THE RADIOLOGICAL PATTERN OF MALE URETHRAL STRICTURES IN NAIROBI

A PROSPECTIVE STUDY AT KENYATTANATIONALHOSPITAL AND THE PLAZA IMAGING SOLUTIONS

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THESIS SUBMITTED IN PART FULFILLMENT FOR THE DEGREE OF MASTER OF MEDICINE IN DIAGNOSTIC RADIOLOGY

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DECLARATION

PRINCIPAL INVESTIGATOR

This thesis is my original work and has not been presented for the award of a degree in any other university.

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LIST OF ABBREVIATIONS

ACU- Ascending Cystourethrography

KNH-KenyattaNationalHospital

CT- Computerized Tomography

MRI – Magnetic Resonance Imaging

SPSS- Statistical Package for focal scientists

MBBS – Bachelor of Medicine and Bachelor of Surgery

MCU- Micturating Cystourethrography

MBChB – Bachelor of Medicine and Bachelor of Surgery

MMED – Masters of Medicine

NBI- Nairobi

PUDD- Posterior Urethral Distraction Defect

UK – United Kingdom

USA – Unites States of America

HDRB – High Dose Rate Brachytherapy

NSAID – Non Steroid Anti Inflammatory Drugs

RGU –Retrograde Urethrography

HIV – Human immunodeficiency Virus

AIDS – Acquired Immunodeficiency Syndrome

ABSTRACT

Urethral stricture is one of the common causes of lower urinary tract obstruction in Africa. Its impact includes pain, disturbance in family and social life and complications include renal failure, and urethral carcinoma. The pattern of causes of urethral stricture are said to be changing with time. Up to early 1980s, infection especially gonococcal infection was the leading cause of urethral stricture. With advent of wide spread antibiotic use, changes in life style and advances in technology, trauma has become the commonest cause.

Objective

The main objective of this study is to determine the radiological pattern of male urethral strictures among adults at KNH in Nairobi, Kenya.

Methodology

This prospective study was conducted at Kenyatta National Hospital Department of radiology and the Plaza Imaging Solutions. Participants included patients sent to the Department of radiology to undergo ascending urethrography or micturating cystourethrography and presenting with clinical evidence of urethral strictures.

Findings

Two hundred adult male patients with clinically suspected urethral strictures were recruited between April and November 2012. The mean age was 45 years (SD ± 18.2). Out of the 200 patients 138 (69%) had a stricture (average size 2.9 cm ± 1.6). Most patients (52%) had pelvic fractures and 21% of patients had iatrogenic strictures following instrumentation or catheterization. Other causes infective causes (10%) or dysuria (17%). Seventy one (35.5%) strictures were located in the posteriorurethra while 36 (18%) were in the anterior and 31 (15.5%) spanned both the anterior and posterior urethra. Most (61.4%) strictures occur in single as compared to multiple (38.6%) sites.

Conclusion and discussion

Most urethral strictures in adult males in radiology units at Kenyatta and Plaza imaging are caused by iatrogenic trauma and accidental pelvic injuries. To avert cases of urethral strictures there is need to improve techniques for surgical intervention and clinical skills in managing urologic conditions in patients.

BACKGROUND AND LITERATURE REVIEW

Introduction

Male urethral stricture disease encompasses a spectrum of divergent ailments that cause constriction of the urethral lumen and this disease is one of the common conditions encountered in urological practice.[1] [2]Urethral strictures commonly presents with progressive symptoms of lower urinary tract obstruction including slowing or blockage of urinary flow secondary to fibrosis of the urethral mucosa and surrounding tissue.

Recent studies in low- and middle-income countries have documented a transition in the etiology of male urethral strictures. [1] [3] The role of socioeconomic status on incidence of urethral strictures in low and middle income settings was not extensively examined in these studies. Historically gonococal urethritis was the commonest cause of urethral stricture, but with early treatment of infection and condom use among other effective preventive strategies, the importance of gonococcal urethritis has declined. Currently, the leading causes of strictures both in developed and developing countries include external trauma, and iatrogenic causes. Iatrogenic causes include urethral catheterization, cystoscopy, TURP and surgery for.[4] Idiopathic strictures include those occurring at any age and at any site where the cause is not known.Despite the recent changes in etiology of the disease it has remained a source of painful suffering, disturbance in family and social life. The majority of stricture patients suffer only moderate complications. These complications commonly include irritative voiding symptoms, or recurrent urinary tract infections.[5] [6]However, more serious but rarer complications related to urethral stricture disease include renal failure, urethral carcinoma and even death related to obstructive uropathy.[5]

Epidemiology

The exact incidence of urethral strictures is unknown but data from existing studies show that the incidence of urethral stricture disease increases with age and that the incidence also varies widely in different settings.[7] [8] Most existing data are based on hospital reports of urethral stricture disease. Such data underestimates the true population burden of disease especially in low income settings like Kenya where a significant proportion of the population do not have access to healthcare services.

Worldwide distribution

Developed countries

Hospital episode statistics in the United States and in the UK, estimate that urethral strictures affect males with an increasing frequency with one in every 10,000 men aged 25 to about one in every 1000 males aged 65 or more.[8]The estimated prevalence of urethral stricture disease in the UK is approximately 10/100 000 men in their youth rising to about 20/100 000 by the age of 55 years then to 40/100 000 by the age of 65 years and to over 100/100 000 thereafter.[7] Estimates from a US population come from an analysis of 10 sets of public and private health care databases to examine disease rates.[8] The incidence in the American population are several-fold higher than that in UK with age specific rates ranging from approximately 150/100 000 among youth to over 1,000/100 000 in the population over 75 years of age. Possible explanations include the race effect demonstrated in American populations with higher stricture rates among non-white populations.[8] The demographic difference between the UK and the US could explain part of this variation.

Similar to the UK study the rate of stricture diseases in the US climbed sharply after age 55 years. This American data also demonstrated that the incidence of stricture varied among different races and peaked in urban and black populations.Data from the stricture clinics show more than 5,000 inpatient

visits yearly and annual office visits for urethral stricture numbered almost 1.5million between 1992 and 2000. [8] The total cost of urethral stricture diseases in 2000 in ten American private and public facilities was almost $200million. These costs covered ambulatory surgery visits, physician office visits, hospital outpatient, emergency room and inpatient costs but excluded medication costs. A diagnosis of urethral stricture increased health care expenditures by more than $6,000 per individual yearly in insured disease and appeared to be more common in the elderly population and in black patients, as measured by health care use. In most data sets services provided for urethral stricture disease decreased with time. Patients with urethral stricture disease appeared to have a high rate of urinary tract infection (41%) and incontinence (11%).[8]

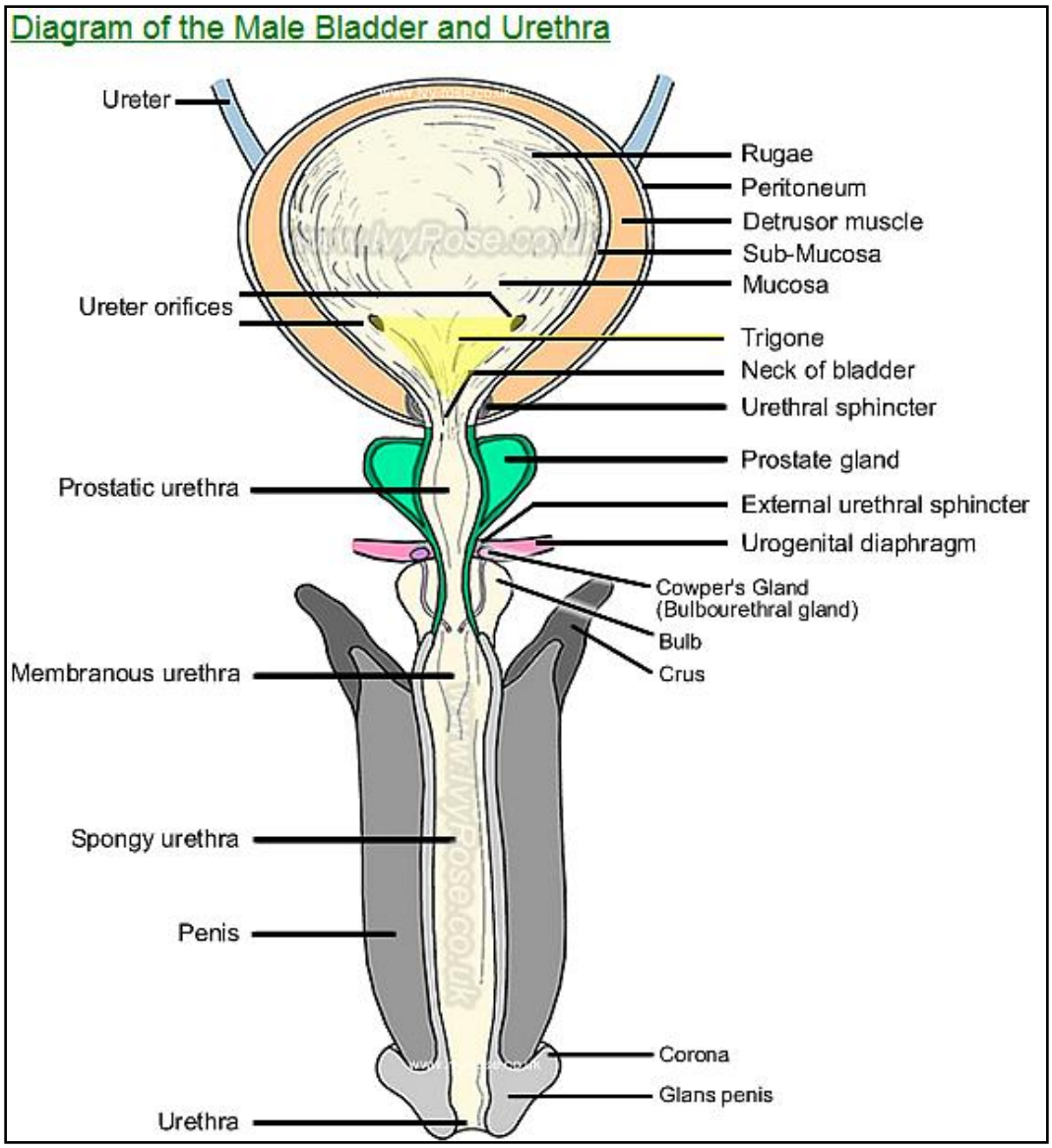
Developing countries settings

Most studies conducted in developing countries prior to 1990 reported STDs as leading causes of strictures. The literature review revealed that there are no prospective studies on the incidence of male urethral strictures in developing countries conducted from the 1990s onwards.

It is estimated that the incidence of urethral stricture is highest in developing countries.[9] In addition because the proportion of infective strictures is greater in developing countries urethral strictures typically affects a much younger populace and with more frequency than in the developed countries.[9] Although there are difference in the incidence of urethral stricture in the developed and developing countries the magnitude of the difference in this incidence is yet to be determined. Despite these gaps in existing literature, the issue of urethral strictures in men is a persistent problem not only in developed countries but even in Kenya. Urethral strictures are not uncommon especially from traumatic causes and iatrogenic causes. However, the exact prevalence of strictures in Kenya is not known.

ANATOMY OF MALE URETHRA

The male urethra is a tubular structure in the lower urinary tract, running from the neck of the bladder to the external urethral orifice at the tip of the penis. It is estimated to have about 20cm in length and variable diameters depending on its anatomical part.



Adapted from Snell, RS (2006) [10]

Male urethra can basically be divided into two main segments, which are (i) Anterior segment (15cm) and (ii) Posterior segment (5cm).

In its posterior segment the urethra comprises of two main parts, which are Prostatic Urethra (3cm) and Membranous Urethra (2cm). Prostatic is said to be the widest part, has a two ridges called Verumontanum and fossae called Prostatic sinuses which are perforated by ejaculatory ducts.

The membranous part is the narrowest part which traverses the urogenital diaphragm.

The Urethra comprises of two parts: bulbar and penile urethra. The bulbar urethra is landmarked by a localized dilatation called intrabulbar fossa. The Penile part is a long and narrow part with a distal localized dilatation called Navicular fossa.

Etiology

Recent transitions in stricture etiology

Recent African studies conducted in Nigeria demonstrate that trauma is now the leading cause of urethral stricture disease in our setting and also described a rapid increase in the incidence of post catheterization strictures.[3] Trauma caused 72.3% of strictures in this series and 20.5% of urethral strictures had an iatrogenic cause. This study reported a very low prevalence of infective causes of strictures. Prior to this epidemiological transition, earlier African studies indicated that infections caused between 45% and 66% of strictures.[11] [12] However, a retrospective single-centric study over a 10-year (1998-2008) in Senegal still reported a predominance of infective strictures (63%).[13]

Inflammatory stricture especially gonococcal induced was a leading cause of stricture prior to the advent of widespread antibiotic use. Recent findings of increasing traumatic related stricture have been reported in Nigeria, where 68 new patients with urethral stricture presented at the University of Benin

Teaching Hospital Benin City, between January 1994 and December 2003, an average of 7 patients per year.[14] Forty-two (61.9%) of these patients were aged between 21 and 50 years, 38 (55.9%) of these strictures were traumatic in origin and of these 23 (60%) were of the bulbomembranous type and resulted from fractures of the pubic bones. Eight (21.2%) of the traumatic strictures were from iatrogenic causes. Thirty-three (48.5%) patients presented without any of the clinical complications of urethral stricture disease. Thirty-four (50%) patients had treatments other than urethral bougienage. This picture contrasts with the situation in the past when urethral strictures were predominantly post inflammatory in origin. The patients presented more with complications, involving almost entirely bulbar or penile urethra in location and were usually treated by periodic serial dilation.

Improved treatment of urethral inflammatory diseases was cited as a possible explanation for the decreasing incidence in post inflammatory urethral strictures in Nigeria.[14] This finding however contrasts the increasing incidence of post-traumatic strictures. Based on the demonstration of a lower but nonetheless significant burden of post-traumatic stricture the study recommended skill acquisition through the training of specialist surgeons in the operative and instrumental management of injuries to the urethra .[14]

Iatrogenic causes of stricture

Approximately 27% of strictures in a Brazilian tertiary hospital have been noted to be iatrogenic.[1]In this series iatrogenic cause was second to traumatic strictures causing 54% of strictures with 84% of these cases having radiological evidence of pelvic fractures. The high rate of pelvic trauma in this study was explained by high incidence of injuries from road traffic accidents due to poor road conditions and inadequate traffic regulation. Similar findings are reported in low-income setting where similarly poor transport infrastructure exists.

Treatment is a challenge and many studies have been conducted to explore simpler, and cost-effective ways of dealing with strictures, one of them being bipolar vaporization technique,[15] a procedure which is not available at our local set up currently. However it is noteworthy that increased numbers of iatrogenic strictures have been reported during treatment. Basok et al,[16] studied 22 male patients with urethral stricture and 5 with bladder neck contracture who were treated by endoscopic bipolar vaporization. The most common etiology for stricture formation was iatrogenic (85.2%) and the mean stricture length was 12.2mm.[16]

All patients were evaluated with urethrography and uroflowmetry 1 month and 3 months after surgery. Urethroscopy was routinely performed at the end of 1st year. Preoperative mean maximum flow rate (Q max) was 4.9 ml/s for urethral stricture and mean Q max was 3.4ml/s for bladder neck contracture. The results were considered as "successful" in patients where re-stenosis was not identified with both urethrography and urethroscopy. Minimum follow-up was 13.8months (range 12 to 20).[16]

Several studies including one conducted by Mosbah A et al suggest that iatrogenic aetiology of urethral stricture appears to be increasing in frequency.[17] Transurethral catheterization and endoscopic manipulation are the principal aetiologic factors. Prevention is based essentially upon a greater respect of the urethra when an endoscopic exploration is necessary and the use of suprapubic catheterization whenever bladder drainage is necessary.[17]

Congenital causes of strictures

Thomas M. Boemersa et al,[18] contributed by a study on Anal rectal malformation and suggested that, damage to the male urethra following pelvic surgery for anorectal malformation (ARM) is a well known problem, usually seen in boys with rectourethral fistulas. Urethral strictures located in the posterior urethra are difficult and conventional reconstructive procedures do not consistently yield good results. Free buccal mucosa grafts placed either ventrally or dorsally have shown superior results to other techniques.[18]

Radiation and stricture etiology

Reports indicate that urethral strictures are a potential complication of radiation treatment in males with prostate cancer.[19] Studies on treatment modalities using high dose radiation report risks of between 4-9% for development of strictures at 5 years after initial radiation treatment exposure.[19] These rates represent conservative estimates of radiotherapy etiology of strictures since the series above only report strictures resulting in clinical symptoms implying that diagnostic evaluation of all patients could reveal higher prevalence of strictures.[19]

Post surgical etiology

Urethral stricture is the most common complication of transurethral resection of prostate, occurring in up to 29 per cent of cases.[20] A prospective trial was initiated to ascertain if the presence of positive urine and urethral bacterial cultures made any significant difference in urethral stricture incidence. 100 patients were entered in the trial, 50 receiving latex catheters and 50 receiving Teflon catheters. There was no significant difference between the two groups in incidence of urethral stricture, and there was no correlation between positive urine and urethral bacterial cultures and stricture formation. It is suggested, therefore, that urethral catheter material and size and the presence of organisms in the urine and in the urethra do not contribute significantly to the formation of urethral stricture following transurethral resection of the prostate as per the study done by A.J.L Hart et al. [20]

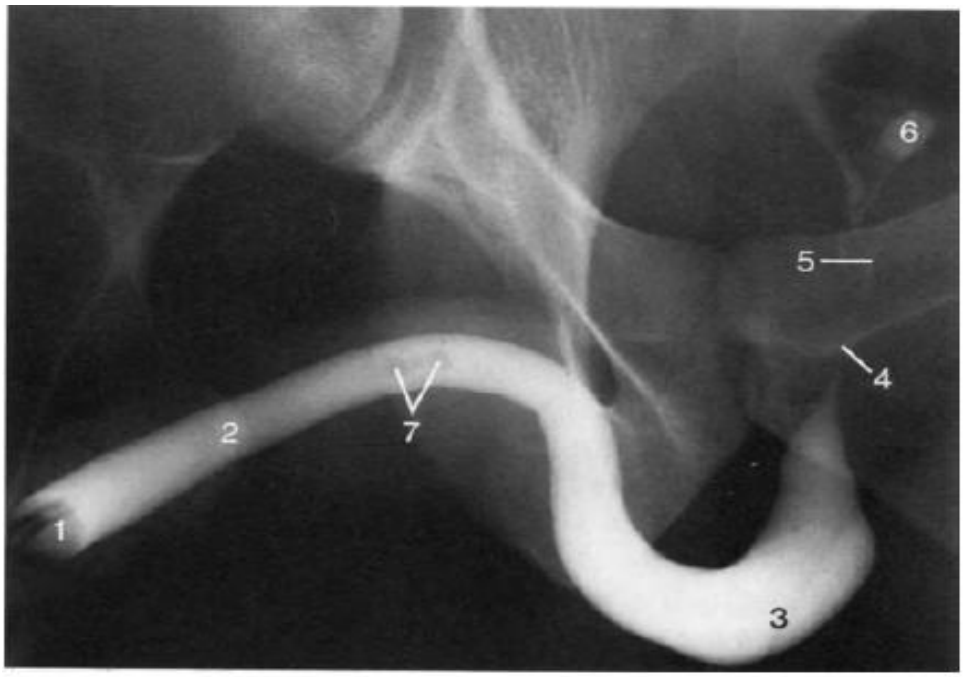
Use of latex instead of silicon catheterization has also been associated with urethral strictures. A controlled randomized prospective study carried out by J.N. Nacey et al,[21] on 100 male patients to compare the incidence of urethritis following catheterization with either latex or silicone catheters. All patients underwent elective cardiac surgery and were catheterized for 48 hrs with antibiotic cover, and were followed up for 6 months post-operatively. Of those with latex catheters 22% developed urethritis, compared with 2% of those in the silicone catheter group. This difference is statistically significant ($P<0.01$).

Two of the former patients developed a decreased urinary flow and both had tight anterior urethral strictures.[21]

According to liedberg H,[22] Urinary tract infections accounts for over 40% of all nosocomial infections, and almost all these infections are associated with indwelling catheters. The acquisition of urinary tract infections following urinary bladder catheterizations are associated with nearly a threefold increase in mortality among hospitalized patients.[22]

Between 4 to 29% patients undergoing TURP get urethral strictures related to mechanical,thermal trauma caused by resectoscope, severe urethritis or trauma due to Folleys catheter and luminal ischemia. There are suggestions that the use of NSAID for 3 weeks have improve the outcome for stricture formation.[23]

Retrograde Urethrography



NORMAL ASCENDIN

1. Balloon of catheter in navicular fossa
2. Penile urethra
3. Bulbous urethra
4. Membranous urethra
5. Impression of verumontanum in prostatic urethra
6. Filling of utricle (not usually seen)
7. Air bubbles in contrast

The changes in the diagnosis and evaluation by modern radiographic imaging and flexible endoscopy have refined the staging of the disease, thus improving effectiveness of surgical planning. In addition to classic retrograde and antegradeurethrography some centers now use intra urethral ultrasound and MRI to define the extent of urethral injury and fibrosis. In place of rigid scopes, flexible urethroscopy is used more frequently to define the gap between the two normal ends. Post operatively uroflowmetry is more frequently being used to assess the success of any operation done for urethral stricture in place of retrograde urethrogram. Effective and safe management of urethral stricture diseases has long been the dream of the urologic surgeons and their patients.

Urethral dilatation is one of the oldest operations in urology. Initially wax tapers remained in use for centuries and with time they were replaced by gum elastic material as flexible bougies. Metal bougies are very old instruments

known since the 6th century BC, however, various modifications have been made since their shape remains the same except for minor alterations. With the progress in technology, the treatment for urethral stricture has also changed.The gonococcus is no longer the common cause and wax bougies are no longer used for relief. Repeated urethral dilatation with metallic bougies is by no means an acceptable remedy by many patients. After urethral dilatation, visual internal urethrotomy under local, spinal or general anaesthesia and ideally aided by a guide wire placed through the stricture remains an alternative to dilatation for short bulbar urethral strictures. Complications associated with internal urethrotomy include bleeding, infection and urosepsis, extravasation, incontinence, impotence and stricture recurrence.[23]

Diagnostic imaging of urethral strictures

Several imaging modalities are conducted before a definitive diagnosis of urethral strictures. However, the male urethral imaging and pathology is not widespread in the radiology literature because this part of the urinary tract is easily studied by urologists with clinical or endoscopic examinations.

Ultrasonography and MR imaging are increasingly being used in association with voiding cystourethrography and retrograde urethrography. The posterior urethra is being studied with voiding cystourethrography or voiding sonography which allows the detection of bladder neck pathology, post-surgical stenosis, and neoplasms. The functional aspects of the bladder neck and posterior urethra can be monitored continuously in patients with neuromuscular dysfunction of the bladder. The anterior urethral anatomy and pathology is commonly explored by retrograde urethrography, but recently sonourethrography and MR imaging have been proposed, distending the lumen with simple saline solution instead of iodinated contrast media. They are being used to study the urethral mucosa and the periurethral spongy tissue which can be involved in the urethral pathologies such as strictures, diverticula, trauma, and tumors. Imaging has an important role to play in the study of the

diseases of the male urethra since it can detect pathology not visible on urethroscopy. The new imaging techniques in this area, such as sonography and MR, can provide adjunct information that cannot be obtained with other modalities.[24]

The advent of sonourethrography is another achievement in imaging of male urethra as tipped by the study done by S. Chauthary et al,[25] who conducted a prospective study to evaluate the abnormalities of the male anterior urethra using high-resolution ultrasound using operative findings as the gold standard. Where seventy patients with symptoms of lower urinary tract obstruction underwent RGU followed by sonourethrography. The sonologist was blinded to the findings of RGU. The parameters studied were compared with the intra-operative findings as gold standard, and the sensitivity, specificity and overall accuracy for the procedures were calculated. All patients were found to have urethral stricture disease by RGU were also detected by sonourethrography and confirmed intra-operatively. In the estimation of stricture length, RGU showed a lower sensitivity (60-80%) for lengths 1-4cm, compared with sonourethrography (73.3-100%).[25] Spongiofibrosis was detected by sonourethrography with a sensitivity of 77.3 -83.3%. All the false tracts and calculi detected at sonourethrography were confirmed at surgery, whereas RGU showed a low sensitivity in their detection. The complications encountered during the procedures were pain, urethral bleeding and contrast intravasation. The frequency of pain during RGU was greater ($p<0.001$); however, the difference in frequency of bleeding after the two procedures was not significant ($p<0.5$). it was concluded that RGU and sonourethrography are equally efficacious in detection of anterior urethral strictures. Further characterization of strictures in terms of length, diameter and periurethral pathologies, like spongiofibrosis and false tracts, is done with greater sensitivity using sonourethrography as compared with RGU, with the added benefit of lower incidence of complications.[25]

Treatment of urethral strictures

Treatments of urethral strictures range from invasive and the less invasive techniques, however most of such procedures need special skills and experts, and this has been a challenge even in western countries suggesting that such a challenge can be even worse in Kenya and other developing countries. A survey of practicing urologist in the United States conducted by Bullock et al found that most urologists (63%) treat 6 to 20 urethral strictures yearly.[26] The most common procedures used by those surveyed for urethral strictures were dilatation (92.8%), optical internal urethrotomy (85.6%) and endourethral stent (23.4%).[26]

Minimally invasive procedures are used more frequently than any open urethroplasty technique. Furthermore, most urologists (57.8%) do not perform urethroplasty.[26] When used, the most common form of urethroplasty performed were end-to-end anastomotic urethroplasty, perineal urethrostomy and ventral skin graft urethroplasty. Few urologists (4.2%) performed buccal mucosal grafts. Unfamiliarity with the literature and inexperience with urethroplastic surgery have made the use of endoscopic methods inappropriately common.[26]

Many other studies are going on to achieve minimum invasive treatment modalities with fewer complications, Jerilyn M. Latini et al,[27]suggests that minimally invasive treatments of urethral strictures in men intend to durably restore normal anatomy and function with relief of urinary symptoms and avoidance of morbidity. Minimally invasive treatments for bulbar urethral strictures include bougienage and coaxial balloon dilation, endoscopic urethrotomy with a cold-knife or laser, and urethral wall stents.[28] Adjunctive techniques including brachytherapy and the injection of steroids, mitomycin C, or captopril, have been employed to reduce the high restricture rates with minimally invasive treatments for bulbar urethral strictures.[27] This review

discusses recently published data concerning indications for these commonly performed minimally invasive procedures, along with their efficacy, durability and potential for adverse events.[27] Although many currently available studies report on small numbers of patients, some conclusions can be made. Ultimately, long-term, randomized, controlled prospective studies of larger numbers of men with bulbar urethral strictures are needed.

STUDY JUSTIFICATION

Available statistics show a global reduction in inflammatory related strictures especially those caused by gonococcal urethritis following the advent of strong antibiotics which are widely available in Kenya. However, there are still a significant number of urethral stricture cases seen in radiology departments in Kenyan health facilities.

There is a two-fold reason to study this epidemiological transition associated with urethral strictures. Firstly, it is critical to identify the conditions that are replacing gonococcal infections as the leading cause of strictures to enable planning of preventive interventions. Secondly, these causes need to be characterized so as to ensure appropriate treatment and management of urethral strictures. The use of retrograde urethrography will provide a detailed description of imaging and diagnostic details of the urethral stricture disease presenting at the radiology department at KNH.

In addition the need for such a study is further intensified by the presence of HIV AIDS pandemic which has high prevalence in Sub Saharan Africa. Several studies have shown patients with HIV AIDS to have an increased incidence of urinary tract infection as well as genital urinary tract tuberculosis. Urinary tract TB contributes between 10-14% of extra pulmonary tuberculosis and is implicated in the stricture causation.[29 30]

The findings in this study are intended to highlight the burden of urethral strictures in the Kenyan population. These findings will eventually be availed to Kenyan policy makers to help with better planning on how to prevent causes of urethral strictures and propose better ways of managing patients with strictures in terms of financial, materials and human resources.

STUDY OBJECTIVES

A. Broad Objective(s)

1. To determine the radiological pattern of male urethral strictures among men referred to the radiology department in KNH.

B. Specific Objectives

1. To determine the factors associated with radiological urethral stricture patterns among men in KNH.

2. To determine the common urethral segment involved in strictures (Anterior or Posterior).

3. To determine the percentage of the iatrogenic related strictures among men.

MATERIALS AND METHODOLOGY

Study Area

The study was conducted concurrently at two radiologic imaging centers in Nairobi that is Kenyatta National Hospital Department of radiology and the Plaza Imaging Solutions. KNH is a tertiary teaching and referral hospital. It serves as the national referral facility in the Kenya, alongside the Moi Teaching and Referral Hospital. KNH has a radiology department staffed by radiology consultants and registrars. The Plaza Imaging Solutions is a private radiologic imaging center offering MRI scan and spectroscopy, CT scan, Ultrasound and Doppler and Xray services including general X-ray for chest, musculoskeletal system and fluoroscopic investigations like barium swallow, barium enema, barium meal and ascending/ micturating cystourethrography. The Plaza Imaging Solutions is an independent radiologic unit receiving referral for diagnostic radiology from both public hospitals and private practitioners. It is staffed by radiologists, registrars and radiology technicians.

Study Design

This study is a prospective cross sectional study, conducted over a period of 8 months between April and November 2012.Relevant clinical and demographic information were obtained from the radiologic request form and filled into the study questionnaire. (Appendix) Radiologic features associated with urethral strictures were recorded following interpretation of Xray films by a qualified radiologist.

Materials and study procedures

The equipment used during the study included contrast medium, tilting radiography table with fluoroscopy unit and Foley catheter. All procedures

were conducted using imaging protocols employed within the respective radiological units by the study investigator with assistance from radiography technicians. Informed consent for inclusion in the study was sought before any procedures were conducted. Aseptic technique was observed during insertion of the tip of the catheter in the fossa navicularis and the balloon inflated with 1-2 mls of water. Low Osmolar Contrast Medium (LOCM) was then injected under fluoroscopic control and films taken. Ascending urethrography was followed by micturating cystourethrography to demonstrate the proximal urethra.

Study Population

The study's target population comprised all patients sent to the department of Radiology at KNH and The Plaza Imaging Solutions to undergo ascending urethrography of micturating cystourethrophy and presenting with evidence of urethral strictures. Evidence of urethral stricture was based on imaging findings confirmed by a qualified radiologist.

Inclusion Criteria

The inclusion criteria in this study included:

1. Male patients referred to the department of radiology or Plaza Imaging Solutions with complaints related to obstructive uropathy including dysuria, and difficulty in passing urine.
2. Patients qualified for recruitment if they were investigated usingascending urethrography and micturating cystourethrography and the findings showed the typical features of Urethral stricture as counterchecked and proven by a qualified radiologist.

Exclusion Criteria

The following groups of patients were excluded from this study:

1. Patient with any recurred stricture after surgical correction of the primary stricture.
2. Patient with stricture in relation to any pelvic malignant disease process like Prostatic cancer prior to therapeutic interventions.

Sample Size

The sample size calculation for this study was conducted to ensure that an adequate number of patients were included in the study to provide the required precision (± 5%) around the estimated prevalence of male urethral stricture and radiological patternsin films of patientsreferred for MCU.

The sample size calculation was based on the formula by Fisher et al (1998).The calculation using an estimated proportion of black African males with urethral stricture abnormalities detectable using contrast X-ray retrograde urethrogram of 84.6%,[31]and a margin of error of ± 5% is shown below:

$$N = \frac{z^2 \times P \times (1 - P)}{C^2}$$

Where P=is proportion of male urethral stricture detected using contrast retrograde X- ray urethrogram in black African males (Akano 2007[31]).

Z=standard normal distribution.

C=the level of significance desired.

When this formula applied at C = 0.05, z =1.96 and p = 0.846.

N = 200 cases.

Sampling Methods

Sample of cases were obtained in the department of Radiology as well as Urology clinics; whereby all cases of strictures were interviewed for their clinical history and review of related investigations such as urinalysis, urine culture and pelvic radiography in order to establish the etiology responsible for the cause of strictures.

Study Limitation

1. There was no computerized data storage of patients; resulting in difficulties in collection and retrieval of laboratory investigation data.
2. The real prevalence of stricture in Kenya is not known, this may affect the study by lacking a true representative sample.
3. Lack of adequate study funding was another major limiting factor because it was difficult to let all patients have additional investigations like urine culture and others which could have enriched the description of urethral stricture etiology.

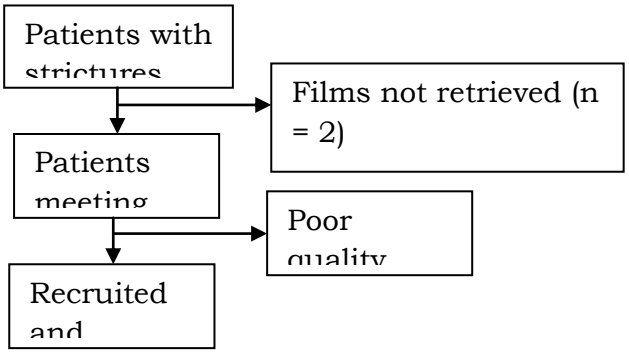
DATA MANAGEMENT

Data Collection

At KNH, patients data and type of examination was traced from Radiology Department and Urology clinic register. Further information of patients was obtained from Medical record department, where file information were studied and patients followed up on their next appointment as given by the clinicians.

In Plaza Imaging Solutions, eligible patients were approached as they arrived for care at the facility. All attendees with stricture diagnosis were screened for

eligibility. Patients who met study eligibility and also consented to participate in the study were recruited until the desired sample size was achieved. Information about their illness was obtained from their request and referral notes. The flow chart of study recruitment is shown below:



Flow chart: Study recruitment of patients with urethral strictures

Data Analysis

All radiologic films were independently reviewed and interpreted by the principal investigator and a qualified radiologist. In cases where there were inconsistencies between the two interpretations the opinion of the urologist was sought and all the three investigators reviewed such films to establish consensus on interpretation of the films. All demographic and laboratory data were entered into customized data bases designed in Microsoft Excel. Data cleaning and analysis were conducted using Statistical Package for Social Sciences (SPSS). The descriptive analysis involved calculating measures of

centrality (mean or median) for continuous variables like age. These measures of central tendency are presented with measures of variability including standard deviations, or interquartile range. Descriptive data are presented using frequency tables, charts and graphs for categorical data. The main outcome was calculated as the percentage of male with strictures presenting different radiological patterns. These patterns were correlated with patient factors using chi-square test.

Radiological images are presented for selected cases.

URETHROGRAPHY TECHNIQUE

Indication

The procedure is indicated in stricture, urethral tears, periurethral or prostatic abscess and fistulae or false passage.

Procedure

1. The patient lies supine on the X-ray table.

2. Using aseptic technique the tip of the catheter is inserted so that the balloon lies in the fossa navicularis and its balloon is inflated with 1-2 mm of water. Contrast medium is injected under fluoroscopic control and films are taken in the following positions:

a. 30^{O} LAO, with right leg abducted and knee flexed

b. Supine PA

3. Ascending urethrography was followed by micturating cystourethrography or excretory micturating cystourethrography to demonstrate the proximal urethra. Ocassionally, urethral urethral fistula or periurethral abscess is seen only on

voiding examination; reflux of contrast medium into the dilated prostatic ducts is also better seen during micturation.

Stricture length measurement

Stricture length was determined by placing a radio-opaque ruler between limbs during filming and reading the length of stricture on the film based on markings of the ruler image on the film. The calibration of the ruler is done in centimeters. The use of this method reduces the magnification error associated with estimating length of strictures on films. Proper training and supervision of radiology technicians was also done to ensure accuracy in use of this method of stricture measurement.

Classification of stricture etiology

The main categories considered while evaluating etiology of urethral strictures were: trauma, infective causes, dysuria and iatrogenic causes. In cases where evidence of trauma preceded instrumentation or occurrence of infection or dysuria the etiology was classified as trauma.

ETHICAL CONSIDERATION

The approval to conduct this study was sought from the relevant ethical board following approval by the supervisor at the departmental level. The patients were requested to give a voluntary and informed consent by signing a consent form.

Moreover, personal identifiers like patient name were not used in order to ensure confidentially. Information obtained from the patient was strictly confined to academic use only unless there was a clinical indication necessary to allow shared confidentiality in the interest of the concerned patient.

The main complications that could have arisen during the procedure were classifiable into categories: complications due to contrast medium and due to catheterization technique. Patients were informed of the possibility of these risks including adverse reactions to contrast medium, urethral trauma, and painful catheterization. In addition post procedure care involving monitoring of patients until they stabilized was provided. Only stable patients were allowed to leave the procedure room and those requiring additional care were referred for that care. Exposure to unnecessary radiological radiation was minimized through observing utmost care during exposure and ensuring production of high quality films to reduce chances of repeat investigations.

Patients were not subjected to additional payable investigations for the sake of this research apart from a normal course of management as when it was needed by the clinician.

RESULTS

Two hundred male patients with clinically suspected urethral strictures attending KNH and Plaza Imaging Solutions were recruited in this study. There were no major complications related to contrast media or technique during all the urethrography procedures conducted in this study. Minor complications were reported in 23 patients including dysuria (n = 20), UTI (n = 2)and haematuria (n = 1).

The age of patients with urethral strictures ranged from 18 to 88 years. The average age was 45 years (SD ± 18.4). Table 1 shows the age distribution of all patients in the study. Urethral strictures commonly occurred in adults (aged 20 years and above) as compared to children and adolescents below 20 years (5%). The most frequently presenting age group was 20-29 years (36%) and 40-59 years (34%).

Table 1: Age distribution of male patients with urethral strictures

Age in Years	**Frequency**	**Percent**
18-20	10	5
20-39	72	36
40-59	68	34
60 and above	50	25
Total	200	100

Clinical presentation of urethral strictures varied among patients. Out of the 200 cases, a total of 171 (85.8%) reported dysuria, with durations of dysuria ranging from 4 days to 3 years. One patient aged 22 years reported life-long dysuria lasting 20 years. Overall, the median duration of dysuria was 7 months with an interquartile range from 3 months to 12 months.

Patients aged 40-59 years reported significantly longer durations of dysuria compared to other age groups (p value = 0.02). The median duration of dysuria

in this age group was 12 months (Table 2) compared to 8 months or less in the other age groups.

Table 2: Comparison of median duration of dysuria according to age group in males with urethral stricture

	Frequency	Median (IQR)	P value
Age in Years			
18-20	9	2(1-6)	0.02
20-39	63	6(1-12)	
40-59	54	12(2-12)	
60 and above	44	8(3-12)	

Etiology of urethral strictures

Figure 1 shows etiology of clinical features that preceded the urethral stricture diagnosis in patients enrolled in this study. Most patients (52%) had pelvic injuries strictures and 21% had iatrogenic strictures following instrumentation or catheterization (Figure 1). Out of the 42 patients with iatrogenic strictures, 18 strictures occurred following TURP procedure and the remaining 24 were due to catheterization.

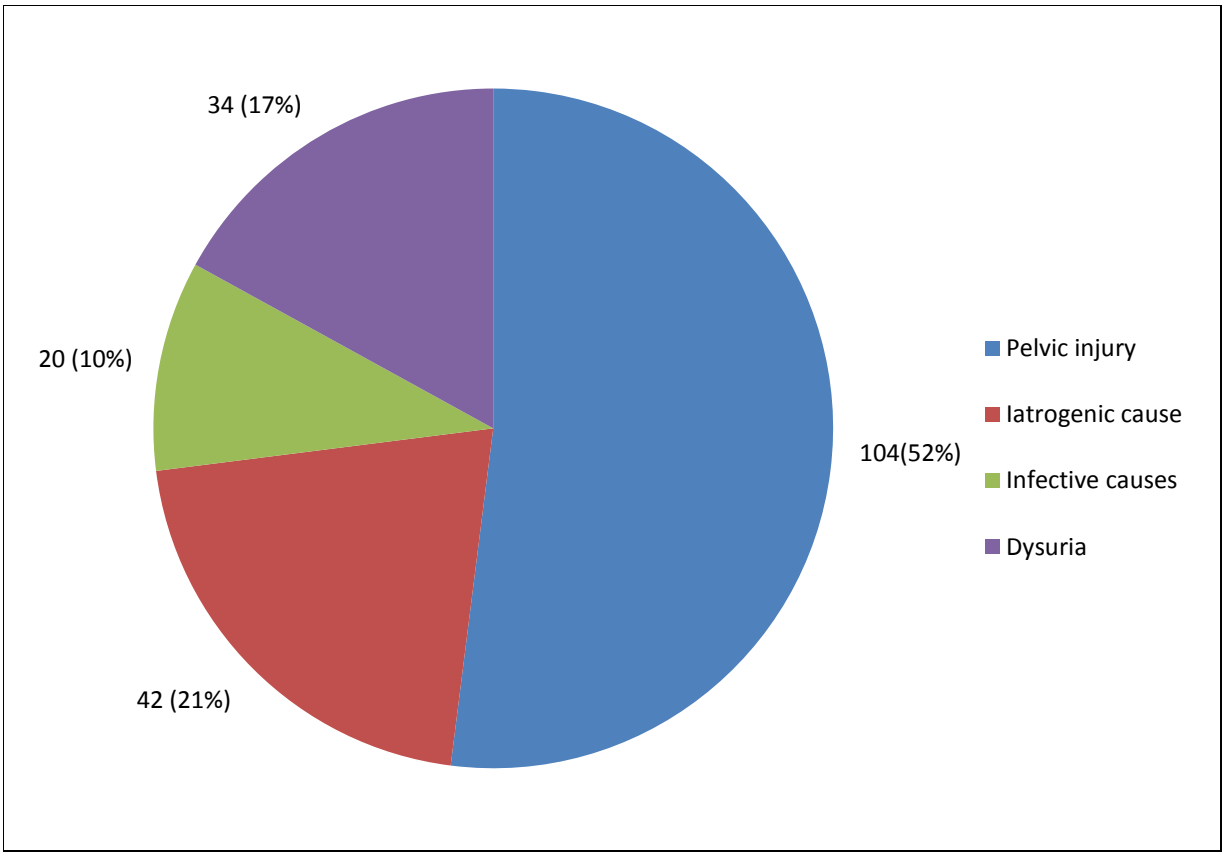


Figure 2: Clinical features of male patients with urethral stricture at KNH and Plaza Imaging Solutions, Nairobi

Sexually transmitted infections (STI) and urinary tract infections (UTI) were commonly reported among the other features that preceded urethral stricture diagnosis.

Imaging findings

The findings of retrograde micturating cystourethrogram (MCU)/ ascending cystourethrogram (ACU) are summarized in Table 3. Out of the 200 patients 138 (69%) had a stricture visualized using either MCU or ACU. No strictures could be visualized in the remaining scans (62, 31%).

Table 3: MCU/ ACU findings in patients with clinically suspected urethral strictures

	Frequency	**Percent**
Stricture visualized		
Yes	138	69%
No	62	31%
	Mean ± SD	
Average stricture length, mean ± SD	2.9 cm ± 1.6	

The average length of urethral strictures was 2.9 cm (range 0.5 – 6.4 cm). Figure 2 shows one of the long strictures measuring 5 cm seen in the study. Overall stricture length was not significantly different depending on anterior or posterior location (average of 2.8 cm versus 2.9 cm, p value = 0.92)

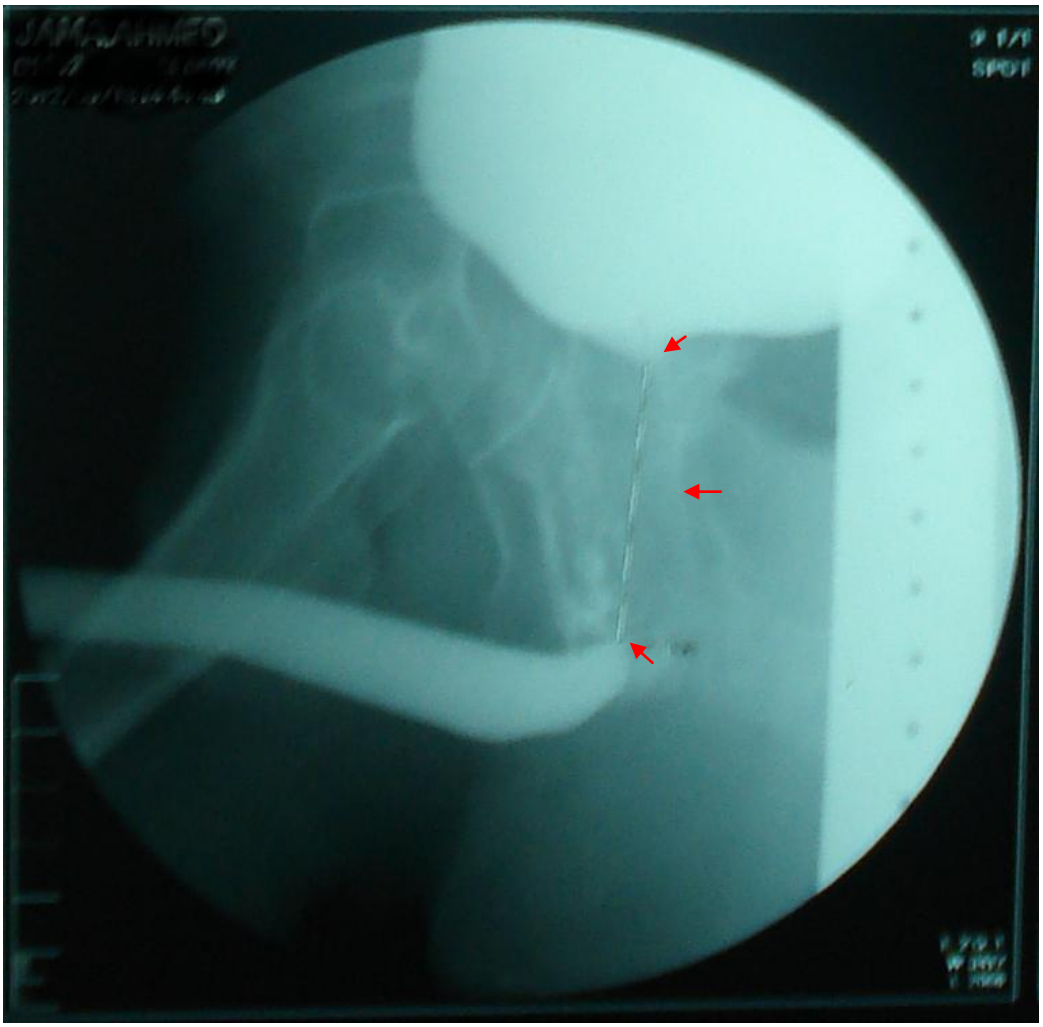


Figure 2: Posterior urethral stricture of length 5 cm visualized on MCU/ ACU

Stricture location –The strictures occurred in the bulbar urethra, penile, bulbo penile and in the membranous parts of the urethra.

Scans of 71 (35.5%) patients revealed strictures in the posterior urethra involving the prostatic and membranous structures (Figure 3). Anterior urethral strictures occurred in 36 (18%) patients.

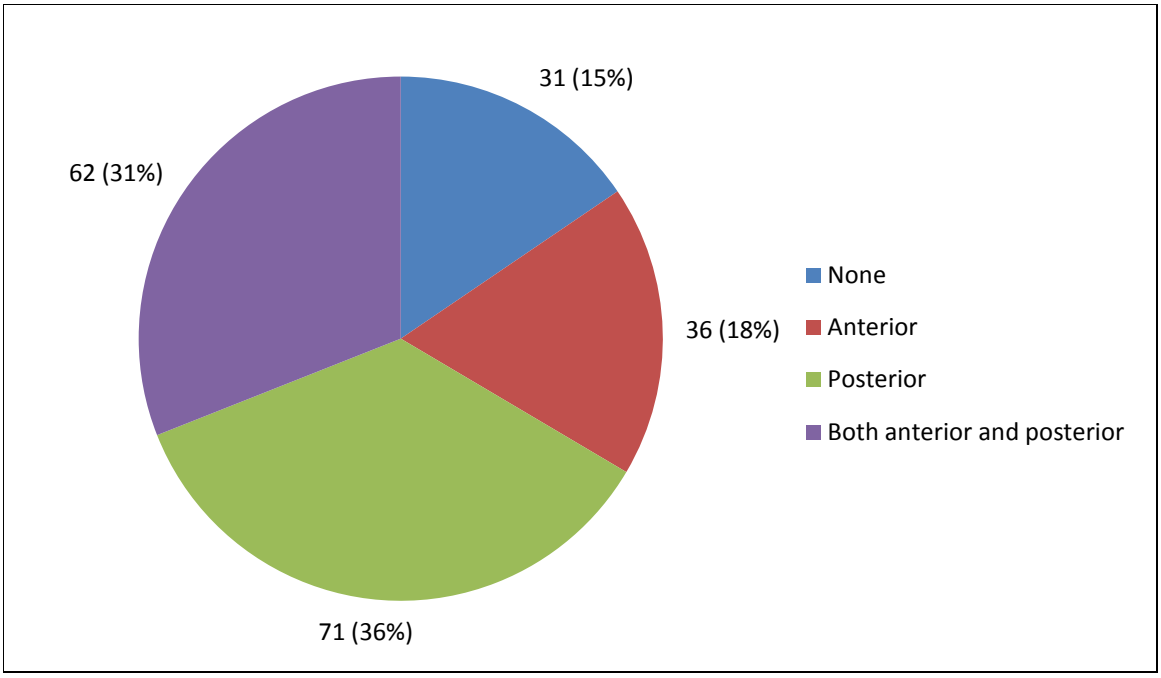


Figure 3: Stricture location in the 138 urethral strictures visualized on ACU/ MCU at KNH and Plaza Imaging Solutions

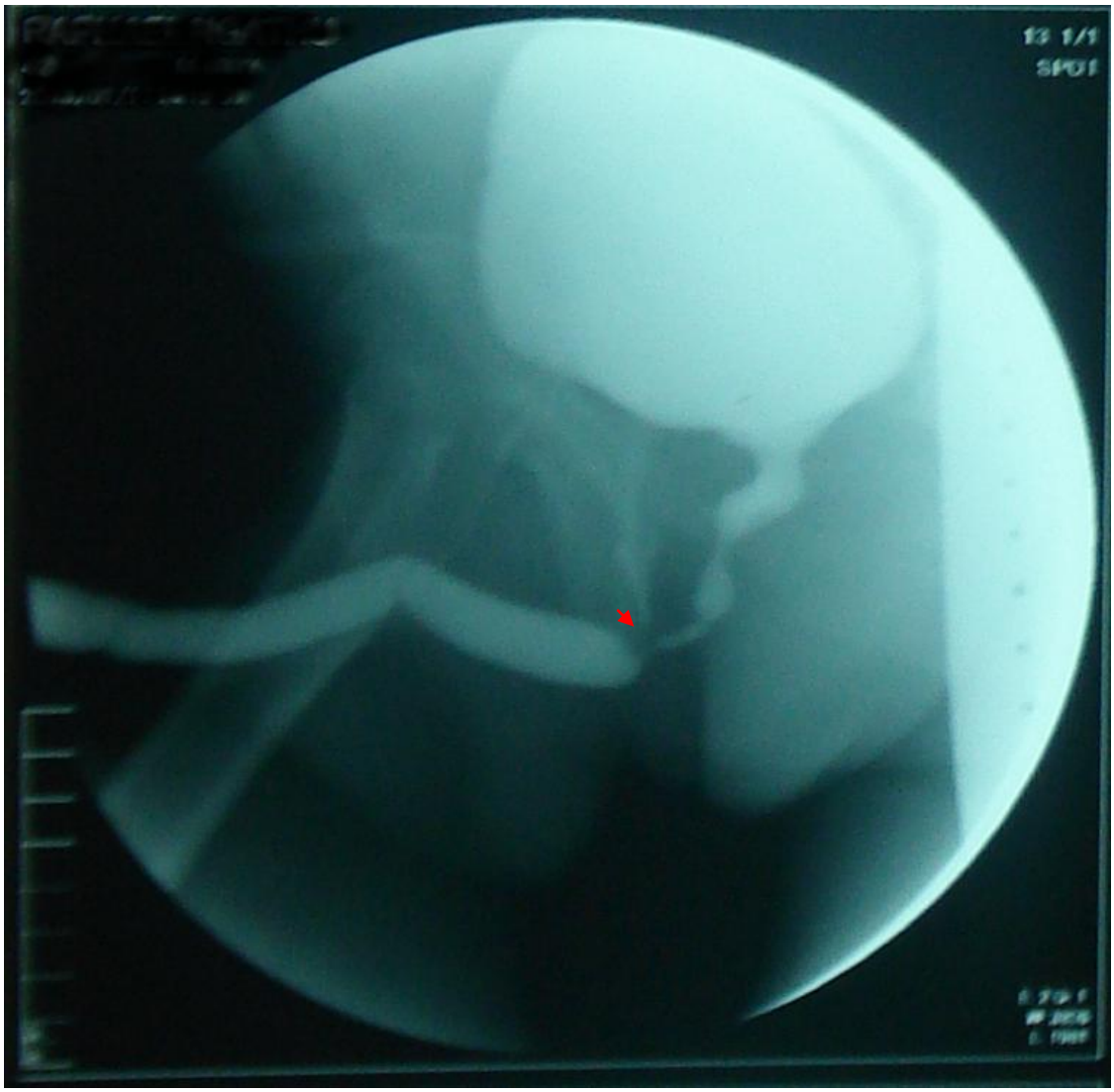


Figure 4: Anterior stricture visualized on MCU in one study participant

Strictures involving both the anterior and posterior urethra were visualized in 62 (31 %) patients. Figure 5 presents a scan showing one of the strictures with both anterior and posterior involvement.

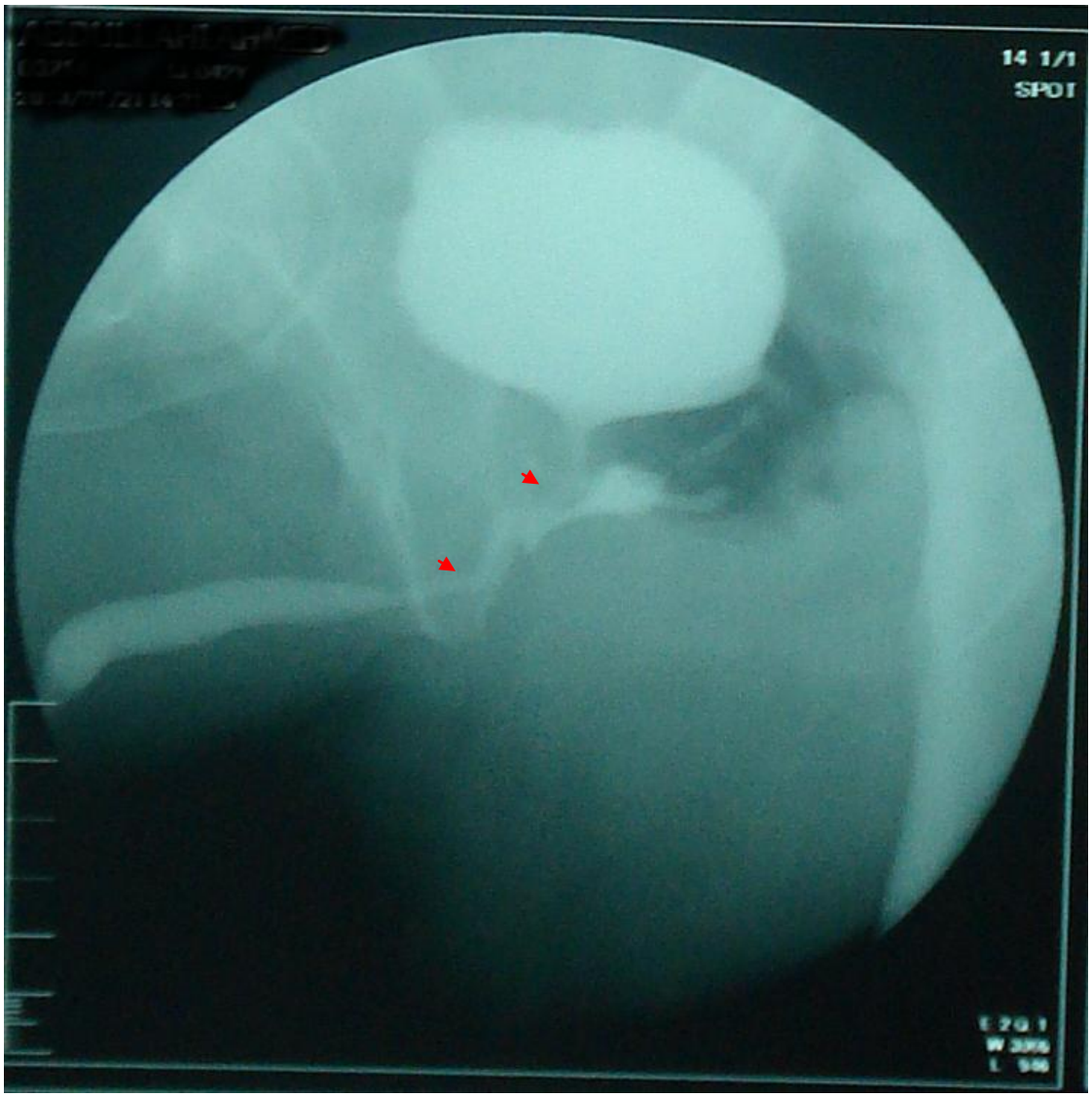


Figure 5: Urethral stricture involving both the anterior and posterior urethra

There was a statistically significant association between stricture etiology and stricture location ($p = 0.04$). Most strictures due to iatrogenic or accident related causes occurred in the posterior urethra.

The scans of 31 (15%) patients revealed no urethral strictures. Among these patients with no strictures on scans, 20 (10%) had cystitis, 5 (2.5%) had bladder trabeculation, 7 (3.5%) had various findings including calculi, prostatic

hypertrophy, diverticulum and the remaining 32 patients had no signs of infection or visible urethral abnormalities on ACU/ MCU .

Number of strictures

The strictures visualized on ACU/ MCU were mostly (61.4%) single strictures. There were 51 (38.6%) multiple strictures. There was a significant association between number of strictures and etiology. Most of the multiple strictures were inflammatory while the single strictures were commonly traumatic.

Laboratory investigations

Urinalysis results were available for 63 (36.5%) patients. Table 4 shows that pus cells were the most commonly identified abnormality occurring in 28.3% of the patients with clinically suspected urethral strictures. Other positive findings were haematuria (13.5%), positive nitrite test (5%) and proteinuria (3.5%).

Table 4: Urinalysis results for male patients with suspected urethral strictures

	Number of cases	Percentage
Urinalysis findings		
Pus cells	57	28.5%
Haematuria	27	13.5%
Positive nitrite test	10	5%
Proteinuria	7	3.5%

The detection of infection in urine samples and the microscopic finding of positive pus cells both showed statistically significant associations with stricture etiology. Positive urinalysis findings were more commonly associated with strictures due to trauma ($p < 0.001$).

Urine culture

A total of 123 patientsurine were cultured with clinically suspected urethral stricture. The most frequently grown microbial was Staphylococcus aureus

(26.5%) followed by Esherichia coli (16%). There was a significant association between stricture etiology and isolation of microbial from culture (p = 0.02).

Table 5: Urine culture growth for male patients with suspected urethral strictures

	Number of cases	Percentage
Microbial isolates		
Escherichia coli	32	16%
Klebsiella species	23	11.5%
Proteus species	15	7.5%
Staphylococcus aureus	53	26.5%

DISCUSSION

Studies on male urethral strictures in Kenya are few and separated by considerably long time periods[32 33]. There are no published Kenyan studies dealing with radiographic studies of the urethra in men. The current study conducted at a national teaching and referral hospital and a major private referral imaging facility is therefore a significant addition to the literature on male urethral stricture in Kenya.

The mean age of patients with urethral stricture in this study was 45 years and is similar to that reported in Tanzania by Musau and Mteta[34] and also agrees with Nigerian reports from two separate time periods (mean age 40 years in 1998[11] and 43.1 years in 2009[3]). In addition this study reports dysuria (17%) is a common presentation of urethral strictures and that the duration of dysuria is variable in patients attending hospital for imaging and diagnostic evaluation of clinically suspected strictures. This finding confirms previously reported presentation of strictures.[35]

In the literature, urethral strictures are reported to occur commonly following both inflammatory and iatrogenic traumatic events. Existing studies report between 26.8% and 79% of urethral strictures has an iatrogenic cause[1 36 37]. External trauma, was however a rare cause of anterior urethral strictures in the series reported above.[37] The most common cause of urethral trauma (52%) documented in this study was pelvic injuries. Iatrogenic causes, infective causes and dysuria account for 21%, 10% and 17%, of strictures, respectively. The predominance of pelvic injuries in causation of male urethral stricture has been reported previously in India (59.2%), and also in developing countries.[1] This is explained by the high incidence of injuries in these settings, especially related to traffic accidents. Second and, in common with studies from both developed and developing countries this study confirms that urethral instrumentation and urethral catheterization are important causes of iatrogenic strictures in Kenyan patients.

Separately, penile discharge preceded 14.5% of all strictures in the present study and other signs of infection including cystitis and STI or UTI treatment was noted in 25.5% of patients. The study reported here confirms previous descriptions of changes in etiology of urethral strictures in sub-Saharan Africa.[3] With the advent and widespread use of antimicrobial treatment the importance of infective causes of urethral strictures were reported to have declined significantly. In Nigeria,infections caused 66.5% of strictures at a teaching hospital during 1980-1989[11]. Data from a second Nigerian teaching

hospital for the period 1998-2005reported infective causes were present in 26.5% of the diagnosed strictures[3]. This recent estimate of the prevalence of infective urethral strictures in Nigeria (26.5%) agrees with the estimate of 14.5% to 25.5% reported in this current analysis.

Imaging studies

About two-thirds of patients with clinically suspected strictures were confirmed to have strictures using ascending cystourethrography and micturating cystourethrography in the present study. The scans of thirty-two patients failed to reveal any pathology. The present study did not compare cystourethography to gold standard methods of stricture diagnosis for example surgery limiting its ability to inform discussion on the value of cystourethography for detecting strictures in Kenyan and African patients. However, based on work done in previous studies the sensitivity and specificity of ultrasound studies in detecting urethral strictures in one prospective study with a relatively large number of patients was relatively high at 98% and 96%, respectively.[38]In fact based on its high sensitivity the method has been proposed as the preferred diagnostic method for evaluating male urethral strictures. Advantages of the sonography include its ease of use and ability to evaluate urethra for strictures without exposing gonads to ionizing radiation.[35]

Additionally, the rates of complications during MCU and ACU procedures were very low and indeed with the exception of a few extravasations of contrast medium no major problems were noted in this study. More severe and possible complications arising from the rapid and forceful introduction of contrast into the urethra include rupture of the urethra.It is noteworthy that no such outcomes were observed in this study. Conventional urethrography is likely to remain the preferred technique in the evaluation of urethral strictures due to lack of experience with other diagnostic approaches in our setting.

Other important imaging findings related to location of strictures, number and size of strictures. The range and average size of strictures seen in the study are similar to that in African literature[34]. In the present study 38.5% of all strictures were in multiple urethral sites. However, an Indian study previously reported a lower prevalence of multiple strictures at 7.5%[1]. This discrepancy can be explained by the different etiology of strictures in the two studies. Evidence from African case series show that up to 85% of inflammatory strictures are multiple while 90% of traumatic ones were single[11].Thus the prevalence of between 14% and 25.5% for inflammatory etiology in this study could explain this high occurrence of multiple strictures compared to a lower prevalence (15.2%) in India. Most strictures in this study occurred in the posterior urethra and there was an association between stricture location and etiology. Similar to findings in existing studies most of these posterior strictures were traumatic due to instrumentation[11].

In conclusion, the findings of this study confirm that the etiology of urethral strictures in Kenyan adult males is commonly trauma with instrumentation and catheterization being prominent causes of strictures along with accidental pelvic trauma. Most strictures are single and occur in the posterior urethra. Both stricture location and number of strictures are significantly associated with stricture etiology with most multiple strictures being inflammatory and most posterior urethral strictures being caused by trauma. To avert cases of urethral strictures there is need to improve techniques and clinical skills in managing urologic conditions in patients.

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APPENDIX A

PATIENT INFORMATION SHEET

My name is Dr Intasab U. Qureshi, I am pursuing Masters of Medicine degree in the department of Diagnostic Imaging and Radiation Medicine in the University of Nairobi.

I am doing a research study on matters related to causes and complications of Urethral strictures in men.

Purpose of the study

The aim of this study is to document the patterns of male urethral strictures visualized using radiology.

Risks and benefits

There are no direct benefits from participating in this study. However, the findings of this study will be applied in helping to plan for treatment in the future for people with similar problems.

There are no direct risks in providing your data for the study but the radiologic procedure you will undergo has certain known risks which are also rare. Reaction to the drugs used during the investigations (contrast medium) has been reported. Like all forms of radiations there are risks associated with X ray radiations but the doses delivered during the investigation are safe and you will be protected from any unnecessary exposures.

What is expected of participants?

I am requesting to use your data and findings of radiological investigation for my study. I may seek clarification from you concerning your illness and investigation done.

PATIENT CONSENT FORM

No name is required and your information will be treated as confidential.

Please may it be known to you that your participation is voluntary and you have the right to refuse or withdraw from this study without being affected in the normal patient care provided at this hospital.

Signature …….

Date …….

I certify that the patient has understood and consented to participate in this study.

Dr. Intasab.U.Qureshi

Signature…….

Date …….

APPENDIX B

FOMU YA RIDHAA (RUHUSA) YA MGONJWA

JinalanguniIntasabQureshi.

Ninasomashahadayauzamilikatikaidarayauchunguziwamagonjwakwamionzi (Radilojia) yachuokikuu cha Nairobi.

Ninafanyautafitikatikaeneo la shidayakuzibakwanjiayamkojokwawanaumenamatatizoyanayowezakuambatana.

Ninaombaridhaa/ruhusayako, niwezekupatanakutumiataarifazakokatikautafitiwangu, ilihatimayemaoniyautafitiwanguyasaidiekatikamatibabuyamagonjwayanamnahii.

Tafadhalifahamuyakuwataarifazakonizasirinaunahakiyakukubali au kukataakushiriki au kujitoakatikazoezinzimabilakuathirihudumanyinginezitolewazomahalihapa.

Sahihi …….

Terehe …….

Nathibitishayakwambamhusikaameelewanaameridhiakushiriki**katikautafitihuu.**

DaktariIntasabQureshi.

Sahihi ……

Tarehe ……

APPENDIX C

BUDGET

No Requirement	**Cost in (Kshs)**
1. Stationery, typing and photocopying	25,000/=
2. Secretarial Services	10,000/=
3. Assistant Data Collectors	20,000/=
4. Transport	15,000/=
5. Data Analysis	20,000/=
6. Scanning/Printing	20,000/=
7. Contingency Expenses	20,000/=
TOTAL	**140,000/=**

APPENDIX D

QUESTIONAIRE; DATA COLLECTION FORM

1. Patient Number .....
2. Age .....
3. Sex .....

4. For how long have you been in difficult urination .....
5. Did the problem of urine passing relate with the following history before it started?

6. (a) Painful urination YES NO
   (b) Penile discharge YES NO
   (c) Blood in urine YES NO
   (e) Instrumentation/Catheter YES NO
   (f) TURP procedure YES NO
   (g) Pelvic injury YES NO
   (h) Pelvic Radiotherapy YES NO
   (i) Any other reason .....

APPENDIX E

IMAGING FINDINGS

MCU/ACU

Stricture noted	Anterior	Posterior
Segmental location		
Number of stricture(s)		

Any other observation seen.

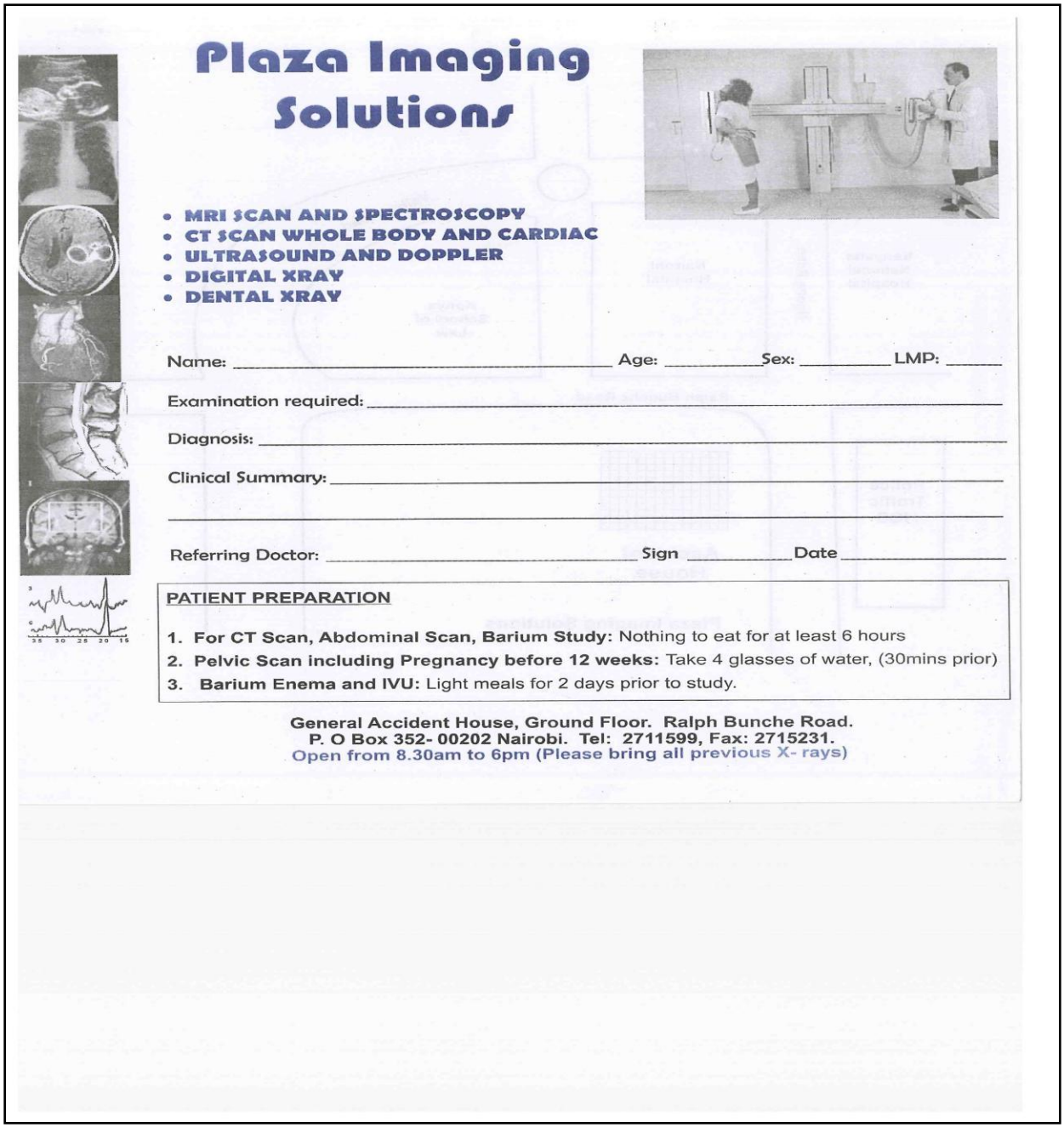
APPENDIX F

LABORATORY INVESTSIGATION ORDERED BY PHYSICIAN

Type	Negative	Positive
Urine analysis		
Urine culture		
Any other test done		
Any other important notification.		

APPENDIX G

Radiological request form



Plaza Imaging Solutions

- MRI SCAN AND SPECTROSCOPY
- CT SCAN WHOLE BODY AND CARDIAC
- ULTRASOUND AND DOPPLER
- DIGITAL XRAY
- DENTAL XRAY

Name: _____ Age: _____ Sex: _____ LMP: _____

Examination required: _____

Diagnosis: _____

Clinical Summary: _____

_____

Referring Doctor: _____ Sign _____ Date _____

PATIENT PREPARATION

1. **For CT Scan, Abdominal Scan, Barium Study:** Nothing to eat for at least 6 hours
2. **Pelvic Scan including Pregnancy before 12 weeks:** Take 4 glasses of water, (30mins prior)
3. **Barium Enema and IVU:** Light meals for 2 days prior to study.

General Accident House, Ground Floor. Ralph Bunche Road.
P. O Box 352- 00202 Nairobi. Tel: 2711599, Fax: 2715231.
Open from 8.30am to 6pm (Please bring all previous X- rays)

KNH 206

KENYATTA NATIONAL HOSPITAL

X-RAY REQUEST / REPORT FORM

TYPE OF INVESTIGATION REQUESTED				NAME
WALKING	CHAIR	TROLLEY	PORTABLE	SEX AGE
APPOINTMENT		TIME		HOSPITAL NO.
L.M.P.			IF PERIODS MISSED	X-RAY NO.
IS EXAM STILL NECESSARY.....			(YES / NO.)	
BRIEF CLINICAL SUMMARY				REPORT TO BE SENT TO
				PREVIOUS X-RAY NO
				OFFICIAL USE ONLY
REQUESTING DOCTOR *(Print Name)*		SIGNATURE		NO. of Films / Charges
RADIOGRAPHER NAME				Comments
DATE.....				