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RADIOGRAPHIC EVALUATION OF URETHRA AND URINARY BLADDER BY ASCENDING AND DESCENDING URETHROGRAM- A RE-VISIT TO CONVENTIONAL URETHROGRAMS

Radio-Diagnosis

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ABSTRACT

Background: Conventional ascending and descending urethrograms are the routinely used conventional radiological special procedures used to evaluate male urethra and urinary bladder in conditions like dysuria (difficulty in micturition) and/ or painful micturition. Micturating cysto-urethrograms are also used in conditions involving female urinary bladder to some extent. They are OPD procedures and need only local preparation, investigation being cheap. Commonest causes of dysuria are stricture urethra, prostatic enlargement and congenital causes like posterior urethral valves (PU valves). **Materials And Methods:** This project was a prospective study done during the post-graduate residency and was the dissertation topic of the corresponding author, done for period of two years including total 196 cases [including both adult male (120 cases) and adult female (16 cases) subjects of all age groups and also including paediatric cases (60 cases)]. Retrograde urethrography (RGU) or ascending urethrograms were done by injecting dilute water soluble iodine containing contrast through external urethral meatus while micturating cysto-urethrogram (MCU) was done by introducing diluted contrast into bladder through urethral catheterization or through suprapubic catheter. **Results:** The study conducted revealed 1) Stricture urethra- 49 % cases 2) Benign enlargement of prostate- 8.3% 3) Posterior urethral valves- 3.3 % 4) Rupture urethra (3.3 %) 5) Urethritis – 2.5 % 6) Neurogenic bladder- 2.5 % 6) Miscellaneous conditions including diverse conditions like primary vesico-ureteric (VUR), anterior urethral diverticulum or valves, periurethral abscess, rectovesical fistulas, vesicovaginal fistula-12 % 7) Rest 16 % cases were normal studies. **Conclusions:** By performing ascending and descending urethrograms, we can determine length of stricture in male urethra, detect presence of PU valves in children, presence of VUR and reflux nephropathy in such cases and plan surgical treatment modality. MCU study is investigation of choice for vesico-ureteric reflux and in neurogenic bladder. RGU is the investigation of choice in rupture urethra especially due to straddling injury and/or road traffic accidents. No morbid complications are associated with RGU and MCU studies.

KEYWORDS

ascending urethrogram, descending urethrogram, male urethra, posterior urethral valves, stricture urethra

INTRODUCTION

Cysto-urethrography has an important role to diagnose conditions having dysuria [9]. Dysuria can be defined as difficulty in micturition or painful micturition due to inflammation in bladder and urethra or both [9]. Dysuria is usually associated with frequency, urgency, hesitancy, dribbling micturition and weak stream of urine while voiding. Rarely patient may have haematuria, pyuria or nocturia [9]. Dysuria at the start of micturition is suggestive of the urethral pathology while dysuria at the end of micturition is suggestive of bladder origin [22,29,52,68,69,75].

Cysto-urethrography can be done in two ways: ascending or retrograde urethrography (RGU) and descending cystography or micturating cysto-urethrogram (MCU). It is an OPD procedure, no written consent is required [9,16,22,29,31,45,68,74]. Only local preparation of the parts is required. It is cheap, and a very useful diagnostic modality to determine cause of dysuria. Daily 3-4 patients attending a general hospital OPD have above complaints. Commonest causes of Dysuria are stricture urethra, prostatic enlargement and congenital urethral causes like posterior urethral valves (PU valves)[22, 29, 52, 68, 69,75]. We determine the length of the strictures especially in male urethra and plan the surgical treatment modality accordingly [44, 47]. It gives perfect details of associated vesico-ureteric reflux (VUR)[5, 6, 9, 21, 22]. RGU is procedure of choice for rupture urethra [1,2,4,8,9,22,31,38,44,45].

RGU is done by injection of dilute contrast through external urethral meatus, while MCU is done by introducing contrast (diluted) through catheter or suprapubic catheter. No morbid complication is associated with RGU and MCU [16,22,31,44,47,46,48,74,75].

The main intention of publishing the dissertation research project was to highlight the definite and conclusive role played by the conventional urethrography procedures still relevant today and also to highlight different and many diverse clinical conditions ranging from strictures in male urethra, prostatic enlargement, PU valves, periurethral abscess, urethral rupture in male and female urethra, anterior urethral valves, vesico-ureteric reflux, fistulae like recto-vesical fistulas, vesico-vaginal fistulas and types of neurogenic bladder (upper motor neuron and lower motor neuron type) [52, 69, 75]. Huge number of subjects were included in this two-year project- total 196 cases out of which nearly 12% cases were normal, rest all had abnormal conditions of urethra and bladder as mentioned above. The images we got while fluoroscopying the RGU and MCU studies on an ideal 1000 mA Siemens fluoroscopy unit with IITV monitoring were exceptionally optimal to provide diagnosis. Though there was delay in publication, the basic & honest intention is toshowcase such images, conditions, found out with great dedication and hard work done by ourthen team of post-graduate residents in working hours. The other idea being the research work done to highlight the findings which were clinically very relevant, relevant even in today'surological practice and such work done instead of being just available to few residents in department from department book shelf, be available to one and all who access such journals. Point to make is 'The study should not be lost to posterity'.

Aims and Objectives of the Study [22,31,52,69,75]: -

1) To find the cause of dysuria.
2) To find the site involved in the patients complaining of dysuria.
3) To study cause of dysuria in children especially in congenital lesions like PU valves and fistulas.
4) To correlate the findings during radiologic findings with surgical findings (clinical) & endoscopic findings.
5) To study prevalence of dysuria in females.
6) To determine incidence of stricture urethra in patients with dysuria and demonstrate the specific location of stricture urethra.
7) To study incidence of vesico-ureteric reflux associated with dysuria pathology.

MATERIAL & METHODS

This prospective study was conducted in outpatient department building, Department of Radiology in Shri Chatrapati Shivaji Maharaj General hospital, Solapur during the corresponding first authors post-graduate residency period of month of July 1997 to November 1999. It was done on 300 and 1000 mA radiographic fixed machines with over-couch X-ray tube. 1000 mA unit has IITV monitoring device. The instruments used were: 50, 20, and 5 cc syringes, bowl for contrast, simple rubber catheter, infant feeding tube, sterile towels, rubber cannula, Xylocaine jelly, normal saline bottles.

Patients having complaints of Dysuria where subjected to MCU & RGU.Only local preparation was required. Patient was asked to empty bladder before procedure. Procedure was explained to the patient. No written consent is required. No sedation was required.

Contrast Media Used: -We used Urograffin 60% and 76% diluted in

normal saline. Urograffin contents are Sodium and meglumine diatrizoate. Urograffin 76% has contents 7.2 gm Iodine in 20 ml whereas Urograffin 60% has 5.4 gm Iodine in 20 ml. We also used Triovideo 280 and Triovideo 400, also containing same compounds.Male urethra was anesthesized with 2% Xylocaine jelly before introduction of urethral catheter.

Technique

A. MCU In Infants And Small Children [16, 22, 29, 30, 31, 48, 67, 68, 74, 75, 77]: Rarely sedation is required in apprehensive patients. Bladder is catheterised with 4 or 5 no. infant feeding tube. Catheter is taped to thigh. All this is done under all strict aseptic precautions. Residual urine is drained from bladder. Bladder is steadily filled with diluted contrast medium (15%). Contrast medium was injected by hand injection method. Fluoroscopy was used intermittently to assess bladder filling and to check for VUR. The AP film of cystogram was taken. When bladder was fully distended patient was given supine oblique position with dependent thigh flexed and non-dependent thigh extended. Films including urethra and bladder where taken while child voided on X-ray table. X-ray was centred on upper border of pubic symphysis. Films taken included KUB and urethra.Later post-voiding film was taken to see effect of VUR.

B. MCU In Adults [22, 29, 31, 48, 67, 68, 77]: Procedure is done under sterile conditions usually via a bladder catheter. Patient is requested to empty bladder prior to procedure and then patient lies supine on X-ray table. Perineum and external urethral meatus is cleaned with mild antiseptic solution and local anaesthetic gel is applied. Simple rubber catheter or infant feeder tube was introduced. Urograffin diluted upto 15% was used and bladder was filled by 200 to 350 cc of diluted contrast till patient has desire to micturate. Films are taken supine oblique position with dependent thigh feed.Lateral views were taken if VVF or vesico-rectal fistula were suspected.

Alternative Techniques [14,22,29,31,67,77,68]

1) Suprapubic bladder puncture: It is useful in infant and children where bladder lies high direct suprapubic puncture can be done with full bladder. We did not use this method.
2) Suprapubic catheter technique: In tight stricture - the bladder can be filled with suprapubic catheter.
3) Urethrography: Contrast is introduced in the bladder during ascending urethrography with Foleys catheter or Knutson's clamp.
4) Following IVU: Excretory cystogram can be done following, but VUR is not easily detected by such method.

Retrograde Urethrography (RGU)[22,45,46,48,77]

Procedure is explained to patient. Aseptic precautions are used. Patient is given supine oblique position with right dependent thigh and 10-16 cc of diluted contrast (30%) was introduced via rubber cannula through external urethral meatus and over couch films were taken including urethra and bladder.

Complications Of MCU & RGU [26,46,77]

1. Urinary tract infection [26] (Incidence estimated followed cystography is 30% so prophylactic antibiotics are given).
2. Complication of catherisation: Urethral Trauma, Bladder trauma, Insertion of suprapubic catheter into peritoneal cavity.
3. Urethro-cavernous reflux [46]: Due to tight strictures and high injection pressure, contrast intravasates into cavernous and venous sinuses. It is complicated by bleeding. Prophylactic antibiotic is advised to prevent septicemia.

Contradictions Of MCU & RGU [77]: are 1. Urinary tract infection, 2. Hypersensitivity to contrast medium.

RESULTS

We studied 196 cases of dysuria in a period of two years. We found that commonest cause of dysuria was stricture urethra followed by BEP in adults and posterior urethral valves in children. [Please refer to Pie Diagram 1, Tables I, Tables II, Table III, Table IV, Table V, TABLE VI, TABLE VII]

Total Cases Studied – 196 Cases [TABLE I]

1) Stricture urethra – 100
2) Benign enlargement of prostate (BEP) – 18
3) Posterior urethral valves (PU Valves) – 6
4) Rupture urethra – 6
5) Urethritis – 5
6) Neurogenic bladder – 5
7) Periurethral abscess – 4
8) Urethro-cutaneous fistula – 4
9) Urethral calculus – 3
10) Vesical calculus – 2
11) Vesico-vaginal fistula (VVF) – 2
12) Recto-vesical fistula (RVF) – 2
13) Urethral diverticulum – 1
14) Carcinoma bladder – 1
15) Recto-urethral fistula – 1
16) Tuberculous cystitis – 1

DISSCUSSION

DYSURIA: It is defined as difficulty in micturition or painful micturition. It is usually caused by inflammation (Franklin and Brendley et al)[21,30,51,68,69,75]. This pain is usually referred to tip of penis in males and labia in females. If pain starts at onset of micturition it suggests urethra pathology. If pain starts at end of micturition, it suggests bladder pathology. Dysuria is frequently associated with frequency, urgency, hesitancy, dribbling micturition and patient usually has to strain during voiding.

Causes of Dysuria are

a) RELATED TO BLADDER [22, 30, 52, 69, 75]: Cystitis, Foreign body, Vesical Calculus, Fistula, Neurogenic bladder, Ca bladder & Rupture of bladder
b) RELATED TO URETHRA [21, 30, 52, 69, 75]: Stricture urethra, BEP, Ca prostate narrowing urethra, Prostate urethral valves, Periurethral abscess, Urethral Calculus, Urethritis, Rupture urethra, foreign body and fistula.

Historical Aspects And Review Of Literature [22,30,52,69,75].

Human bladder and urethra have been studied with X-ray techniques ever since early days of radiology.In 1902, Wulff used retrograde filling for cystography. In 1922, Bellere and Henry, in 1910 – Cunningham and in 1945, Ediling – focussed study on urethra and demonstrated strictures and Ca prostate by RGU. In Early 1930's – Intravenous urography made study of bladder possible. In 1945, Edley emphasized that to visualize bladder and urethra in adults, micturition method should be used. In 1957, Kjell-berg and co-workers wrote first comprehensive account on child's lower urinary tract on their experience with 1461 children. In 1965, Burrows monograph on urethral lesions in children was based on findings obtained by micturition studies. In 1960, Shoffner[13] wrote extensively on methodology and physiology of the Bladder and Urethra. In Late 1950's and early 1960, cine cysto-urethrography in children was popular [14]. Originally RGU was performed with penile clamps. McCallum & Colapinto (1976) [45] used Foleys catheter in distal urethra to retain contrast in urethra.

Contrast Media Used In RGU and MCU: In 1910 – Cunningham used 50% argyrol Suspension whereas in 1912 – Gray injected Bismuth suspension into urethra. In 1925 – Sicard and Forestier used Lipiodal for RGU. Due to morbid and mortal complication of lipiodal and Barium like oil embolism, newer contrasts were developed.In 1970 – Shopfer showed that sodium acetrizoate was irritating to the bladder more than meglumine diatrizoate. In 1972 & 1974, McAlister and co-workers used 30% & 25% meglumine diatrizoate on experimental basis.In recent days, Sodium and meglumine salts of diatrizoate & iothalamate are routinely used 15% of the solution for MCU and 30% for RGU. Omnipaque (iohexol) can also be used.

Anatomy of Urinary Bladder [22, 78, 79]: It is receptacle for storage of urine. In adults, it has maximum capacity of 500 ml. It is situated behind pubic bones within pelvis. Empty bladder lies within pelvis, as it fills it rises into hypogastric region. In children, it can extend upto umbilicus when full. Base is triangular, supero-lateral angles are joined by ureters and inferior angle gives rise to urethra. Base is related to two vasa deferentia and seminal vesicles, separated from bladder by Fascia of Denonvilliers.Neck of bladder rests on the apex of prostate. Neck is held position by puboprostatic Ligaments in male and pubovesical Ligaments in female.Interior of bladder shows mucous membrane thrown into folds in empty bladder and disappears when the bladder is full.Trigone is an area of smooth mucous membrane covering internal surface of base of bladder. Ureters piece bladder wall obliquely and open at supero-lateral angles of the trigone. Internal ureteric ridge is a muscular ridge, which joins the two ureteral openings. Uvula vesicae is small elevation situated immediately

behind urethral orifice and is produced by median lobe of prostate. Muscular coat is called Detrusor and has three layer of interlacing muscle fibres. At neck, it forms a circular sphincter vesicae. Mucosa is transitional epithelium. Arterial Supply to bladder is from superior vesical, inferior vesical arteries and branches of internal iliac artery. Venous drainage is through veins from vesical venous plexus & drain into internal iliac veins. [Illustrations A, B and C]

Nerve Supply Of Bladder

a) Sympathetic: Postganglionic fibres originate from L1 and L2 lumbar ganglia & descend to bladder via hypogastric plexuses. They inhibit contraction of detrusor and stimulate closure of sphincter vesicae.
b) Parasympathetic: Preganglionic fibres arise as pelvic splanchnic nerves from S2, S3 & S4 cord segments and pass through inferior hypogastric plexus to reach bladder wall, where they synapse with postganglionic neurons within bladder wall. They stimulate detrusor and relaxes sphincter vesicae.
c) Sensory fibres: From bladder reach CNS via pelvic splanchnic nerves. Some travel via hypogastric plexuses to reach L1, L2 cord segments.

Male Urethra [22, 78]: It is 20 cm long, extend from neck of bladder to external urethral meatus on glans penis. It has three parts: Prostatic, membranous and penile

Prostatic Urethra: 3- 4 cm long, passes through prostate, continues as membranous urethra. It is widest and most dilatable part of entire urethra.On posterior wall is a longitudinal ridge called as veru montanum or urethral crest. On each side of the crest is a groove called prostate sinus. On summit of urethral crest is opening of prostatic utricle. On each edge of mouth of utricle are opening of 2 ejaculatory ducts.

Membranous Urethra: 1.25 cm long, lies within urogenital diaphragm, surrounded by external sphincter urethrae. It is least dilatable portion of urethra.

Penile Urethra: 12 – 16 cms long, enclosed in bulbous and corpus spongiosum of penis. External urethral meatus is narrowest part of penile urethra. Part of urethra lying within the glans is dilated to form fossa navicularis.Bulbar urethra is dilated portion of penile urethra continuous with membranous urethra.

Female Urethra [22, 78]: 3.8 – 4 cm long, extends from neck of bladder of external meatus where it opens into vestibule 0.5 cm below clitoris. It traverses sphincter urethrae and lies immediately in front of vagina. At edge of meatus lie openings of para-urethral glands.

Embryology of Bladder [79]: Cloaca divides into primitive urogenital sinus and rectum. Primitive urogenital sinus divides into vesico-urethral canal (cranial) and definitive urogenital sinus (caudal).Epithelium is derived from vesico-urethral canal (endoderm). Epithelium of trigone is derived from mesonephric ducts (mesoderm). Muscle develops from splanchnic- pleuric mesoderm.

Embryology of Urethra [79]

a. Female urethra is derived from caudal part of vesico-urethral canal. Posterior wall is derived from mesonephric ducts.
b. Male urethra: Part upto ejaculatory duct develops from caudal vesico-urethral canal, rest of prostatic urethra and membranous urethra is derived from pelvic part of definitive urogenital sinus. Penile part is from phallic part of definitive urogenital sinus. Part in glans is derived from ectoderm.

Physiology Of Micturition [22,52,69,75]

In toilet-trained individual, micturition reflex action is controlled by higher centres of the Brain. When the urine volume reaches 300ml, stretch receptor in bladder walls are stimulated and transmit impulses to CNS, and so individual has conscious desire to micturate.Afferent impulse pass via pelvic splanchnic nerves to S2, S3 & S4 cord segments, others via sympathetic nerves to L1 & L2 cord segments. Efferent parasympathetic impulses leave cord from S2, S3 & S4 via pelvic splanchnic nerves to produce contraction of detrusor and relaxation of sphincter vesicae. Efferent impulses also pass to urethral sphincter via pudendal nerve (S2, S3 & S4) and relaxes it. Reflex can be assisted by abdominal muscles.

In children, micturition is a simple reflex act and takes place whenever bladder distends. This simple reflex is inhibited by action of cerebral cortex in adults, until time and place for micturition are favourable. Inhibitory fibres pass via corticospinal tract to end in S2, S3 & S4 cord segments and voluntary control develops by second to third years of life.

Radiology Anatomy [22,31,69,77,78]: [As in Figures 1A and 1B, 2, 3A and 3B, and 4A and 4B]

In MCU, bladder and urethra is demonstrated in entirety. The female urethra is analogous to male prostatic urethra and membranous urethra.In AP recumbent position, neck of bladder lies just above pubic symphysis and fundus rises to a variable distance above symphysis depending upon the degree of distention. Distended bladder is ellipsoid in shape in adults. In children, it tends to be elongated in its long axis. Outline of bladder is usually smooth when distended but may be irregular in collapsed state. In male, there is minimal rarefaction of neck of bladder due to impression of prostate. In undistended bladder, there are indentations on dome of bladder by pelvic colon, uterus, etc.

Urethra: Prostatic urethra is slightly spindle shaped and is 2 – 4 cm long, it joins the base of bladder abruptly. The narrowness of membranous portion extends for a distance of 1 to 1.5 cm. Outline of penile urethra is uniform throughout.Female urethra is 4-5 cm in length and resembles closely prostatic urethra. Its walls are smooth and as minimal luminal diameter about 3mm and maximum 8 mm.

Various Pathological Conditions Found On RGU and MCU, Cystogram Studies Are As Follows:

Stricture Urethra [10,22,28,31,32,35,44,45,70]

It is a scar in urethra resulting from tissue injury or destruction. Two basic causes of stricture urethra are trauma and inflammation. Charles Devine and Co-workers found that the most common cause of stricture urethra in their study was trauma. But in our study of 100 cases of stricture urethra, inflammatory strictures (74 cases) were more common than traumatic strictures (25 cases). Age group affected with stricture was 8 years to 75 years.

Causes of stricture urethra in posterior urethra are: Fracture pelvis (8 cases), Post- prostatectomy stricture [Figure 7 of our case] (8 cases). The site of stricture urethra was usually located proximal to junction of membranous to bulbous urethra but distal to veru montanum. (Walsh Petal). Cause of post-prostatectomy stricture [64] is poor mucosa to mucosa apposition of bladder to urethra at time of anastomoses. Elkins et al [21] states that causes of inflammatory strictures are gonorrhoea, chlamydia, tuberculosis and very rarely syphilis. Most of the patients in our study had h/o gonorrhoea after episodes of sexual exposure (25 patients). Various studies were done to demonstrate stricture urethra by Cysto-urethrography.

Study (A): Marberger & Frick J et al 1966 studied 258 patients. Causes of Stricture urethra in this study were: Trauma – 41%, Gonorrhoea – 29 %, Tuberculosis – 8%, Nonspecific infection – 13%, Congenital – 9%. The sites of stricture urethra found were: Bulbar urethra – 49%, Membranous urethra – 18%, Meatal stricture – 14%, Penile – 8%, Prostatic – 2%, Multiple – 9%

Study (B): Fernandes and Draper J.W. 1969 et al [17] studied 99 cases. The causes of stricture urethra in this study: Gonorrhoea – 85%, TRUP – 8%, Straddle injury – 5%, Foleys catheter trauma – 1%. The sites of Stricture urethra were: Penile – 18%, Bulbo-penile – 14%, Membrano-prostatic – 68%

Study(C): Colapinto 1969 et al [8] studied 99 cases. The causes of stricture urethra in this study: Trauma – 50%, Infection – 39%, Unknown – 11%. The sites of stricture urethra were: Bulbar – 66%, Penile – 20%, Membranous urethra – 24%

In our study of 100 patients of stricture urethra, aetiology of stricture urethra was as follows: [Figures 6A, 6B, Figure 8, Figure 9, Figure 10]

Inflammation – 32%, External Trauma – 30%, Catheter Trauma – 30%, Multiple factors– 8%

The various complications of stricture urethra we found were: Periurethral abscess (3 cases), Urethro-cavernous reflux (3 cases), Vesico-ureteric reflux (6 cases), Urethro-cutanous fistula (5 cases), false passage (1 case) and contrast extravasation (1 case)

Benign Enlargement Of Prostate (BEP) [41,51,52]: [Figures 5A and 5B]

On RGU, stretched elongated posterior urethra is seen especially prostatic urethra with elevated bladder base showing concave

depression due to enlarged median lobe of prostate.

We did ultrasound scan of each patient of BEP and found that the prostate was enlarged. USG findings correlated with our radiological findings. No case of Ca prostate was found.

Posterior Urethral Valves [7,9,11,13,22,24,27,31,34,50]
These valves arise from distal end of verumontanum and obstruct the flow of urine. These are the three types of posterior urethral valves. (Edmond T.S. & Gonjales J.R et al)

Type I PU Valves: Obstructing membrane that radiates in distal direction from verumontanum posteriorly downwards towards membranous urethra anteriorly with opening in membrane.

Type II PU Valves: These are the folds radiating from verumontanum cranially towards posterolateral aspect of bladder neck. They do not exist. They actually are muscle diaphragm slips that extend cranially, commonly seen associated with PU Valves.

Type III PU Valves: These are obstructing membrane that is actually incomplete dissolution of urogenital membrane with central opening & situated distally to verumontanum. They have wind sock like prolapsing folds into bulbar urethra (Field & Stephen et al (22)).

We found six cases of PU valves in children of age group ranging from 1 month to 10 years.
-Three cases were due to type I PU valves.
-Three cases were due to type III PU valves.

Out of these six, three patients had bilateral grades 5 VUR with gross hydronephrosis and hydroureter. Two patients had no VUR. One patient had unilateral VUR. All of them showed poor renal function, all of them were successfully treated with endoscopic fulguration. MCU showed dilated posterior urethra with abrupt transition into normal caliber anterior urethra. Radiologically, PU valves of type I had deep anterior notch as compared to central origin of bulbar urethra from dilated posterior urethra in type III PU Valves. Retrospectively, we confirmed these findings on endoscopy done by surgeon.

Rupture Urethra [1,2,4,8,9,22,31,36,38,49,51,56,65,66,69]
They can be divided as follows: Posterior urethral injuries and anterior urethral injuries

Posterior Urethral Injuries [8,30,31,45]**:** The most common case is fracture pelvis. Colapinto and McCallum classification of Rupture urethra is as follows:
Type I: Prostatic urethra is stretched by hematoma no e/o extravasation,
Type II: Extravasation occurs from posterior urethra into extraperitoneal space limited below by urogenital diaphragm.
Type III: Extravasation occurs above and below ruptured urogenital diaphragm.

Complications found in their study were (1) Infection (2) Stricture (3) Incontinence (4) Impotence

Anterior Urethral Injuries [30, 31]**:** They are uncommon causes are straddle injury, direct blow to urethra, self inflicted injury or iatrogenic.

V Colapinto & McCallum (1972) [8] et al studied 15 cases. All 15 cases had fracture pelvis. Results were: Type I – no patient, Type III – 13 patients, Type II – 2 patients

In our studies, we found six cases of Rupture urethra. One had straddle injury with rupture bulbar urethra. Other five had type III rupture urethra with #pelvis. Five patients were male group (age group 35 – 70 years). One patient was female [Figure 16] with fracture pelvis and peri-urethral hematoma (age 10 years) [Figures 15A, 15B]

URETHRITIS [22,31,21,69,75]
We found six patients, three were associated with the following findings:
1) 35 years old male with stricture bulbar urethra & meatal stenosis.
2) 60 years old male with BEP.
3) 72 years old male with periurethral abscess and stricture urethra.

Actually, these patients presented with dysuria and hand no e/o fulminant infection so MCU was done. In our series of six patients, all had history of (h/o) sexual exposure with possibly gonococcal or chlamydial infection. Radiological Findings – RGU revealed loss of smooth outline of urethra and irregularity of urethral outline.

Neurogenic Bladder [3,9,20,22,25,31,51,69,75]
Following are causes of neurogenic bladder: Suprasacral cord lesion, injury to cerebral or micturition, damage to sacral cord or peripheral nerves supplying bladder, multiple sclerosis, Parkinsonism, spinal dysraphism and myelodysplasia.

Thomas et al 1973 [3,21] studied neurogenic bladder in detail. He found that: Suprasacral cord or brain lesion leads to loss of voluntary detrusor with control with uncoordinated voiding and unstable bladder, seen as 'FIR-CONE BLADDER' or 'PINE-TREE BLADDER' on MCU (suggesting upper motor neuron type of neurogenic bladder). Sacral cord or peripheral nerve root damage leads to non-contractile detrusor so bladder is large, smooth walled and dilated with huge capacity upto 1 litre (suggesting lower motor neuron type of neurogenic bladder). Complication of neurogenic bladder in his study were: Infection (UTI), Stricture, VUR and sphincter incompetence.

In study of Stuart B. Bauer et al Campbell's Urology, 6th Edition, and most common causes of neurogenic bladder were myelomeningocele, meningocele and agenesis of sacrum. 85% of these patients had Arnold – Chiari malformation. VUR was seen in 3 – 5% of the cases

In Our Study Of Five Cases
1) Case I: 48 years old male H/O # T-L spine case of paraplegia had large atonic bladder, no VUR. Lower motor neuron type bladder.
2) Case II: 7 years old female e/o Lumbar meningocele and partial agenesis of sacrum showed 'pine tree bladder' with VUR grade 3 right side. Arnold Chiari malformation is the cause in this case.
3) Case III: 10 years old female e/o operated lumbar meningocele showed Fir-cone bladder with VUR grade 5 right side. Arnold Chiari malformation is the cause in this case. [Figure 18]
4) Case IV: 6 years old female e/o Dorsolumbar Diastematomyelia with VUR grade 5 left side & 'Fir-cone' bladder. Arnold Chiari malformation is the cause in this case. [Figure 17A and 17B]
5) Case V: 7 years old male case of meningocele had neurogenic bladder, no VUR and dilated bladder neck.

Periurethral Abscess [26]
It is a complication of stricture urethra and catheter trauma or instrumentation injury. Radiologically it was seen as contrast leakage from urethra with loculated collection around urethra.

We Found Four Cases Of Periurethral Abscess – Two patients had stricture urethra, One had h/o long term urethral catheterisation. Sites of abscess were: Around prostatic urethra only in three cases and around whole urethra in one case. All had pus cells in urine prior to MCU & RGU. Procedure was done in all cases after full course of antibiotics when infection was under control as suggested by Repeat urine exam. [Figures 11A and 11B]

Urethro-Cutaneous (Urethro-Perineal) Fistulae [22,31,52,69,75,]
Most common cause of fistula is a periurethral abscess secondary to stricture urethra, (Elkins et al 1980), other causes are trauma (external) & iatrogenic trauma.

In our study of four cases of urethro-cutaneous fistula – findings were as per follows:
Case I: 35 years old male with watering can perineum, & h/o exposure had multiple urethro-perineal fistula.
Case II: 25 years old male with h/o catheterisation stricture bulbo-penile urethra with urethro-perineal fistula.
Case III: 28 years old male had penile urethro-cutaneous fistula.

In all of them; cause was complicated stricture urethra with periurethral abscess as seen on clinical findings.

Urethral Calculus [19,22,23,37]
George W Drash et al [19] studied cause of urethral calculus, causes were: Calculus expelled from bladder, primary development in urethra if stricture is present and urethral diverticulum. It forms < 1% of calculi in urinary tract.

Englisch et al (1909) [23] studied various cases of urethral calculus; 41%

had Posterior urethral calculus, 19% had bulbar urethral calculus, 29% had penile urethral calculus.; 11% had calculus in navicular fossa.

We Studied Three Cases Of Urethral Calculus. All 3 Patients Had Dysuria, Hematuria And Acute Retention Of Urine:
Case I: 10 years old male had stricture bulbar urethral with two bulbar urethral calculi.
Case II: 7 years old male had stricture prostatic urethra with calculus proximal to it.
Case III: 75 years old had penile urethral calculus passed from bladder. [Figure 22]

Vesical Calculus [2,22,31,68,69,75]
Causes are Stasis, infection, foreign bodies or descent from kidneys. Composition is uric acid or magnesium ammonium triphosphate apatite.

We studied two cases of Vesical calculus complaining of Dysuria at end of micturition on excretory cystography. The calculi can be noticed on plain X-rays also. We confirmed vesical calculus by ultrasound examination showing echogenic focus with posterior acoustic shadowing.

Vesicovaginal Fistula [21,43,52,69,75]
Schlomo Ray, Naomy A, Saad Juma et all 1966 studied VVF. Various causes of VVF found were: Abdominal hysterectomy & vaginal hysterectomy. Urologic and GI surgery, Obstetric injuries & surgeries.

In 1956, Everrett & Mattigley studied 149 bladder fistula; causes were: 44% - due to Gynaecological surgery, 32% - due to Ca Cervix & Radiotherapy, 20% - due Obstetric trauma and 4% -other causes.

We studied two cases of VVF. We advised IVU cystogram in both cases, to demonstrate renal function in same sitting as well. These patients had the following symptoms: dysuria, continuous dribbling of urine, bloody urine and watery vaginal discharge. In both the cases dysuria was due to bladder infection.
Case I: 48 years old female known case of Ca bladder infiltrated into vaginal to produce VVF.
Case II: 35 years old female with Caesarean section 2 month back with VVF. [Figure 22]

Rectovesical Fistula [57,72,74,75]
This fistula presents with dysuria due to association with infection. Commonly it is acquired rather than congenital (Elkins 1890 et al). Basics cause is congenital Rectovesical Fistula. It is due to defect in formation of urorectal septum and its fusion with cloacal membrane associated commonly with imperforated anus.

We studied two cases. We did not find any acquired cause of rectovesical fistula.
Case I: 7 months old male had imperforated anus. [Figure 21]
Case II: 1.5 years old male had imperforated anus with VUR grade 3 right side.

Vesico-Ureteric Reflux (VUR) [5,6,9,22,31,33,61]
It is associated with dysuria pathology. Kutschner (1910) and Bumper (1924) presented early observation of clinical cystographic appearance of VUR. Incidence of VUR in 0-2% in children. [Lowell R King (1996) et al]. If UTI is seen, 20-30% children develop VUR [Shopfner (1970), Snellie & Normaal (1960), Walker (1977)]

Aetiology of VUR are: 1) Short or absent intravesical ureter e.g. Golf hole ureter, primary VUR, ureteral lateral ectopia.2) Absence of detrusor buttress e.g. Paraureteric diverticulum, weak thin neurogenic bladder. 3) Cystitis, 4) Ectopic ureter, 5) Iatrogenic reflux, 6) High intravesical pressure

Dwarkin and Perlmitten (1973) [18] graded VUR as follows: -
Grade 1 – lower ureteral filling
Grade 2A – ureteral and pelvicalyceal filling without dilatation.
Grade 2B – ureteral and pelvicalyceal filling with mild dilatation.
Grade 3 – Calyceal clubbing and moderate pelvic dilatation without ureteric tortuosity.
Grade 4 – Ureteral dilatation and tortuosity with gross clubbing of calyces.

We Found Thirteen Cases Of VUR.
1) 2 cases of primary VUR with imperforate anus. [Figure 19]
2) 4 cases of stricture urethra due to high intra-vesical pressure.
3) 3 cases with posterior urethral valves.
4) 3 cases of primary VUR with rectal atresia.

We did not find any associated complication of VUR like intra-renal reflux, pyelonephritis & renal hypertension [31,61] as in other studies.

Anterior Urethral Diverticulum/ Valve [22,31,52,69,75]
They can arise due to: Congenital anterior urethral diverticulum; Secondary to surgery for imperforate anus, Urethroplasty & instrument. It may be rarely associated with calculus or carcinoma.

We found single case of anterior urethral diverticulum arising just distal to bulbar urethra. Cause was not known in this adult male.

Carcinoma Of Bladder [40,51,52]
Primary bladder tumours are: 1) Epithelial in Origin: a) Transitional cell carcinoma (90%); b) Adenocarcinoma (1%), c) Squamous cell Carcinoma (10%); 2) Nonepithelial Tumors:

Diagnosis is based on cystoscopy, cystogram, IVU and biopsy.

Findings on cystogram are: Well demarcated filling defect usually round with lobulated margins, may show bilateral VUR.

We could study a single case of Ca bladder in 65 years old male presenting with hematuria & dysuria, and was later biopsied revealing transitional cell carcinoma treated by radiotherapy and chemotherapy as it was inoperable.

Recto-Urethral Fistula [57,72,74,75],
It was associated with dysuria due to infection. Urethro-rectal fistula of congenital origin is always associated with imperforate anus. Other causes are Ca rectum, Urethra Stricture etc.

We found a single case of urethro-rectal fistula of 2.5 years old female having imperforate anus.

Tubercular Cystitis [12, 22,31,59,69,75,76]
Radiological findings are: 1) Early stage – trabeculations are seen with irregularity of bladder outline and slight decrease in capacity.2) Late stage - reduced in capacity called as thimble bladder. Bladder gets calcified, urethral classification may be seen.

We found a single case of tubercular cystitis clinically diagnosed as Ca bladder 60 years old male complaining of dysuria, hematuria and frequency. He had thimble bladder with bilateral grade 2 VUR.

SUMMARY AND CONCLUSION

We studied 196 causes of dysuria referred to Radiodiagnosis department. We did MCU alone in 76 cases, RGU alone in 56 cases and MCU & RGU combined in 64 cases, Total -196 cases.

The various common causes of Dysuria in our study are:
Stricture urethra – 49%
BEP – 8.3%
PU valves – 3.3%
Urethritis – 2.5%
Neurogenic – 2.5%
Periurethral abscess – 2%
Rupture urethra – 3.3%
Urethral Fistula – 2%
(Rest 16 % cases were having normal studies)

In Stricture urethra, the common sites were penile 39 cases. Bulbar 34 cases, Posterior urethra 31 cases, and multiple sites in 10 cases.

The causes of urethral stricture were:
Inflammation 74%, # pelvis 8% & Catheter trauma 9%, Post – prostatectomy 8%, congenital 1%.

Vesico-ureteric reflux was associated with Stricture urethra (6 cases), Tubercular cystitis (1 case), Neurogenic bladder (3 cases) and Primary VUR (3 cases).

We found six cases of posterior urethral valves – three cases were due type I valves, Other three were due to type III valves.

We found five cases of Neurogenic bladder, causes were:
1) Meningocele – 3 cases
2) Diastematomyelia – 1 case
3) # spine – 1 case.

We could diagnose BEP on the basis of RGU alone and in some cases with help of MCU. In 4 cases of urethral fistula, 2 drained into base of scrotum and 2 drained around penile urethra.

We found five cases of rupture urethra, the most common cause was # pelvis and Straddle injury – four cases were seen involving posterior urethra and one involved bulbar urethra.

Modifications we did were supra-pubic puncture & IVU cystography. No serious complications were noted excepted two cases of bleeding due to urethro-cavernous reflux.

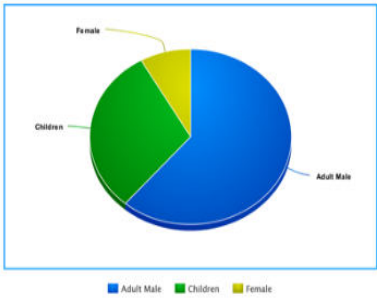
It is a cheap, easy and OPD procedure. No preparation of patient is required. No sedation is required.

RGU is investigation of choice in rupture urethra.

MCU is the best investigation to demonstrate VUR.

We found cystourethrography as very safe, non-invasive and accurately diagnostic procedure for dysuria.

Pie Diagram, Illustrations, Tables And Radiographic Diagnostic Images Of RGU And MCU:



Pie Diagram 1: Sex-wise And Age –wise Distribution Of Patients (adult Males- 120, Adult Females- 16, Male Children- 40)

Table I: List Of Final Radiologic Diagnosis (percentage And Number Wise)

Sr. No.	Radiological diagnosis	No. of cases	%
1	Stricture urethra	100	49
2	BEP	18	8.3
3	Posterior urethral valves	6	3.3
4	Urethritis	5	2.5
5	Neurogenic	5	2.5
6	Periurethral abscess	4	1.95
7	Urethro-perineal fistula	4	1.95
8	Urethral calculus	3	1.5
9	Vesical Calculus	2	1.1
10	Rupture urethra	6	3.3
11	Vesicovaginal fistula	2	1.1
12	Rectovesical fistula	2	1.1
13	Vesical ureteric reflux (Primary)	2	1.1
14	Urethral Diverticulum	1	0.49
15	Ca Bladder	1	0.49
16	Rectourethral fistula	1	0.49
17	TB cystitis	1	0.49
18	Normal MCU & RGU	34	16
	TOTAL CASES	196	

Table II: Stricture Urethra

Site of Stricture		No. of cases
Penile		39
Bulbar		34
Membrano-prostatic		31
Multiple sites		10

Table III: Causes Of Stricture Urethra

Cause of urethral Stricture	% of cases
Inflammation	74
Pelvis and Straddle injury	8
Internal trauma	9
Post prostatectomy	8
Congenital	1
TOTAL	100

Table IV: Complications Of Urethral Stricture

Complication	No. of cases
Periurethral abscess	4
Urethro-cavernous reflux	2
Vesico-ureteric reflux	6
Urethro-perineal fistula	5
Urethral Calculus	2

Table V: Sex-wise Distribution

Males with Dysuria	180
Females with Dysuria	16

Table VI: Age-wise Presentation

Sr. No.	Radiological diagnosis	Age presentation
1	Stricture urethra	8 – 75 yrs
2	BEP	50 – 80 yrs
3	Posterior urethral valves	1 mth – 10 yrs
4	Rupture urethra	10 – 70 yrs
5	Neurogenic bladder	6 – 40 yrs
6	Urethritis	35 – 72 yrs
7	Urethro Cutaneous fistula	25 – 70 yrs
8	Periurethral abscess	35 – 70 yrs
9	Urethral calculus	7 – 75 yrs
10	Vesical Calculus	6 – 70 yrs
11	VVF	35 – 48 yrs
12	Rectovesical fistula	7 mth to 1.5 yrs
13	Vesico ureteric reflux	1 yr to 1.5 yrs
14	TB cystitis	60 yrs
15	Urethral diverticulum	40 yrs
16	Recto-urethral fistula	2.5 yrs
17	Ca bladder	65 yrs

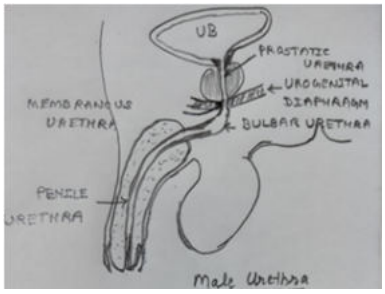


Illustration A- Showing Anatomy Of Male Urethra And Its Parts

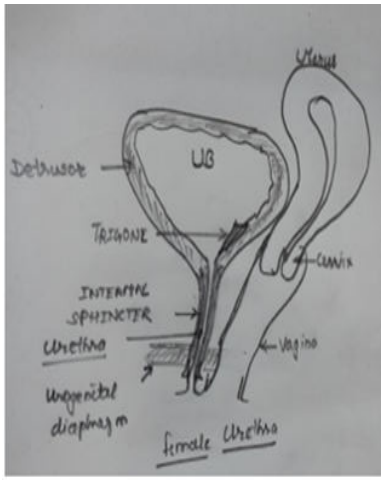


Illustration B- Showing Anatomy Of Female Urethra And Urinary Bladder

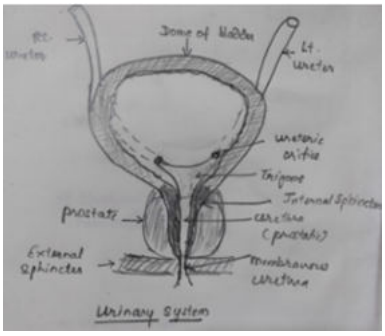


Illustration C- Showing Internal Anatomy Of Urinary Bladder And Posterior Urethra In Male Subject

Figure 1A and 1B: Normal retrograde urethrogram (RGU) and micturating cysto-urethrogram (MCU), in a male child. RGU done by instilling 50 to 60% contrast, and MCU by using 30 % contrast (Urografin- Sodium & meglumine diatrizoate 76%)

Figure 2: Normal RGU in an adult male showing normal anterior urethra as well as posterior urethra- penile urethra (shown by short broad white arrow, bulbar urethra (shown by white short arrow) and membranous urethra (shown by long white arrow)

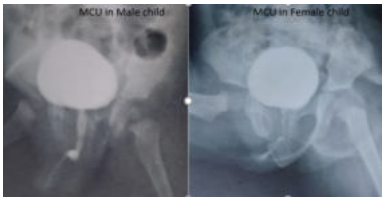
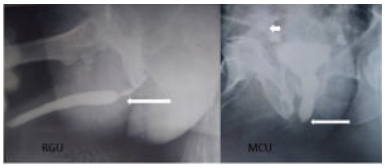


Figure 3A and 3B: Normal studies showing Micturating cysto-urethrograms in a male and a female child.

Figures 4A & 4B: Normal RGU and MCU study in male adult individual

Figure 5A and 5B: RGU studies done in two different old individuals with benign enlargement of prostate confirmed on USG showing stretched and elongated prostatic urethra (shown by long white arrows) with elevated urinary bladder base with indentation by enlarged uvula vesicae portion due to median lobe enlargement if prostate (shown by short broad white arrows)



Figures 6A and 6B: Ascending urethrogram (RGU) and descending urethrogram in a middle aged adult with history of exposure in past, showing short segment tight stricture of bulbo-membranous junction of urethra (shown by long white arrow. Bladder was filled by contrast though suprapubic catheter (short white arrow). There is proximal significant dilatation and holdup of contrast in proximal prostatic urethra.

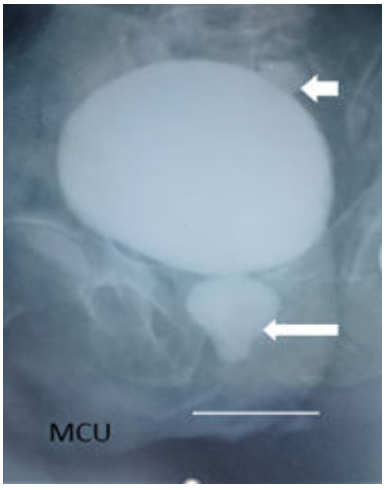


Figure 7: MCU in an old male patient presenting with dribbling micturition after few months of Frayer's suprapubic prostatectomy, showing dilated post-prostatectomy prostatic urethral portion (shown by white broad arrow) with distal strictured narrowing of membranous urethra leading to dysuria. Anterior urethra is shown by long white arrow has normal calibre. Small diverticulum is shown arising from urinary bladder by short broad white arrow.

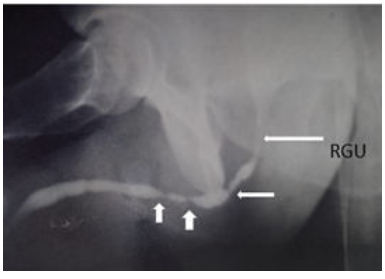


Figure 8: RGU demonstrating multipole urethral strictures shown buy short white arrows involving bulbo-membranous junction of urethra as well as bulbo-penile junction as well as anterior penile urethra in a patient with prior history of gonococcal urethritis. He had h/o exposure in past.

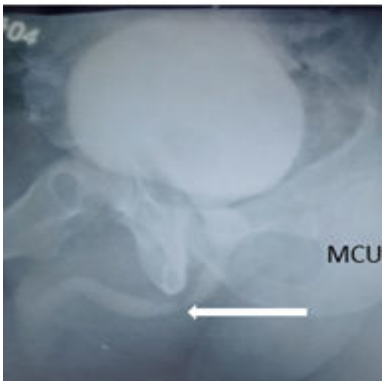


Figure 9: MCU in adult male showing short segment stricture (shown by long white arrow) in bulbar portion of anterior urethra.

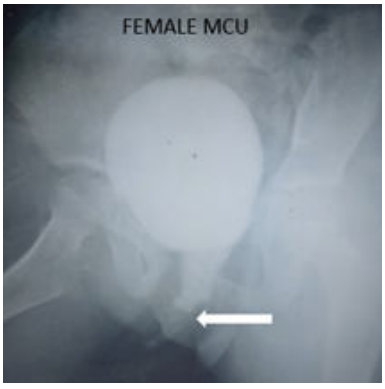
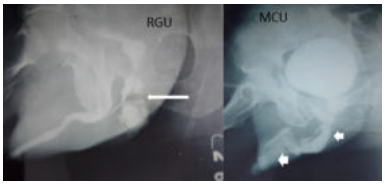


Figure 10: MCU in a young female patient with Mullerian duct agenesis having primary distal urethral congenitalstricture, she had dribbling micturition with difficulty in passing urine.

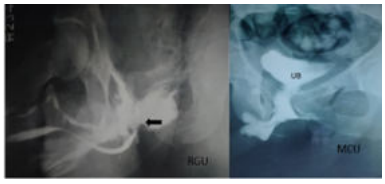


Figures 11A and 11B: RGU and MCU in an adult presenting with watering-can perineum (multiple discharging sinuses) showing periurethral contrast extravasation on RGU as well as MCU study due to multiple periurethral abscesses.

Figures 12: One-year-old male child with posterior urethral valves and Grade 5 vesico-urethral reflux [VUR] (shown by short arrow with notch) on left side showing dilated posterior urethra (shown by short white arrow) with abrupt transition into normal calibre anterior urethra (marked by long white arrow).

Figure 13: MCU in a male child with posterior urethral valves (PU valves) showing bilateral grade 5 VUR with hydronephrotic kidneys (shown by short white arrows) & dilated posterior urethra.

Figure 14: MCU in another case of PU valves with abnormally dilated posterior urethra showing abrupt transition to normal calibre anterior urethra, with the lucent filling defect seen in dilated posterior urethra shown by black arrow suggesting abnormal posterior urethral valve folds converging towards distal end of posterior urethra.



Figures 15A and 15B: Type 3 posterior urethral rupture (McCallum & Colapinto's classification) seen on RGU as well as MCU in same adult male patient with straddling injury in a road traffic accident (RTA).

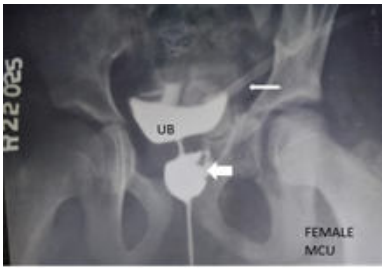


Figure 16: Female patient with RTA having pelvic fractures on left with blood in urine and having suprapubic catheterisation (shown by thin white arrow) showing pooling of contrast in periurethral location (marked by short broad arrow)

Figures 17A and 17B: A male child with diastematomyelia with central bony bar in lower dorsal spine (shown by long white arrow) and widened interpedicular distances and fused posterior neural elements with vertebral fusion abnormality showing Neurogenic bladder with typical 'fir-cone' bladder with grade 4/5 VUR on left side on MCU study.

Figures 18: Another male child with Neurogenic bladder with typical 'fir-cone' appearance of urinary bladder with grade 4/5 VUR on right side.

Figure 19: Grade 3 Primary VUR (left kidney shown by short black arrow) on left side in a male child having Imperforate anus.

Figure 20: A two-year male child with urinary bladder diverticula (shown by short broad white arrows). Normal urethra seen (shown by white long arrow)

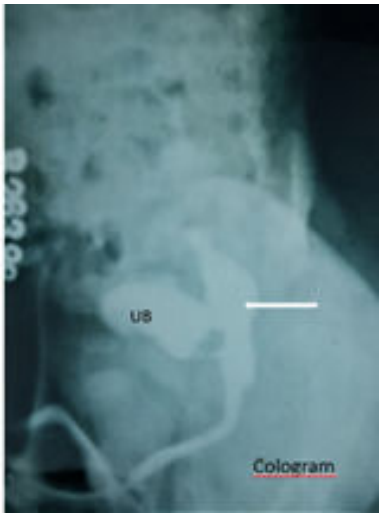


Figure 21: Distal cologram done with water soluble contrast medium showing recto-vesical fistula with opacification of urinary bladder in a male child having fecal contamination of urine.

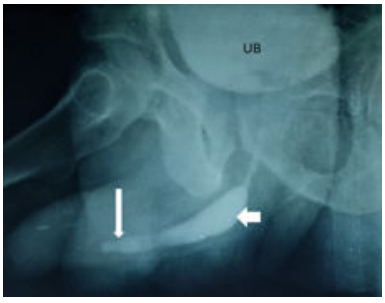


Figure 22: Urethral calculus impacted in mid-penile urethra with holdup of contrast seen proximally in urethra on MCU study in a middle aged adult male.

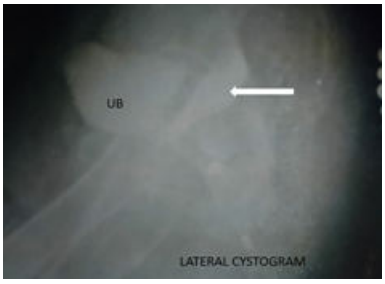


Figure 22: Lateral cystogram projection in an adult female with history of Caesarean section having vesico-vaginal fistula (VVF) with contrast filling the vaginal canal and vault region from bladder.

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