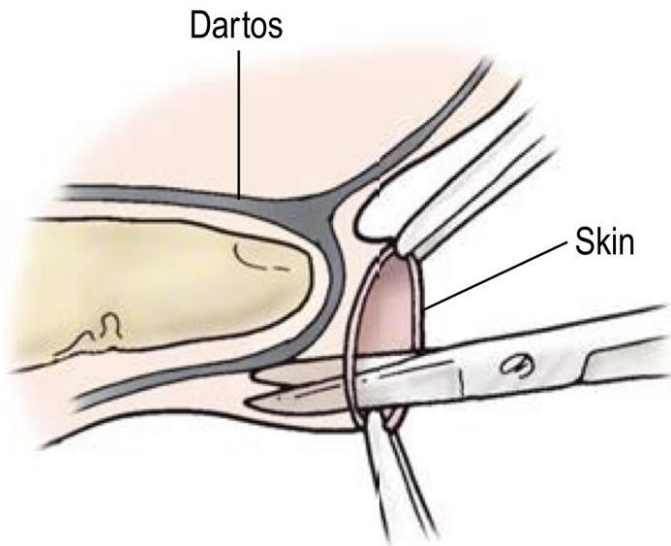
Operative technique



- A tunnel is created from inguinal canal into scrotum using finger or large clamp

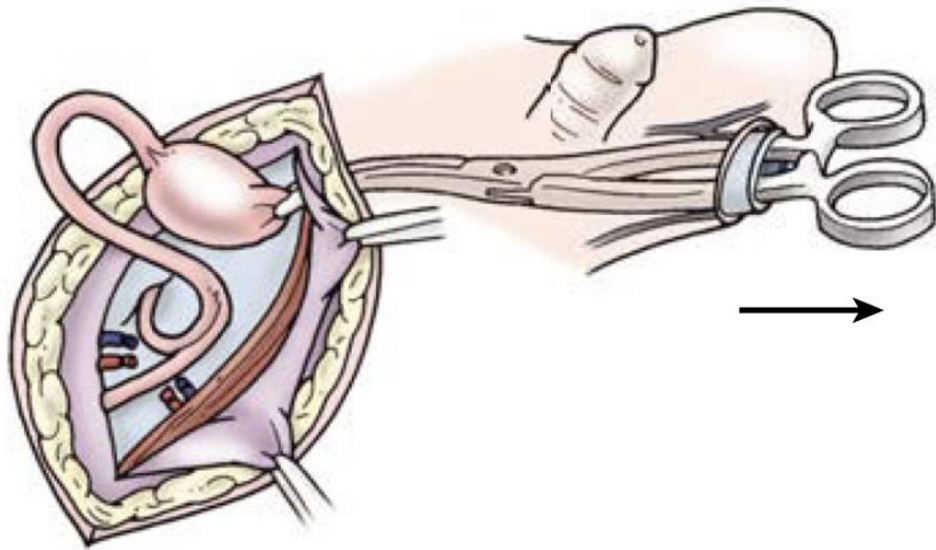
Operative technique

- Subdartos pouch is created, making incision in the scrotum
- Passage of clamp through the scrotum into inguinal canal

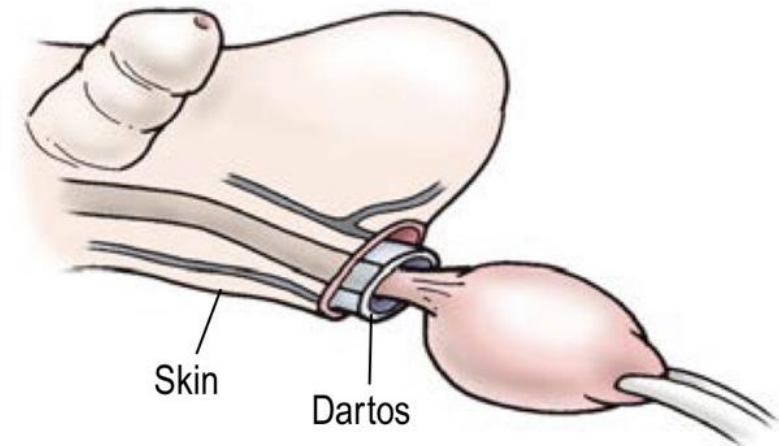


Operative technique

- Adventitial tissue of testis is grasped with the clamp

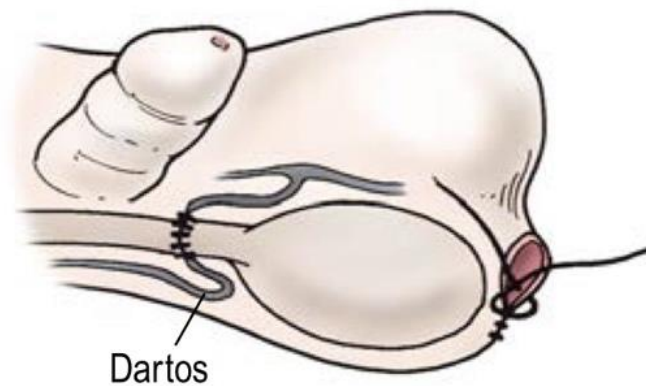


- Testis is brought into the dartos pouch
- Testis measurement and biopsy can be done if desired



Operative technique

- Suture is used to narrow the neck of the pouch
- Dartos fascia and skin are closed with absorbable suture
- External oblique aponeurosis is reapproximated to restore inguinal canal

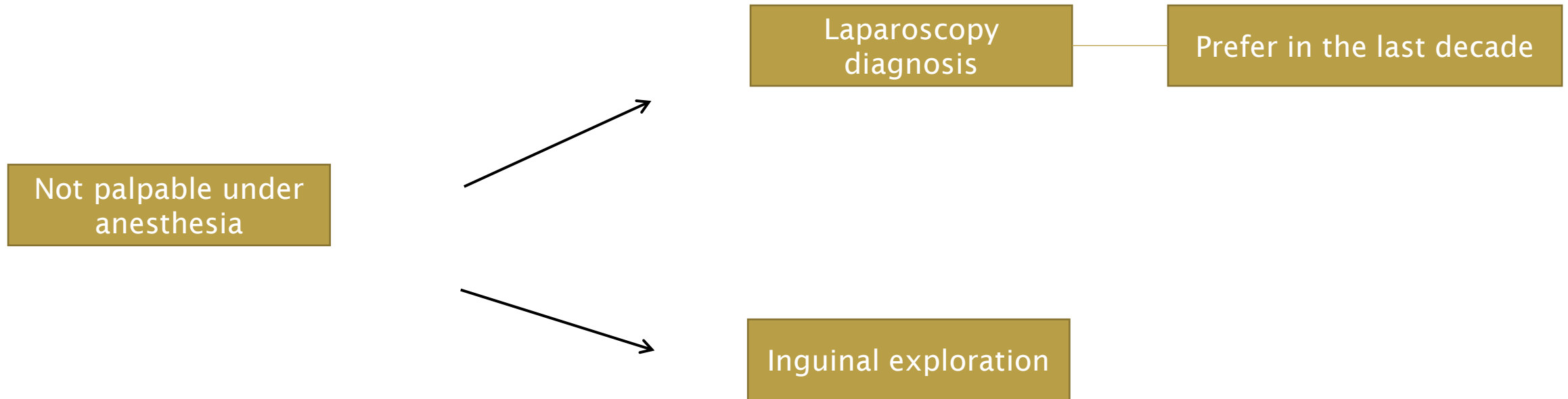


Post operation

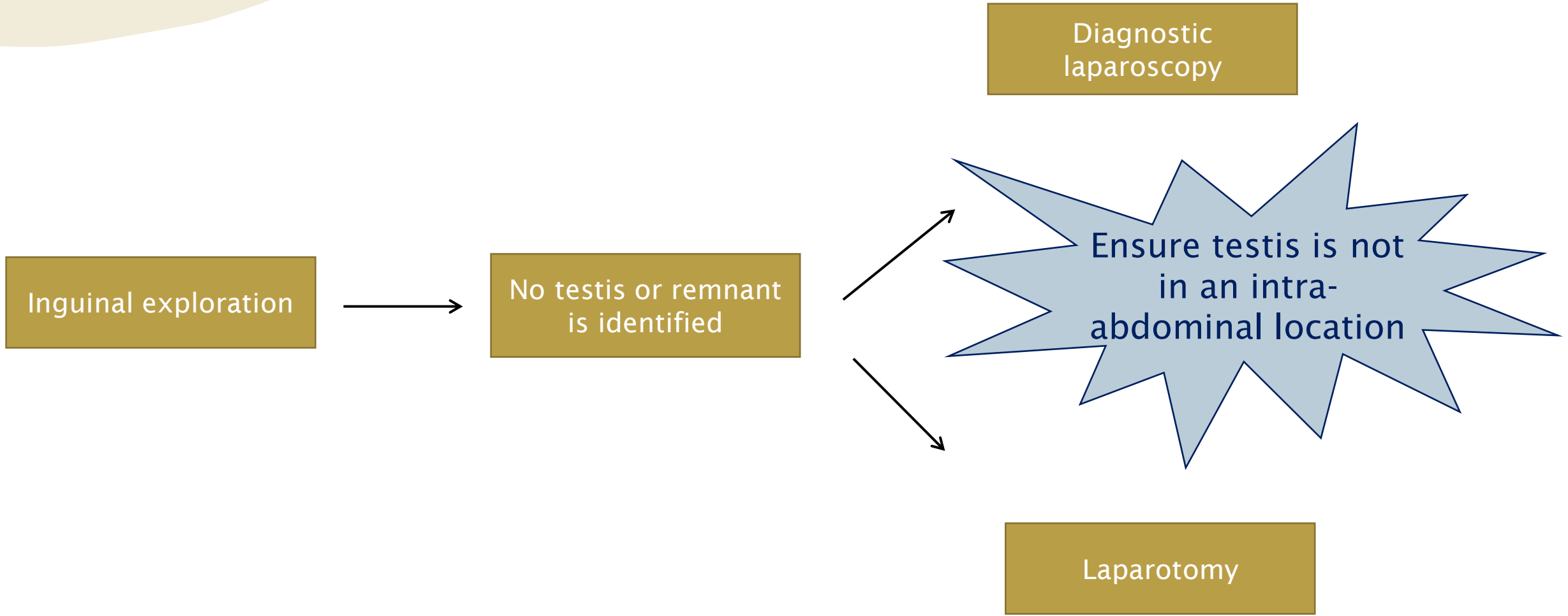
- Check wound after few week
- Testicular examination after several month
- Instruction on testicular self-examination
- Advice on complication atrophy, retraction, fertility and cancer risk

Nonpalpable undescended testis : Unilateral or bilateral

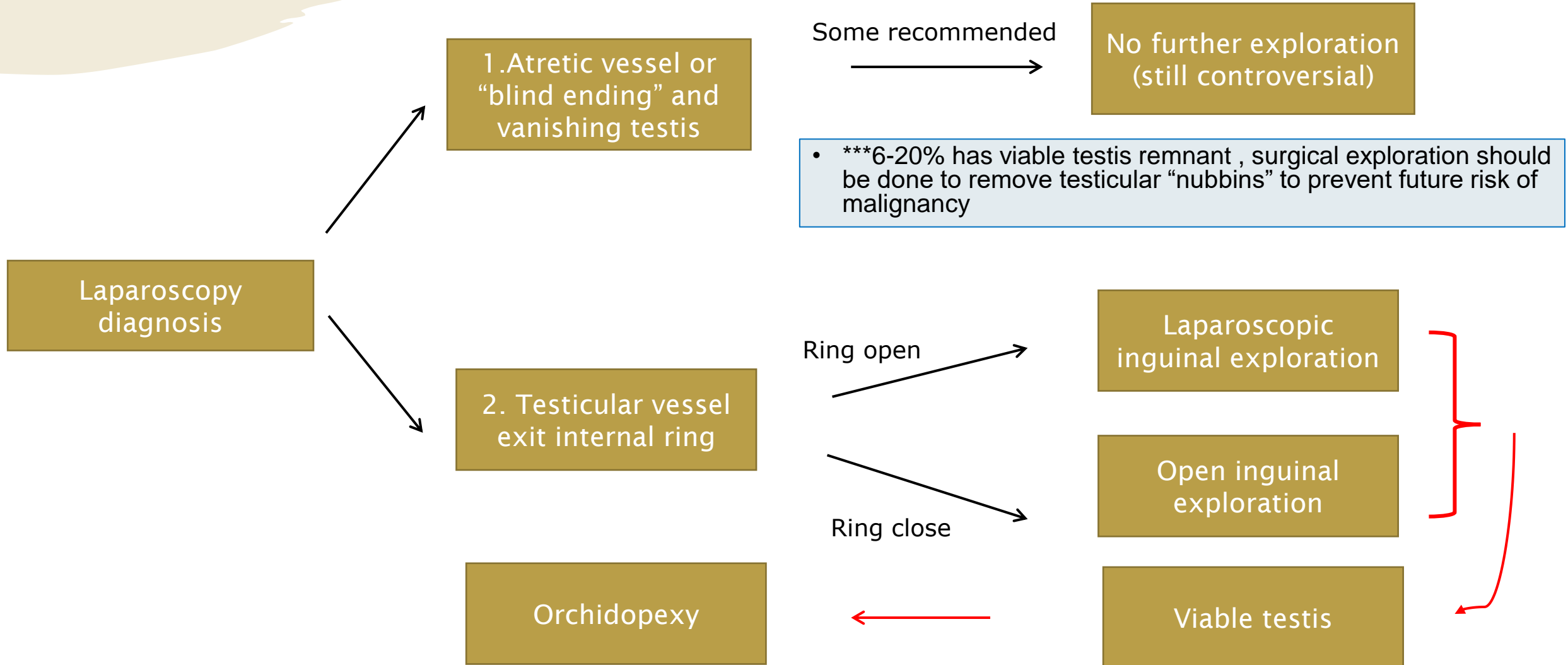
- Unilateral UDT that is not palpable under anesthesia

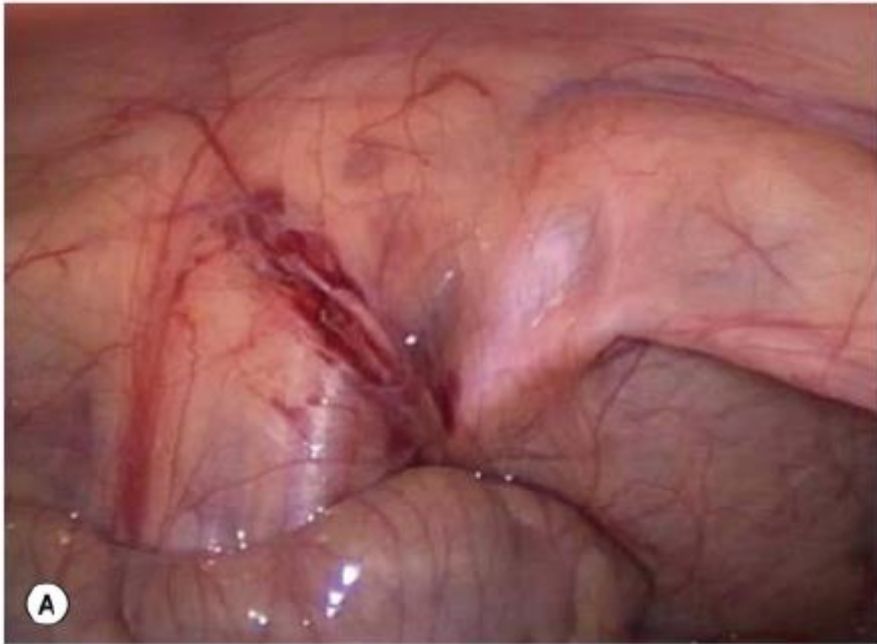


Unilateral nonpalpable undescended testis



Unilateral nonpalpable undescended testis





- Vas deferens and testicular vss end blindly in retroperitoneum
- Internal ring is closed



- Testicular vss and vas enter inguinal canal
- No evidence of patent processus vaginalis

Unilateral nonpalpable undescended testis

3. Viable intra-abdominal testis

Gonadal vessel long enough for tension free mobilization into scrotum

Open or laparoscopic orchiopexy

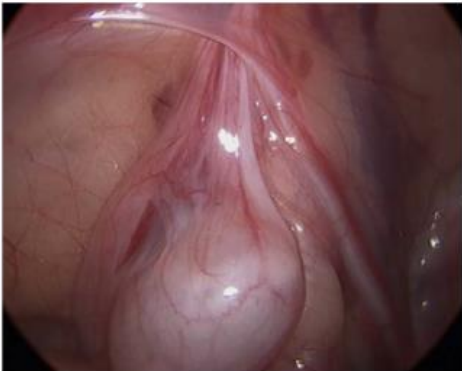
*** No optimal surgical technique -> preservation of the spermatic vessels is preferable whenever possible

Prentiss maneuver

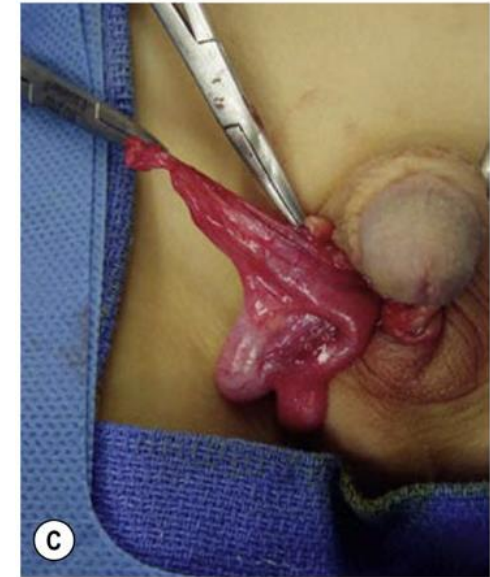
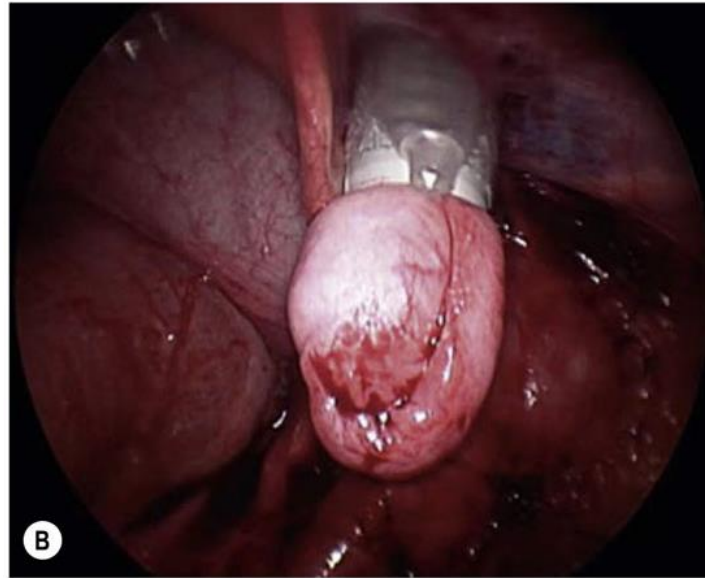
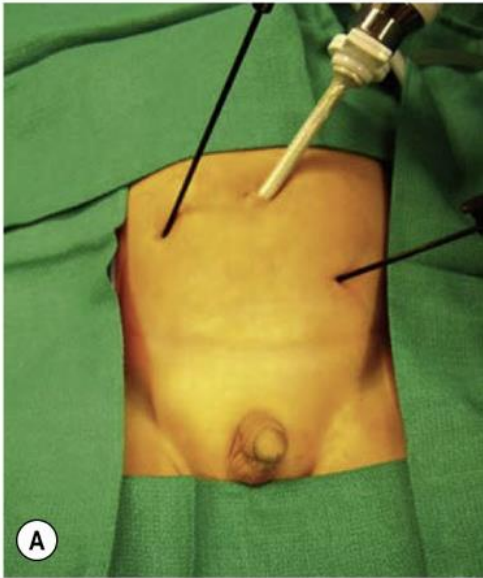
Gonadal vessel is too short

Stage orchiopexy

Two-stage Fowler-Stephens orchiopexy



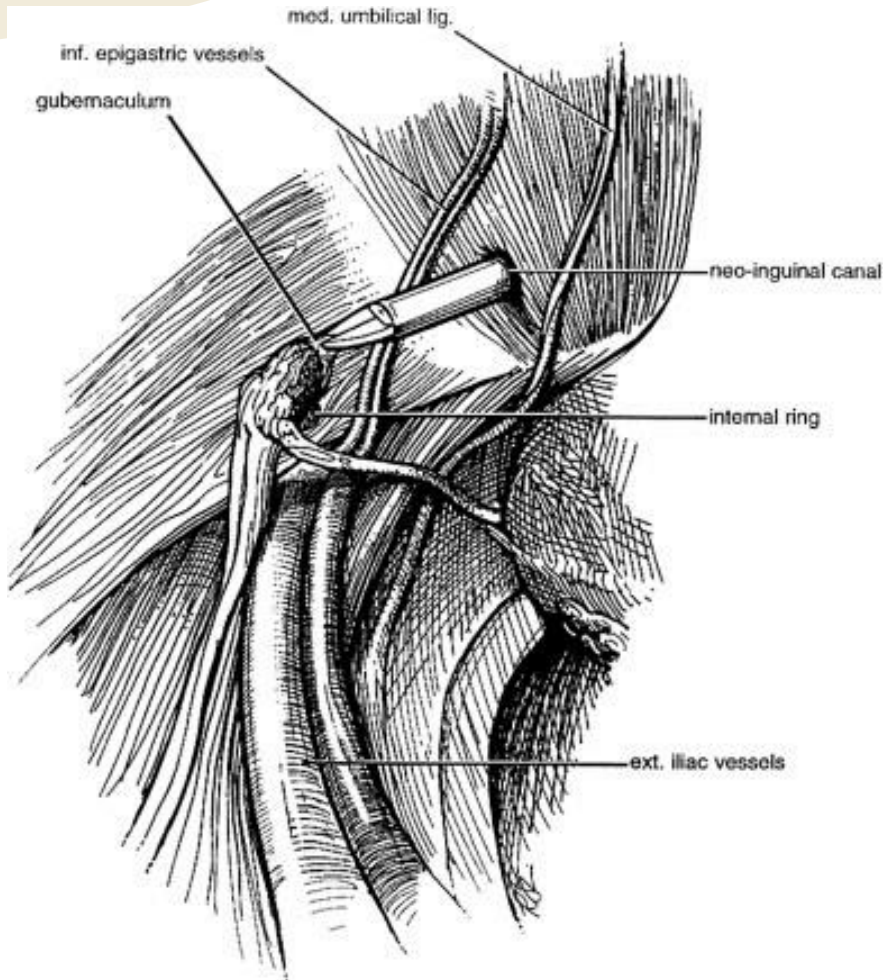
Laparoscopic orchiopexy



- Gubernaculum has been grasped by forcep introduced through scrotal incision
- Testis then withdrawn into cannula

- Testis and cannula are delivered over pubic tubercle and into right hemiscrotum

Single stage : Prentiss maneuver



- Create neoinguinal ring medial to inferior epigastric artery to shorten the path for scrotalization of the testis
- Prentiss manoeuvre increases the effective length of the spermatic cord by an average of 1 cm in most children
- Success rate 95-100%

Two-stage orchiopexy

- **First-stage**

- High abdominal testis and cord structures is first mobilized as low as possible

- **Second stage**

- 6-12 months later mobilization into scrotum

- **Advantage** -> Preserve both primary and collateral blood
- However in second stage, injury may occur due to scarring from surround tissue -> not adequate length

Shehata : staged laparoscopic traction-orchiopexy

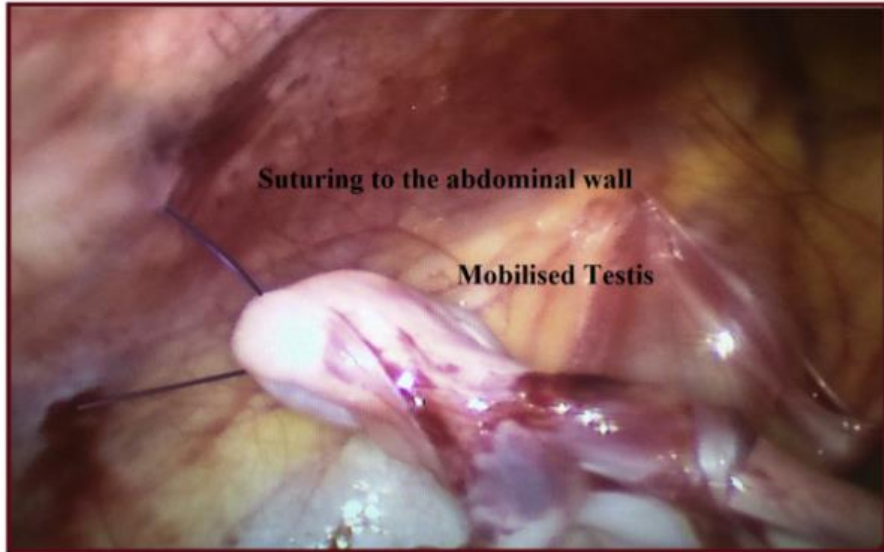
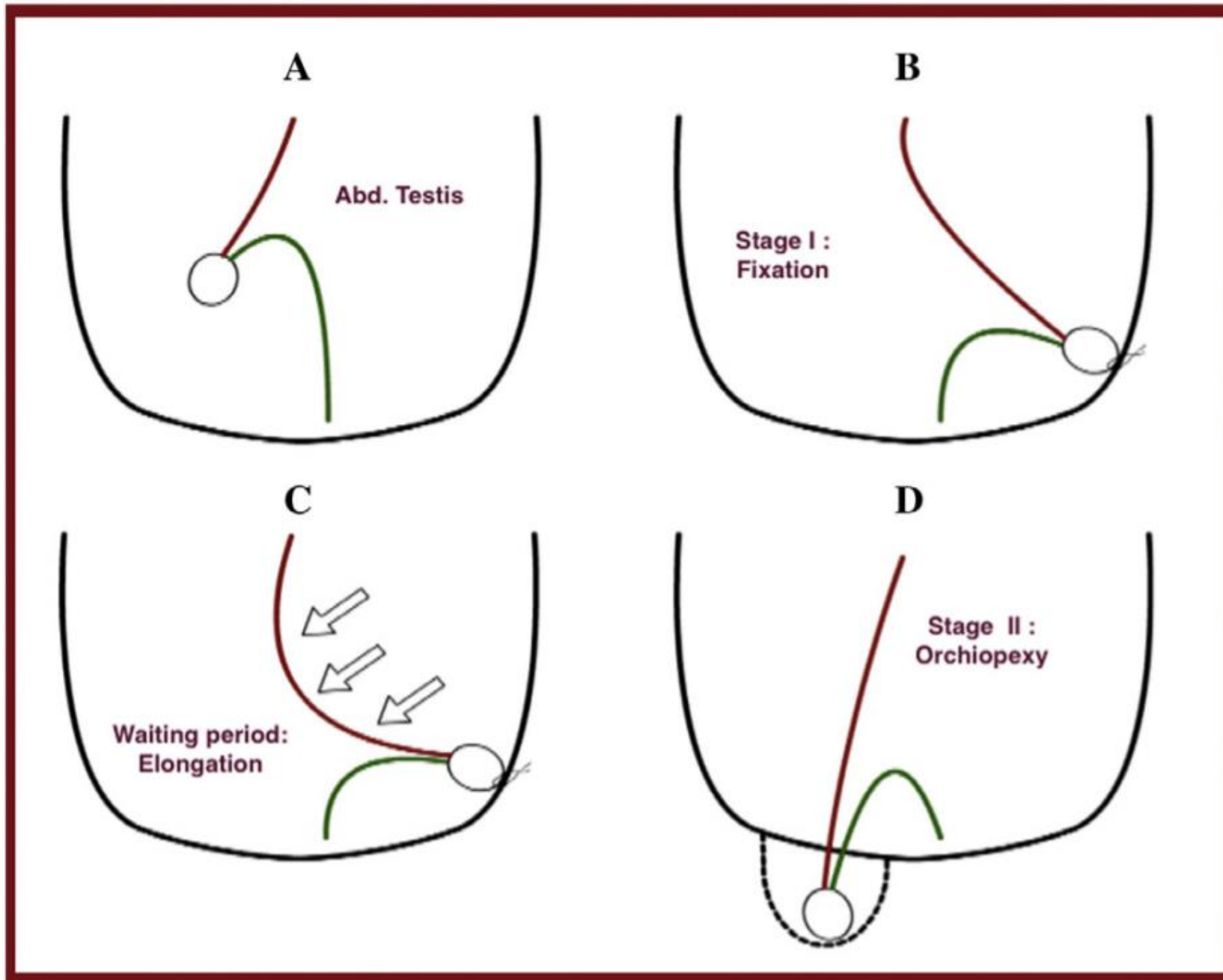


Fig. 2. Traction stitch applied to the testis and passed to the outside 1 inch above and medial to the contralateral ASIS.

- A laparoscopic staged traction procedure that does not require vessel ligation
- First stage
 - Gubernaculum is released
 - The testis is then suture fixated to the anterior abdominal wall to allow spermatic cord vessels stretch over period of time for several month

Sheha

exy



Shehata : staged laparoscopic traction-orchiopexy

- Second stage
- Approximately 12 weeks later, anchoring suture is removed and a laparoscopic mobilizes the testicle into the scrotum (preserving the spermatic vessels)
- Early success rate are 84%
- Higher success in younger patients, but longer term studies are still needed.

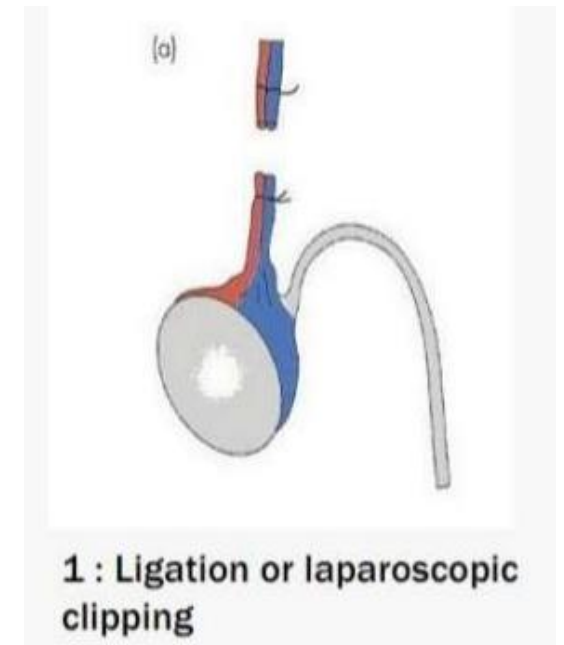
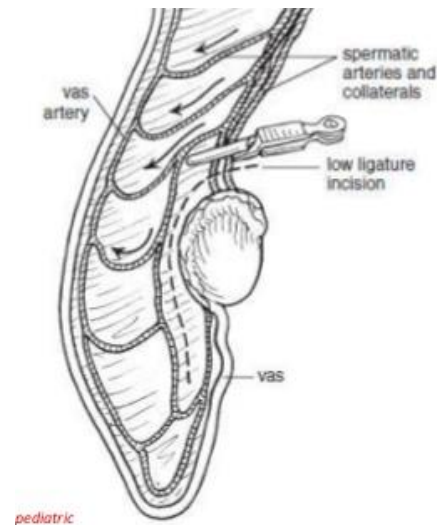
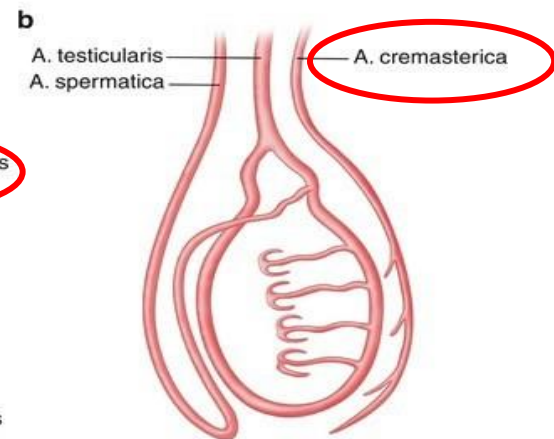
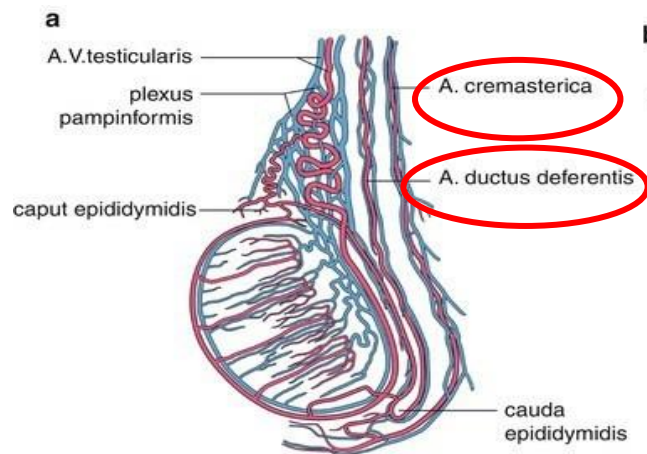
Two-stage Fowler-Stephens orchiopexy

- **First-stage**

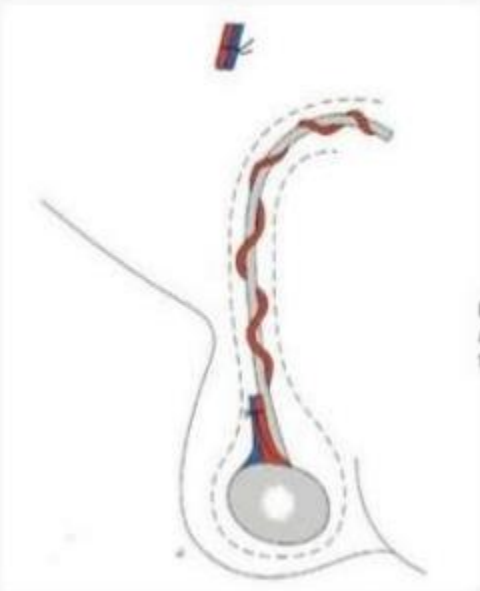
- Clipping and division of spermatic vessel -> testis dependent on vasal and cremasteric vessel

- Contraindication

- Prior inguinal exploration due to vascular blood supply may be disrupted



Two-stage orchiopexy



2 : 6 months mobilised on vas with collateral vascularisation .

- **Second stage**
 - Delay **at least 6 months** to allow full development of collateral circulation
 - Testis is maximally mobilized and positioned within the scrotum
- The success rate in modern single-center case series with follow-up longer than 3 years is between 80% and 90%

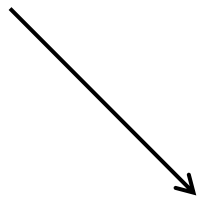
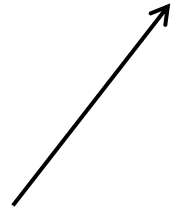
Unilateral nonpalpable undescended testis

Laparoscopic orchidectomy

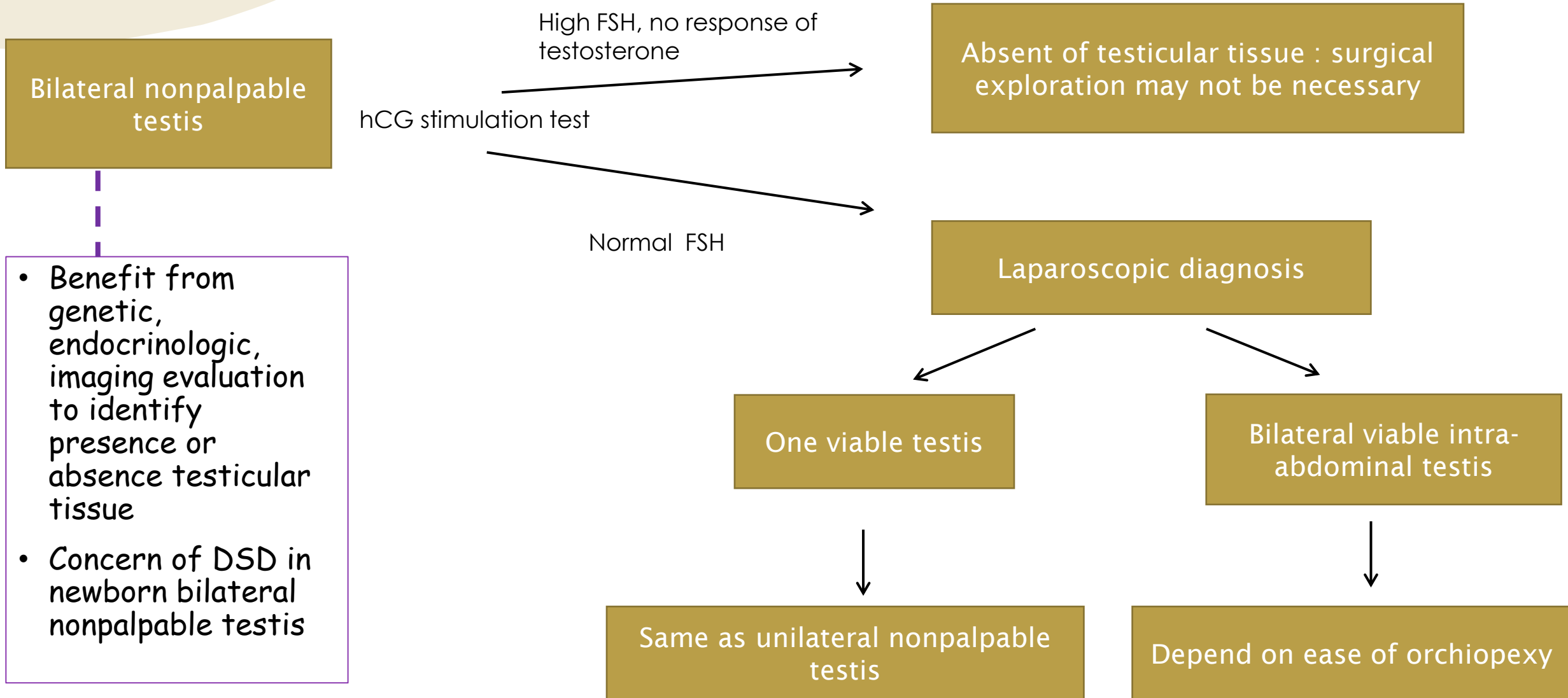
- Role of contralateral fixation in cases of monorchism is still debate

Atrophic testis in
abdomen or inguinal
canal

Open orchiectomy



Bilateral nonpalpable undescended testis



Bilateral nonpalpable undescended testis

Fixed one side first , contralateral side 6-12 month later

Bilateral
intraabdominal testes

Bilateral one-stage or two-stage orchiopexies

Secondary or iatrogenic undescended testis

- Uncommon complication of inguinal hernia repair, orchiopexy, hydrocelectomy



Complication of orchiopexy

Complication

- Risk of complication after orchiopexy is less than 5%
- Most common complication is wound infection > hematoma

TABLE 77-1

Complications of Orchidopexy

Failure of testis to reach scrotum
Secondary atrophy of the testis
Retraction of testis out of scrotum
Occlusion of vas deferens
Hemorrhage
Wound infection

Post operative management

- Reexamined 1-2 weeks later to remove dressing and assess short-term outcome
- Further follow up 6-12 months later to determine atrophy or secondary malposition



Outcomes

Outcomes : Testicular size

- Testicular volume in adults is lower than normal
- 159 patient operated at mean age of 9.8 years
- 19 abdominal testis avg volume 4.9 ml, canalicular testes 9.8ml, superficial inguinal pouch testes 17 ml

Outcomes : Fertility after orchidopexy

- Successful paternity
 - 81 % of unilateral cryptorchidism
 - 50% of bilateral cryptorchidism
- Semen analysis

Outcomes : Malignancy

- At present, no accurate data whether early orchiopexy reduces risk of testicular cancer
- Risk of malignancy for acquired undescended testes is low

Good prognosis	Poor prognosis
Testis near neck of scrotum	Primary dysplasia of testis or epididymis
Ascending or retractile testes	Intra-abdominal or intra-canalicular testis
Possibly operation in early infancy	Assoc with strangulated hernia
	Possibly delayed operation