# ROLE OF SONOURETHROGRAPHY IN THE EVALUATION OF ANTERIOR URETHRAL STRICTURE-A ONE YEAR HOSPITAL BASED OBSERVATIONAL STUDY

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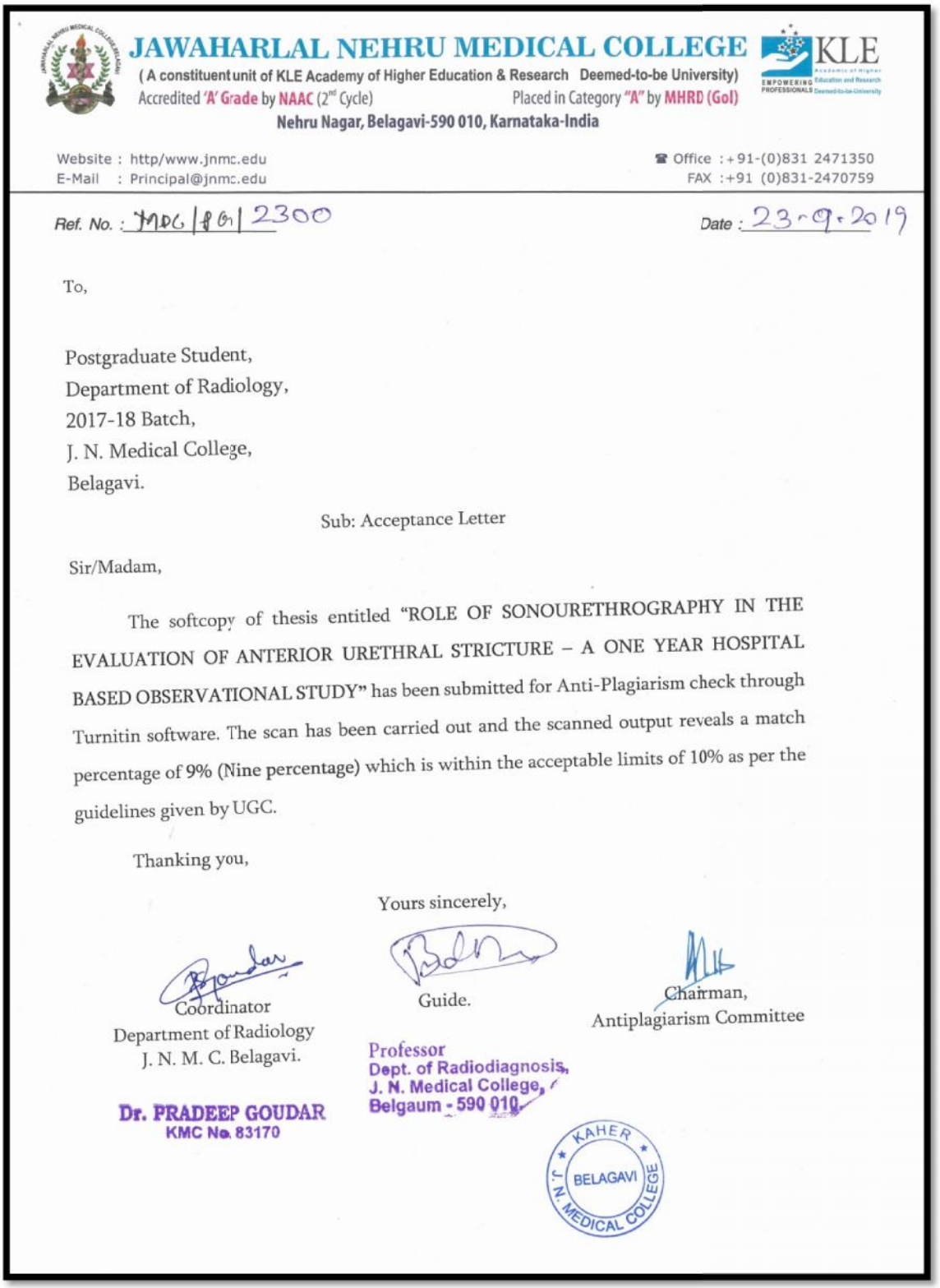

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| SUG | Sonourethrogram |
| RGU | Retrograde urethrogram |
| ASU | Ascending urethrogram |
| CT | Computed tomogram |
| MRI | Magnetic resonance imaging |
| CI | Confidence interval |
| HS | Highly significant |
| NS | Not significant |

# ABSTRACT

**Background & objectives**

Urethral stricture is a pathology involving the anterior urethra or fibrosis involving the urethral epithelium or corpus spongiosum (spongiofibrosis).

The post-operative result of a urethral stricture depends on appropriate pre-operative evaluation, thus accurate preoperative examination and investigations are essential for better post-operative results. The determining points or parameters to the surgical approach are precise measurement of extent of anterior urethral narrowing along with spongiofibrosis.

Radiographic retrograde urethrography or ascending urethrography is considered as the gold standard investigation for identification of urethral stricture affecting anterior urethra. Retrograde urethrography is 91% sensitive and 72% specific in the diagnosis of anterior urethral stricture. Limitations of retrograde urethrography or ascending urethrography are poor definition of stricture length involving proximal portion of bulbar urethra and periurethral spongiofibrosis. Retrograde urethrogram requires multiple image acquisition like right and left oblique views. The radiation exposure is approximately 1-2 mSv which equals approximately 20 thorax x-rays and half year of environmental radiation.

Sonourethrogram is a 3-dimentional technique with advantages of being radiation free and easy repeatability. Sonourethrogram detects stricture and determines its parameters like length and spongiofibrosis. It can also identify complications like fistula formation, diverticulum etc.

The objectives of this study are to establish the sensitivity of sonourethrography in the identification of the anterior urethral stricture and to determine the accuracy of sonourethrography in measuring the span of anterior urethral stricture as well as to detect spongiofibrosis.

**Materials and methods**

One year prospective observational study was done in Department of Radio-diagnosis at the KLE'S Dr. Prabhakar Kore hospital & MRC, Belagavi.

30 patents were included in the study. These patients are subjected to retrograde urethrography and sonourethrography to detect, measure the length and degree of spongiofibrosis in anterior urethral stricture disease.

Sensitivity, specificity, positive and negative predictive values of sonourethrography were calculated. Unpaired t-test was used to determine its ability to measure the length of the anterior urethral stricture. The values were then compared with retrograde urethrgraphy and intra-operative results. The percentage of patients detected to have spongiofibrosis on sonourethrography was also computed.

**Results**

The sensitivity and specificity of sonourethrogram as compared to ascending urethrogram was found to be 92% and 100% respectively with positive and negative predictive values of 100% and 71.43% respectively.

In this study sensitivity and specificity of sonourethrogram as compared to intra-operative results were 92% and 100% respectively with positive and negative predictive values of 100% and 71.43% respectively.

In the current study ascending urethrogram and intra-operative findings correlated well with 100% sensitivity, specificity, positive and negative predictive values.

**Interpretation and conclusion**

Urethral obstructive pathologies are one of the common problems presenting to the urosurgeon. Urethral obstructive conditions are divided into those involving anterior and/or posterior urethra. Radiographic imaging is the gold standard imaging investigation. Other investigations which can be used are sonography, cystoscopy, computed tomography and magnetic resonance imaging. Ascending urethrography has high sensitivity and specificity in identification of anterior urethral strictures. Sonourethrography has extra advantage of identifying the degree of spongiofibrosis and precisely measuring the length of stricture.

Thus the study concluded that though radiographic imaging is the best imaging modality available, sonourethrography can also provide similar results with additional benefits like precise measurement of length of narrowing in the anterior urethra (especially the bulbar urethra) and severity of scarring of corpus spongiosum.

The disadvantage of sonourethrography is that it is a poor imaging modality for identification of strictures involving the posterior urethra.

**Keywords**

Stricture, Sonourethrogram, Ascending urethrogram.

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# INTRODUCTION

Urethral stricture is a pathology involving the anterior urethra or fibrosis involving the urethral epithelium or corpus spongiosum (spongiofibrosis)[1].

Obstructive conditions involving the anterior urethra constitute urethral strictures. Obstruction can be due to trauma like straddle fractures and iatrogenic injury or due to inflammatory conditions like infection and balanitis xerotica obliterans[2].

The post-operative result of a urethral stricture depends on appropriate pre-operative evaluation, thus accurate preoperative examination and investigations are essential for better post-operative results. The determining points or parameters to the surgical approach are precise measurement of extent of anterior urethral narrowing along with spongiofibrosis.

Radiographic retrograde urethrography or ascending urethrography is considered as the gold standard investigation for identification of urethral stricture affecting anterior urethra. Retrograde urethrography is 91% sensitive and 72% specific in the diagnosis of anterior urethral stricture[3]. Limitations of retrograde urethrography or ascending urethrography are poor definition of stricture length, specifically the scarring involving proximal portion of bulbar urethra and periurethral spongiofibrosis[4]. Radiographic urethrography is a 2-dimentional imaging investigation. The way a stricture looks relies upon amount of stress on the urethra and posture of the individual while injecting contrast[5]. Retrograde urethrogram requires multiple image acquisition like right and left oblique views [6]. The radiation

exposure in is approximately 1-2 mSv which equals approximately 20 thorax x-rays and half year of environmental radiation[7,8].

Sonourethrogram is a 3-dinentional technique with advantages of being radiation free and easy repeatability[4]. Sonourethrogram detects stricture and determines its parameters like length and spongiofibrosis[9]. It can also identify complications like fistula formation, diverticulum etc.

The aim of this study is to compare efficacy of sonourethrogram in evaluation of male anterior urethral strictures.

# AIM AND OBJECTIVES

AIM:

To compare the efficacy of sonourethrogram in the evaluation of male anterior urethral strictures.

OBJECTIVES :

1. To ascertain the sensitivity of sonourethrography in the identification of the anterior urethral stricture.
2. To determine the accuracy of sonourethrography in calculating the length of anterior urethral stricture as well as to detect spongiofibrosis.

# REVIEW OF LITERATURE

Urethral stricture is an obstructive pathology of the anterior urethra which can be due to trauma like straddle fracture or inflammatory conditions like balanitis xerotica obliterans [2].

Urethral stricture diagnosis is clinically challenging, thus imaging investigations are necessary for the diagnosis. Retrograde urethrogram is the gold standard investigation but the procedure gives results only about the disease process affecting the urethral lumen. Sonourethrography is an imaging modality which detects the urethral luminal pathology and measures the length of the urethral stricture precisely. Sonourethrography also detect extraluminal pathology like spongiofibrosis which is an important pre-requisite for pre-operative planning.

IC Akpayak, CC Ani, NK Dakum, SI Shuaibu and VM Ramyil [9] performed a prospective study in 2012 on 60 patients clinically presenting with symptoms related to anterior urethral pathology. They compared both retrograde urethrogram and sonourethrogram in imaging of anterior urethral narrowing. The individuals were examined by both RUG and SUG. The sensitivity of sonourethrography was found to be 94%. According to their study, sonourethrographic measurement of stricture length was better as compared to retrograde urethrography. Sonourethrography accurately diagnosed spongiofibrosis in 51.7% patients suspected to have urethral stricture. Hence, they concluded that sonourethrography is an important tool in the imaging of anterior urethral pathology.

In a prospective study conducted by B R Ravikumar, K M Madappa, Chiranjeevi Tejus, Dharakh Prashant and G S Dhayanand[4] in 2015 on 40 patients presenting with symptoms of stricture urethra. In this study findings of

sonourethrogram and ascending urethrogram were compared by sensitivity, specificity, negative predictive value and positive predictive value. The study concluded that sonourethrogram can be used as an imaging modality with efficacy as good as ascending urethrogram. However, sonourethrogram is less efficient in diagnosing obstructive pathology affecting posterior urethra. Sonourethrogram better determined the severity of spongiofibrosis and length of the stricture. Sonourethrogram also has side effects lower than ascending urethrogram.

A retrospective study was done in the year 2010 by Edward, Jeanne S. Chow, Claudia Martinez Rios Arellano and Richard S. Lee [10] using sonographic urethrogram and retrograde urethrogram. The study was conducted on 12 pediatric patients presenting with voiding symptoms. According to retrograde urethrogram 7 cases were grouped into category I-less than 1cm, 4 cases were grouped into category II-1 to 3cm and none were grouped into category III- greater than 3cm stricture and there was no evidence of stricture in 1 case. According to sonourethrogram 9 were grouped into category II, 2 were grouped into category III and in one case there was no evidence of stricture. One case with a category II stricture on ascending urethrography did not show presence of stricture on sonourethrography. One case who had no evidence of stricture on sonourethrography was diagnosed to have stricture on retrograde urethrography. In 10 out of the 12 patients stricture length is upgraded by sonourethrogram. Thus concluded that sonography is beneficial for diagnosing stricture disease of urethra in adolescents and also helpful in preoperative planning by precise calculation of length of stricture.

A Medline and chart literature review was done in 2000 by Jack W Mcaninch and Allen F Morey [6]. The study was done in California on admitted individuals in San

Francisco general hospital, from the year 1988 to 1998. They concluded that in stricture bulbar urethra length calculated by sonourethrography correlated well with intraoperative findings ($p<0.007$) and to a minor degree with ascending urethrogram. According to their study sonourethrogram can be used in patients presenting with symptoms suggestive of urethral stricture especially in patients with need for surgery. In bulbar strictures, length of stricture is measured more precisely by sonourethrography than ascending urethrography. This is helpful in pre-operative assessment of whether excision or grafting needs to be done in a stricture. In long and complex strictures, measuring diameter of stricture helps in determining width of the flap. It also helps in determining the portion of urethra that needs to be excised. Sonourethrography has the advantage of being simple, easily available, precise and additional benefit of being free of radiation.

A prospective study conducted on 17 patients by Jack W Mcaninch, R Brooke Jeffrey and Faye C Laing [5] in the year 1988. The patients included presented with voiding symptoms. The patient first underwent ascending urethrography for detection of stricture. After identification of stricture the patient also underwent sonourethrographic imaging. The findings of both the procedures were determined. The observations obtained from ascending urethrography were not disclosed to the person performing ultrasonography until completion of the sonourethrography. In seventeen patients a total of twenty strictures were identified. According to the imaging findings of sonourethrography, 3 strictures were classified as mild, 6 as moderate and the remaining 11 were classified into severe. There was focal involvement of urethra in 11 strictures and diffuse in 8 urethral strictures. There was a false positive result in sonourethrographic imaging and was thus not considered in the study. Zero false negatives were identified in the study. 7 patients underwent

urethroplasty and sonourethrography was found to be a precise predictor of the length of obstructive narrowing. Thus the study concluded that retrograde sonourethrography is a sensitive technique for detection of pathology affecting the anterior urethra and can also help calculate length of narrowing better than radiographic urethrography. Sonourethrography can also predict the degree of scarring which cannot be predicted by ascending urethrography. Stricture length and the severity of scarring are important pre-requisite to determine the treatment modality. The advantages of sonourethrography identified in this study are its potential to see the urethra in the two planes and its ability to image the urethra in a 3-dimentional view. Sonourethrography is a dynamic study, hence monitoring can be done which is not certain in retrograde urethrography. After treatment, multiple follow-up scanning of the urethra can be done as it is a radiation free procedure. Thus from the study, they concluded that sonourethrography can be a screening procedure in individuals suspicious of anterior urethral pathology.

Many other studies have analysed that SUG is an effective imaging modality in detecting anterior urethral pathologies and can be used as an alternative to ascending urethrogrphy in determining the obstructive narrowing of anterior urethra[11,12].

According to a study by Maciejewski C and colleagues the sensitivity can be increased by combining both retrograde urethrography and sonourethrography[13].

**Anatomy:**

Male urethra measures 17.0 to 20.0 cm and courses upto the external urethral opening or meatus from the level of bladder neck[14]. The divisions of male urethra are preprostatic, prostatic, membranous and penile. Fossa navicularis, pendulous urethra and bulbar urethra are the subdivisions of penile urethra. Male urethra may also be divided into two partitions, anterior and posterior. Prostatic and membranous urethra are parts of posterior urethra. Penile urethra comprises the anterior urethra. Male urethral diameter is not constant throughout its length. The urethral diameter of a normal healthy external meatus corresponds to a 24 F catheter[14]. Proximal adult male urethra is larger in calibre when compared to the distal. Prostatic urethra has the widest calibre of approximately 32 F[14]. The calibre of a normal bladder neck is usually 28 F[14].

The urethra is contained within the glans penis distally and corpus spongiosum proximally. The normal urethral diameter is 8.0 to 9.0 mm[15]. Anterior and posterior urethra is an anatomical division. The anterior urethra extends from perineal membrane to the external urethral opening. The posterior urethra begins from the bladder neck upto perineal membrane. The epithelium of urethral mucosa is transitional epithelium. The distal portion in the glans penis is covered by squamous epithelium. Urethral submucosa contains smooth muscle, connective and elastic tissues. Submucosal glands of littre open into lumen of urethra. The bulbourethral branches of internal pudendal artery gives the arterial supply to the urethra. The venous drainage from the urethra is into the pudendal plexus. The lymphatic drainage is into the internal iliac and common iliac group of nodes.

Prostatic urethra:

The prostatic urethra traverses the entire prostate. It is positioned anteriorly in the prostate. Urethral crest is an elevation seen in the entire length of posterior aspect of prostatic urethra. Urethral crest is not present at striated sphincter. There are many openings of the glands on each side of urethral crest. The transitional epithelium of the prostatic urethra can extend into prostatic ducts. There is an anterior turn at the midpoint of prostatic urethra which divides prostatic urethra into anatomically and functionally different segments[15]. These segments are termed as preprostatic (proximal) and prostatic (distal) segments. The angle may vary from 0 to 90 degrees[15]. The glands open into the prostatic urethra beyond this angle. The widened protrusion of the urethral crest forms verumontanum. The verumontanum contains openings of the prostatic utricles. The utricles orifice is visible cystoscopically and measures 6.0 mm[15]. The prostatic utricle is one of the mullerian remnant. The orifice of utricle lies in the centre with two ejaculatory duct openings on each side. Ejaculatory ducts are formed at the point where vas deferens and seminal vesicles join. The ejaculatory ducts open in the prostatic urethra[12]. When coursing through the prostate, the ejaculatory ducts are encircled by smooth muscle arranged in circular manner. Preprostatic sphincter is formed by thick circular smooth muscle, synonymous with the internal urethral sphincter. Nerve supply to the prostatic segment is by motor somatic fibers with an absence of any autonomic innervations.

Membranous urethra:

Length of membranous urethra measures 2.0 to 2.5 cms and extends from the apex of prostate upto perineal membrane[15]. Membranous urethra is formed by smooth and striated muscles. Striated muscles are arranged in the form of horse shoe shape.

The striated muscle are located in base of the bladder, anterior aspect of prostate and membranous urethra. The striated sphincter is wide based and narrows as it travels through a opening in the urogenital diaphragm to reach apex of the prostate. The striated sphincter inserts into the perineal body. Levator ani forms the medial boundary of striated sphincter and lies anterior to the dorsal veins. Anteriorly, urethra is connected to pubis by a connective tissue which forms the suspensory ligament of the penis. The mucosal lining of the striated sphincter's lumen is made of pseudostratified columnar epithelium. The submucosa of membranous urethra is vascular. Submucosa is surrounded by smooth muscle cells which are arranged in circular and longitudinal pattern. These muscles together form internal part of the sphincter. The striated sphincter is supplied by pudendal nerve and by sacral plexus. The smooth muscles are supplied by cavernous nerves. The stroma of the membranous urethra contains longitudinally organized collagen and elastin fibers. The lymphatic drainage is into the lymphatic channels draining the anteroinferior bladder which end in the medial or anterior retrofemoral nodes and the middle node of the medial group of the external iliac nodes. Nerve supply is solely motor somatic fibers without autonomic innervations. The ventral root of S3 with some contribution from S2, provides the somatic supply. They supply branches to the pelvic (splanchnic) nerve and passes to the pelvic (inferior hypogastric) plexus. Sensory innervation from the striated sphincter travels through the pudendal nerves via S2 and S3 to travel to the node of Onuf centrally.

Penile Urethra:

The penile urethra is also known as the pendulous or spongy urethra. It is located in the corpus spongiosum distal to the membranous urethra. The portion of the

penile urethra at the junction of membranous and pendulous urethra is known as bulbomembranous urethra. Bulbomembranous urethra lies within the urogenital diaphragm, striated urethral sphincter and the few centimeters of the adjacent bulbous urethra. It measures 2.0 cm in length. The bulbospongy urethra begins few centimeters distal to the membranous urethra and extends distally upto suspensory ligament. The lumen widens to form the urethral bulb. The bulbourethral glands or Cowper glands are positioned at membranous urethra and empty their secretions at three o'clock and nine o'clock positions of urethral bulb[15]. The length of the penile urethra from the suspensory ligament to the external urethral opening is approximately 15 cm[14]. It is positioned more dorsally than ventrally within the spongy tissue. The bulb and the fossa navicularis are the two segments of urethral lumen widening elsewhere the lumen diameter is relatively consistent. The mucosa is lined by transitional epithelium until it reaches the fossa navicularis. The muscle layer consists of an inner longitudinal, a middle circular and an inconsistently characterized outer longitudinal stratum. Small mucus-secreting cells of the glands of Littre open into the penile urethra and lubricate it before ejaculation. The glands of Littre are rich in goblet cells and enter the spongy tissue between the vascular spaces and the trabeculae. The arterial supply to the urethra is from bulbourethral branch of the internal pudendal artery. Venous drainage is by bulbar veins that drain into the prostatic plexus. The lymphatic drainage is by lymphatic network within the mucous membrane. These lymphatic channels course longitudinally but anastomose transversely and obliquely. The lymphatic channels drain proximally into trunks at the bulbomembranous urethra. The bulbomembranous lymphatic drainage may be variable. Some lymphatic drainage course along urethral artery, whereas others drain to the medial retrofemoral node after traveling behind the symphysis pubis. Sensory

innervation runs through submucosal axons that pass centrally through the dorsal nerve of the penis.

Fossa navicularis:

The glanular portion of the urethra is known as the fossa navicularis, where its caliber dilates when compared to the urethra proximal to it. It narrows again at the urethral meatus. Unlike the transitional epithelium of the remainder of the urethra, the urethral mucosa that traverses the glans penis is a squamous epithelium. These cells become keratinized near the meatus. The epithelium is separated from the smooth muscle of the spongy tissue by loose connective tissue and muscularis mucosa is absent. There are multiple pockets on the dorsal and lateral surfaces of the fossa navicularis. The lacuna magna (Morgagni) is a large pocket opening on the roof of the fossa navicularis.

**Urethral stricture:**

It is a pathology involving the distal urethra or fibrosis involving the epithelium or corpus spongiosum (spongiofibrosis)[1]. Spongiofibrosis is fibrosis of the corpus spongiosum which lies beneath the epithelium of urethra. In severe cases the scarring may extend into tissues adjacent to corpus spongiosum. Later contration of this scarring process will decrease the diameter of urethral lumen. For example, in case of scarring if the urethra measures 15 Fr then area of the lumen is reduced to 55 $mm^2$. Initially, the patients with stricture urethra may be asymptomatic. As the calibre of urethra is reduced further because of on-going scar contracture the patient develops symptoms. Urethral stricture terminology doesn't include urethral strictures affecting the posterior urethra. In stricture affecting the posterior urethra there is obliteration of the lumen by fibrous tissue and is likely due to distraction at the site of injury caused

by post-radical prostatectomy or trauma. World Health Organization conference definition of stricture is pathologies causing scarring of the anterior urethra. In pelvic fractures membranous urethral injury results in distraction defect. Posterior urethral narrowing is called as urethral contractures or stenoses.

Etiology:

Stricture is due to injury to urethral epithelium which heals as scar tissue. Trauma is the main cause for urethral stricture. The commonest cause of trauma is straddle fracture. Other traumatic cause is iatrogenic. However, the incidence rates of iatrogenic strictures have reduced recently due to use of smaller endoscopes. One etiology of stricture in children can be idiopathic urethrorrhagia. Squamous and transitional epithelium was observed on histopathological analysis of individuals with idiopathic urethrorrhagia. Parts of the epithelium were injured with hemorrhage and neutrophilic infiltration. The injured epithelium also contained microcalcifications and mucin secreating glands were noted in submucosa. No pleomorphic cells or viral and bacterial inclusion bodies were observed. Lichen sclerosis is an inflammatory condition which can cause strictures. Now a days because of efficient use of antibiotics, gonococcal infection as one of the etiology of stricture is rare. Congenital stricture is observed at the point where anterior urethra continues as posterior urethra. Its exact cause is not known, but there is no association with trauma or inflammation.

Diagnosis and Evaluation:

The symptoms are associated with voiding like straining, hesitancy, urgency, incomplete voiding etc. Incomplete voiding leads to retention of urine resulting in lower and upper urinary tract infections, infection involving the prostate and epididymis. When patient presents acutely with obstructive symptoms, an attempt is

made to insert foley's catheter and next retrograde urethrography is performed. If radiographic imaging is not clear, the acute situation is managed by performing a suprapubic cystostomy. Flexible endoscopy can be performed to determine the stricture. Before proceeding to treatment the exact location, length, number and degree of fibrosis needs to be determined[16]. Location and length of narrowing can be identified by retrograde urethrography, sonourethrograpgy and urethroscopy. Spongiofibrosis can be detected by physical examination, sonourethrography and urethroscopy.

Dynamic radiography:

Dynamic radiography was first observed by Colapinto and Mccallum. In dynamic radiography contrast is pushed retrogradely. The contrast medium used must be used in diluted form and should be suitable for intravenous injection. Among the infections contracted in hospital, radiographic urethrography contributes between 0.6% and 1.6%[17,18].

According to few studies, positive predictive value and negative predictive value of radiographic imaging in comparison to intraoperative findings were in the range of 50-93% and 76-100% respectively[19,20].

False passage of the contrast, fistula formation and reflux of the contrast into ducts are complications of the procedure[21].

Radiographic imaging is very beneficial in measurement of urethral distraction injuries[22]. Such measurements are important in deciding surgical approach[23].

There is poor delineation of fibrotic narrowing in cases of higher degrees of urethral obstruction. This can be overcome by combining ascending urethrography and micturating urethrography[24].

Ultrasonography:

McAninch and Morey first explained use of sonourethrography in identification of stricture urethra. Normal saline or lignocaine jelly may be utilized for the procedure, normal saline being cost-effective. According to McAninch and Morey, length of the fibrotic narrowing involving the bulbar portion of urethra can be precisely measured by ultrasonography. In retrograde urethrography if proper angulation is not maintained during the procedure, calculation of length of fibrotic narrowing may be underestimated. Precise calculation is essential for deciding whether anastomotic repair is required or not[16].

Sonourethrography is a 3-dimentional technique which not only identifies fibrotic narrowing but also helps us visualize the relevant anatomy of male urethra and penis. Sonourethrography procedure does not utilize ionizing radiation[25]. According to various studies, sensitivities and specificities of sonourethrography range from 66-100% and 97-98% respectively. Positive predictive values range between 50 and 80%[5,6,26]. Negative predictive values range between 96 and 98%[,6,26].

Technique: Sonourethrography can be performed using a 12 -18 MHz high frequency linear transducer. The urethra is imaged in both cross section and longitudinal section. While performing the procedure, privacy of the individual to be examined has to be considered. Imaging is performed from the proximal aspect of penis upto glans. Next step is to scan the perineum for visualization of bulbous urethra. Normal sterile saline or lignocaine gel is injected through the external urethral meatus. Saline or gel causes

distention of urethra and helps in precise identification of stricture. Sonourethrography also detects degree of spongiofibrosis.

Indications:

- Commonest indication being patients presenting with voiding difficulties.
- Pathologies of the corpora cavernosa like fibrosis.
- Vascular dysfunction involving the penis.
- Detection of foreign body
- Suspected urethral diverticulum assessment.
- Evaluation of pain or trauma involving penis.

Normal findings in sonourethrogram: Sonourethrography is done by keeping the transducer either on dorsal or ventral surface of penis. Urethra is normally collapsed. It distends only when distended with normal saline or during voiding state. In transverse plane imaging, corpora cavernosa are placed dorsally and urethra is located anteriorly. In saggital view, corpus spongiosum appears hypo- to isoechoic[25]. Corpora cavernosa appears hyperechoic and its artery appears as a double linear hyperechoic structure. Corpus spongiosum contains urethra which appears anechoic when distended.

Perineal Ultrasonography: Perineal sonourethrography is for better visualization of bulbous urethra and bulbomembranous junction. Branches of the pudendal artery are visualized. Portion of corpora cavernosa and its supplying artery are also visualized.

Limitations: Imaging of proximal urethra like prostatic urethra is not possible. According a study conducted by McAninch and colleagues, sonourethrogram is not an investigation for identification of strictures involving the proximal urethra[27].

Strictures affecting the posterior urethra can be better identified with a combined imaging by ascending urethrogram and micturating cystourethrogram[27].

Magnetic resonance imaging:

More recently, magnetic resonance imaging (MRI) is also being utilized for study of urethral pathologies. Role of MRI in the imaging of urethra was first studied in the year 1992[28]. Its advantages are identification of fistulae, cavities, false passages, and diverticulae.

According to some studies, intraoperative values regarding length and scarring closely correlated with MRI values and thus MRI can suggest additional information in surgical management[29,30,31,32].

Dynamic and Static CT cystourethrgraphic imaging:

This method of imaging provides adequate information in urethral injuries in pelvic fractures and improve surgical planning[33].

Endoscopic visualization:

After retrograde urethrography, urethroscopic visualization may be done if necessary. Urethroscopic examination can be done transurethrally or through a suprapubically placed tube.

Cystoscopy can identify urethral stricture before the changes are apparent on uroflowmetry[34]. Cystoscopy also provides details of bladder neck involvement. Bladder neck involvement by fibrous tissue has a risk of urinary incontinence and this parameter is significant for the surgery[26].

Treatment:

Dilatation:

Dilatation of stricture is old but simple technique. Dilatation is preferred when only the mucosal epithelium is involved with no involvement of the adjacent spongy tissue. This method stretches the scar and thus relives the symptoms of the patient[16]. Bleed during dilatation can be associated with tear in the stricture. Balloon dilatation cathethers are used for dilatation. In this technique using endoscopic guidance wire is passed through the stricture and then balloon is passed. Dilatation has good short and mid-term curative rates.

Internal Urethrotomy:

In this procedure the stricture is cut through the scar tissue upto normal tissue by passing the instrument through urethra. Later the urethra heals by secondary intention producing a larger lumen[13]. In healing by secondary intention, epithelium grows from the ends of the wound and it is a slow process. To fasten the process, there is wound contraction decreasing the area required for growth of epithelium. This decreases the healing time. The recurrence rates are high in this procedure if wound contraction occurs faster than growth of epithelium. Success of this procedure relies on degree of narrowed lumen as observed by Dubey and colleagues in the year 2005. The thinner part of peri-urethral spongy tissue is between 10 o'clock to 2 o'clock position and thus urosurgeons prefer incising the urethra at 12 o'clock position. But one has to be careful while incising in the bulbous urethra to avoid injury at the triangular ligament and intracrural space. A deep incision in the penile urethra may cause erectile dysfunction. Similarly, deeper incision in the bulbous urethra between 10 o'clock and 2 o'clock position can also cause erectile dysfunction. This procedure should be avoided in deeper involvement of peri-urethral spongy tissue. Bleeding,

recurrence, extravasation during the procedure into the surrounding tissues and erectile dysfunction are the complications of internal urethrotomy. Rare complication is formation of fistula between corpus cavernosum and corpus spongiosum. According to a study by McAninch and Santucci in 2001, the procedure yielded good results in approximately 20%. In another study by Emiliozzi and colleagues in the year 1996, the success rate was approximately 30% to 35%. 74% long-term success rate was observed in strictures measuring less than 1.5 cm in the bulbous urethra. Wound contraction can be decreased by inserting a Foley catheter for 6 weeks post urethrotomy. But, according to some studies 6 weeks of catherization after surgery is nearly equal to catheterization for 3 to 7 days. Other method is home self-catheterization. Self-catheterization combined with internal urethrotomy have shown to have better results than internal urethrotomy alone. However, according to Campbell's textbook of urology, the recurrence rate is high when self-obturation is stopped. Some drugs like colchicines and mitomycin C may also be used to oppose wound contraction. Colchicines acts by binding to tubulin and mitomycin C reduces fibroblast activity and production of collagen. Urethral stents are utilized in opposing wound contraction. Removable stents can be used for upto 1 year. The permanent stents have shown benefit in 84% at 4.5 years. The complications and side effects with permanent stents are pain during sitting and intercourse if implanted beyond scrotal urethra. The contraindications for permanent stents are previously operated with substitution urethral reconstruction.

Open Reconstruction: Excision and Reanastomosis

In this technique, there is complete removal of the area of scarring with an end to end reanastomosis [16]. There are lesser recurrence rates as compared to dilatation and internal urethrotomy. The points to be considered while operating are complete removal of scar tissue, wider spatulation at the anastomotic site and providing a tension-free anastomosis[16].

# METHODOLOGY

**Materials and methods:**

All patients with suspected anterior urethral pathology who were sent to the department of Radio-diagnosis were included in this study.

These patients are subjected to retrograde urethrography and sonourethrography to detect, measure the distance of narrowing and degree of scarring in anterior urethral stricture disease.

**Source:**

Data of patients who are referred for radiological imaging to Department of Radio-Diagnosis at the KLE'S DR. PRABHAKAR KORE HOSPITAL & MRC, BELAGAVI between 1st January 2018 to 31st December 2018 for retrograde urethrography and sonourethrography with suspected anterior urethral pathologies was collected. Patient information is stored in the computer and patient data entry books. These hospital records are the source of data in this study.

**Methods of data collection:**

**a. Study design**: Prospective observational study

**b. Duration:** One year**,** January 1st 2018 to December 31st 2018.

**c. Sample size:** Prevalence of urethral stricture disease in most of the studies done is very less (0.3 to 0.6 %).

Therefore the study comprised of all the patients presenting with signs and symptoms involving lower urinary tract pathologies, who were referred to the department of Radio-diagnosis for retrograde urethrography and sonourethrography during the study period.

**d. Sampling method:** Universal sampling method.

**e. Selection criteria:**

(i)Inclusion criteria:

All male patients presenting with signs and symptoms of urethral outflow tract pathologies.

(ii)Exclusion criteria:

1. Non consenting subjects.
2. History of allergy to the contrast material used in retrograde urethrogram.
3. Patients with watering can perineum.
4. Patients with fournier's gangrene.
5. Patients with posterior urethral stricture

**f. Procedure:**

The included patients gave written informed consent for both radiographic imaging and sonography.

A detailed history was noted in the form of a systematic proforma regarding patient name, age, sex, presenting complaints, past medical/surgical history.

Considering criterias of inclusion and exclusion, the patients were taken up for radiographic urethrography and sonourethrography.

Retrograde urethrography: While performing retrograde radiography, the urethra was moderately stretched by applying external stress and syringe with a cannula tip was utilized for injecting contrast medium. The patient was placed in supine position and the dependent thigh was acutely flexed while the pelvis is tilted obliquely to 45 degree. Under the guidance of radiographic imaging, 10.0 to 20.0 cc of contrast agent was injected (meglumine or sodium diatrizoate, 50% to 60% in adults and 30% in children). During injection of contrast, images were obtained. Retrograde urethrography can also be done by utilizing a 12-16 F Foleys catheter which can be inserted trasurethrally for 2 to 3 cm in the distal portion of urethra and by inflating its balloon with 2.0 to 3.0 cc of water. Precaution was taken to prevent entry of air bubbles into the urinary tract during the procedure.

The stricture was identified with its location and length of the narrowed portion was calibrated by using electronic caliper.

Dynamic retrograde urethrography is called so because the distal urinary tract (urethra) is visualized during the procedure under fluoroscopic guidance[35].

Topical anesthetic agents mixed with lubricating agents can produce mucosal edema and are less beneficial during the procedure[36].

Sonographic imaging: Role of sonographic imaging for study of male urethral narrowing was first done in 1985 by McAninch et al. Earlier sonourethrographic images were also obtained by Wagner and Merkle in 1988[37]. 7 to 12 MHz high

frequency linear transducer was used during the procedure. Sonographic imaging was done by placing the transducer directly on ventral or dorsal aspect of penis, scrotum and perineum. Saline or sterile gel was repeatedly injected by utilizing cather-tip syringe and the images were simultaneously obtained. Imaging is done in a systematic manner, beginning from the base of penis upto glans penis. Another way of sonographic imaging was by filling the urinary bladder and later applying firm suprapubic pressure. This method is termed as pseudoantegrade study. Pseudoantegrade method helps in precise calculation of stricture length. Approximately 10 to 15 ml saline was needed for adequate and precise study of anterior urethra. Images were obtained in both planes. Parameters like location, length and number of strictures are identified. Degree of spongiofibrosis can also be identified. The entire sonourethrography can be done by an experienced radiologist in approximately 10 to 15 minutes.

Sensitivity, specificity, positive predictive value and negative predictive value of both the procedures were determined. Length of narrowed segment is measured by unpaired t-test. The number of patients detected to have scarring of spongy tissue on sonourethrography was identified. Sonourethrography can also detect extra-luminal pathology and thus help in identification of degree of spongiofibrosis which is a helpful guide for surgical management[38,39].

# RESULTS

**Table 1: Detection of stricture by sonourethrography in comparison to RGU.**

| | RGU | | |
|---|---|---|---|
| **SONOURETHROGRAM** | **YES** | **NO** | **TOTAL** |
| **YES** | 23 | 0 | 23 |
| **NO** | 2 | 5 | 7 |
| **TOTAL** | 25 | 5 | 30 |

**SENSITIVITY =** 92.00% (at 95% CI)

**SPECIFICITY =** 100.00% (at 95% CI)

**POSITIVE PREDICTIVE VALUE :** 100.00% (at 95% CI)

**NEGATIVE PREDICTIVE VALUE:** 71.43% (at 95% CI)

Out of 25 patients detected to have strictures by RGU, sonourethrogram could detect in 23 patients.

Thus sensitivity, specificity, positive and negative predictive values are 92%, 100%, 100% and 71.43% respectively.

**Graph 1: Detection of stricture by sonourethrography.**

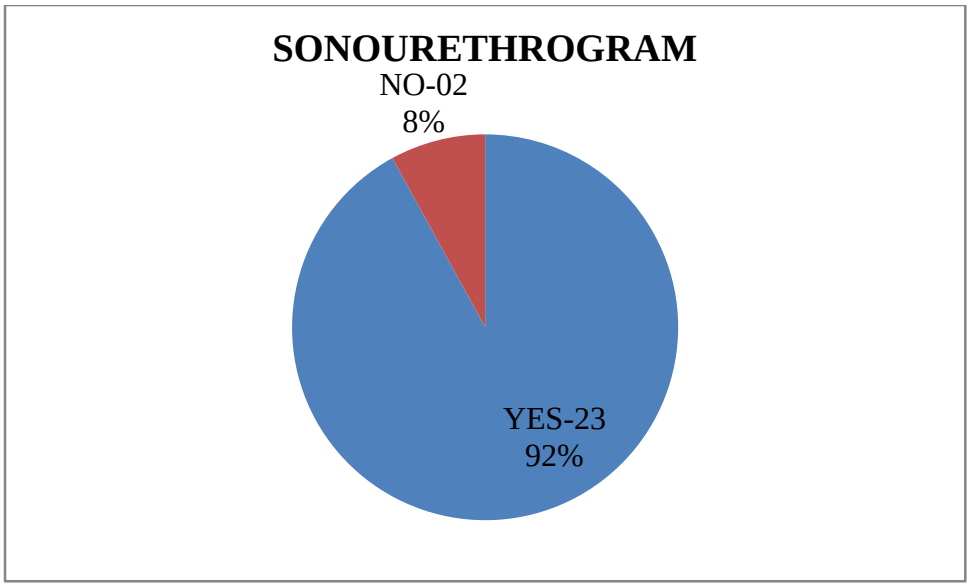


**Table 2: Detection of stricture by sonourethrography in comparison to intraoperative findings.**

| | INTRA-OPERATIVE | | |
|---|---|---|---|
| **SONOURETHROGRAM** | **YES** | **NO** | **TOTAL** |
| **YES** | 23 | 0 | 23 |
| **NO** | 2 | 5 | 7 |
| **TOTAL** | 25 | 5 | 30 |

**SENSITIVITY =** 92.00% (at 95% CI)

**SPECIFICITY =** 100.00% (at 95% CI)

**POSITIVE PREDICTIVE VALUE:** 100.00% (at 95% CI)

**NEGATIVE PREDICTIVE VALUE :** 71.43% (at 95% CI)

Out of 25 patients detected to have strictures by intraoperative findings, sonourethrogram could detect in 23 patients.

Thus sensitivity, specificity, positive and negative predictive values are 92%, 100%, 100% and 71.43% respectively.

**Table 3: Detection of stricture by RGU in comparison to intraoperative findings.**

| | INTRA-OPERATIVE | | |
|---|---|---|---|
| **RGU** | **YES** | **NO** | **TOTAL** |
| **YES** | 25 | 0 | 25 |
| **NO** | 0 | 5 | 5 |
| **TOTAL** | 25 | 5 | 30 |

**SENSITIVITY =** 100.00% (at 95% CI)

**SPECIFICITY =** 100.00% (at 95% CI)

**POSITIVE PREDICTIVE VALUE :** 100.00% (at 95% CI)

**NEGATIVE PREDICTIVE VALUE :** 100.00% (at 95% CI)

**Graph 2: Outcome of the three procedures in the detection of stricture.**

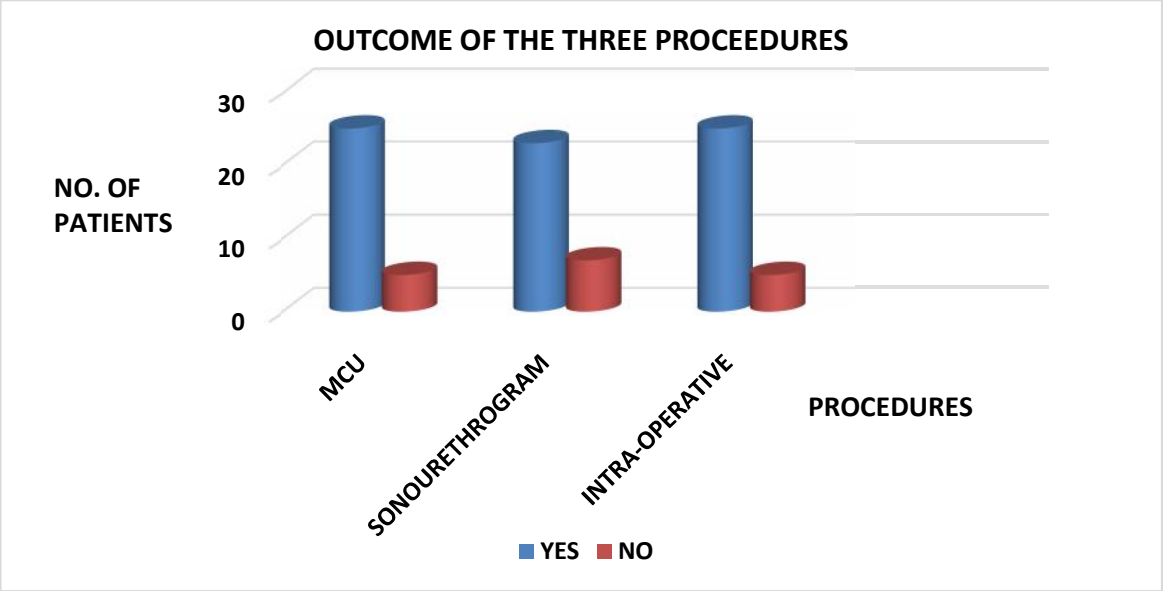



**Table 4: Determination of length of stricture by RGU and sonourethrogram.**

| RGU | | SONOURETHROGRAM | | | |
|---|---|---|---|---|---|
| **MEAN (cm)** | **S.D.(cm)** | **MEAN (cm)** | **S.D. (cm)** | **p VALUE** | **INFERENCE** |
| 1.06 | 0.56 | 1.70 | 0.56 | 0.0004 | HS (Highly significant) |

There was significant difference in the mean length of stricture observed by RGU and sonourethrogram (p value 0.0004). Thus there was no significant correlation in measurement of length of stricture by both procedures.

**Table 5: Determination of length of stricture by sonourethrogram and intraoperative finding.**

| SONOURETHROGRAM | | INTRA-OPERATIVE | | | |
|---|---|---|---|---|---|
| **MEAN (cm)** | **S.D. (cm)** | **MEAN (cm)** | **S.D. (cm)** | **p VALUE** | **INFERENCE** |
| 1.70 | 0.56 | 1.69 | 0.55 | 0.93 | NS (Not significant) |

There was no significant difference in the mean length of stricture observed by sonourethrogram and intraoperative result (p value 0.93). Thus the measurements obtained by sonourethrogram correlated well with surgical results.

**Table 6: Determination of length of stricture by RGU and intraoperative finding.**

| RGU | | INTRA-OPERATIVE | | | |
|---|---|---|---|---|---|
| **MEAN (cm)** | **S.D. (cm)** | **MEAN (cm)** | **S.D. (cm)** | **p VALUE** | **INFERENCE** |
| 1.06 | 0.56 | 1.69 | 0.55 | 0.0003 | HS (Highly significant) |

There was significant difference in the mean length of stricture observed by RGU and intraoperative result (p value 0.0003). Thus measurements on RGU did not correlate well with intraoperative results.

**Graph 3: Graph wise distribution of outcome of mean length of stricture by the three procedures**.

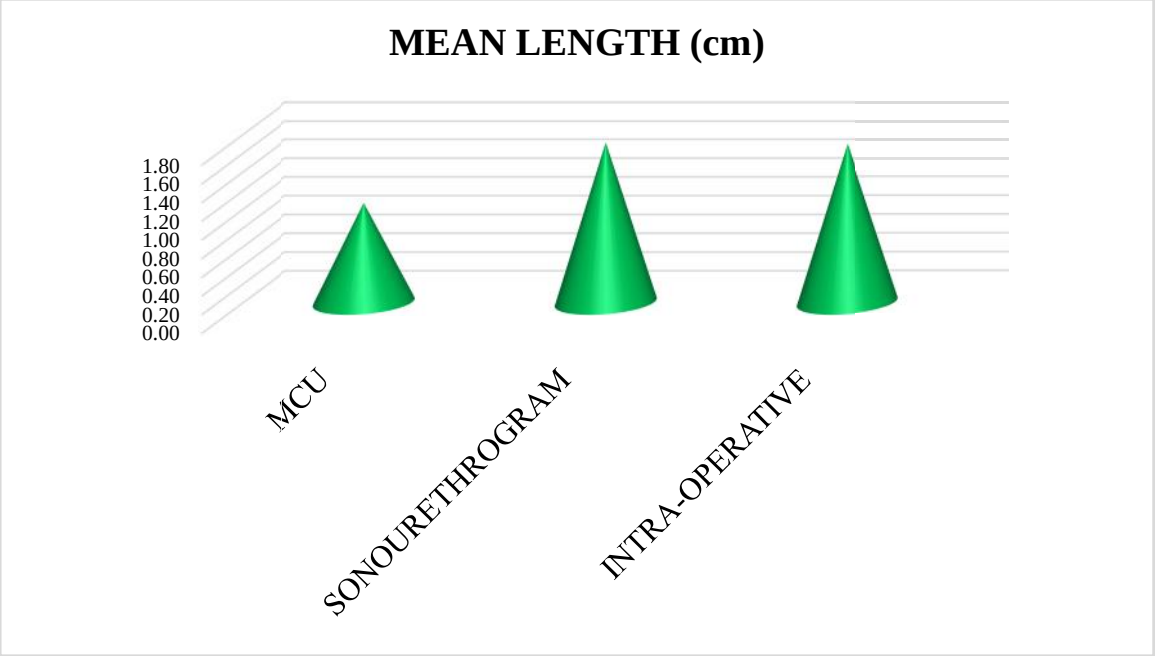



**Table 7: Location of stricture.**

Intra-operatively 25 out of 30 patients had strictures, with location as follows:

| LOCATION OF STRICTURE | NUMBER | PERCENTAGE |
|---|---|---|
| PENILE | 04 | 16 |
| BULBAR | 11 | 44 |
| PENILE & BULBAR | 01 | 4 |
| BULBOMEMBRANOUS JUNCTION | 09 | 36 |
| | 25 | 100 |

**Graph 4: Graph wise distribution of location of stricture**

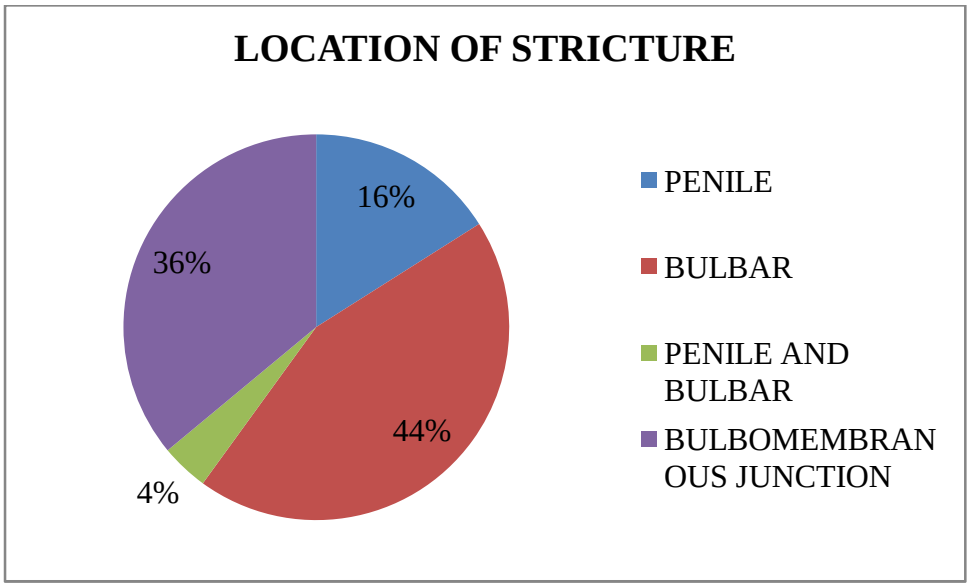



**Table 8: Degree of spongiofibrosis by sonourethrogram.**

Sonourethrogram could detect stricture in 23 out of the 30 patient sample with degree of spongiofibrosis as follows:

| DEGREE OF SPONGIOFIBROSIS (SONOURETHROGRAM) | NUMBER | PERCENTAGE |
|---|---|---|
| MILD | 01 | 4.34 |
| MODERATE | 08 | 34.78 |
| SEVERE | 14 | 60.86 |
| TOTAL | 23 | 100 |

**Table 9: Degree of spongiofibrosis as observed intraoperatively.**

Out of 30 patients, 25 had urethral stricture intraoperatively with degree of spongiofibrosis as follows:

| DEGREE OF SPONGIOFIBROSIS (INTRA-OPERATIVE) | NUMBER | PERCENTAGE |
|---|---|---|
| MILD | 02 | 8.0 |
| MODERATE | 08 | 32 |
| SEVERE | 15 | 60 |
| TOTAL | 25 | 100 |

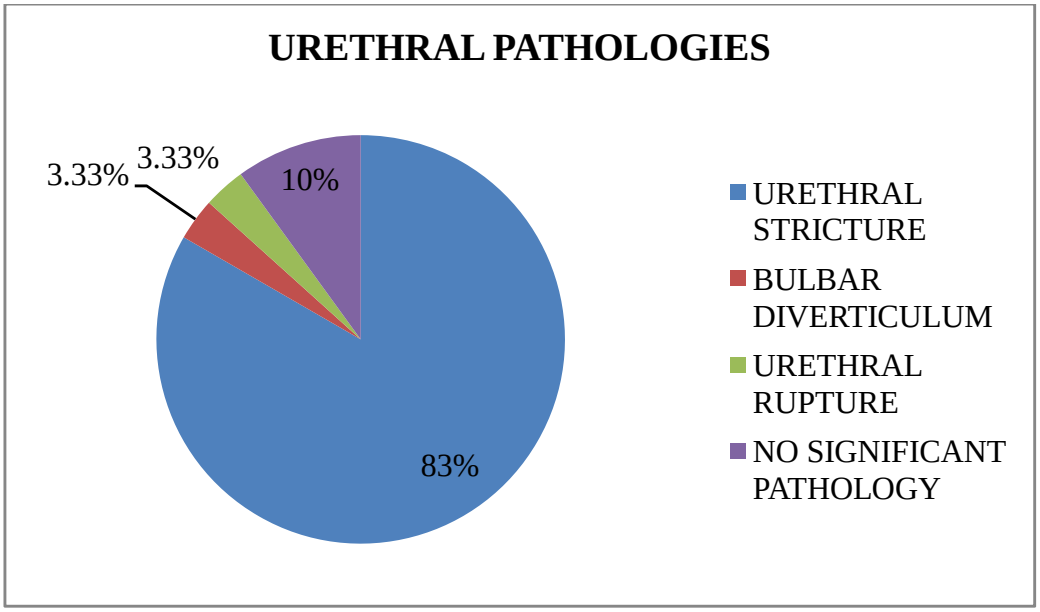
Sonourethrogram could detect spongiofibrosis accurately in 22 out of 23 patients (95.6%).

**Table 10: Urethral pathologies detected on sonourethrography.**

| URETHRAL PATHOLOGY | NUMBER | PERCENTAGE |
|---|---|---|
| URETHRAL STRICTURE | 25 | 83.3 |
| BULBAR DIVERTICULUM | 1 | 3.33 |
| URETHRAL RUPTURE WITH FISTULA FORMATION | 1 | 3.33 |
| NO SIGNIFICANT PATHOLOGY | 3 | 10 |
| TOTAL | 30 | 100 |

Out of 30 patients, 25 had urethral stricture, 1 patient had bulbar urethral diverticulum, 1 had urethral rupture with fistula formation and 3 did not have any pathology detected on imaging and intraoperatively.

**Graph 5: Urethral pathologies detected on sonourethrography.**



# DISCUSSION

Anterior urethral stricture is one of the common condition presenting to the urology department. Retrograde urethrogram was first performed in 1910 by Cunningham and is now considered as a gold standard imaging modality for pre-operative diagnosis of strictures affecting anterior urethra[40,41,42].

Sonourethrography is another diagnostic modality for detection of anterior urethral strictures[43,44,45]. It was first performed by McAninch[5]. It has other advantages in diagnosis like accurate detection of stricture length and degree of spongiofibrosis, which is a drawback of retrograde urethrography.

In our study age is not a determining factor as the etiology of stricture is not age dependent. The mean age of patients in our study was 49.33. The mean age of patients in a study conducted by Mahmud SM and colleagues in 2008 was found to be 42.8 +13.2 years[3].

In this current study sonourethrogram could detect 23 patients having strictures and MCU could detect 25 patients. Thus sonourethrogram was 92% sensitive in detecting strictures as compared to MCU. In a prospective study conducted by IC Akpayak and colleagues in 2012 on 60 patients, sensitivity of sonourethrography was found to be 94%[9]. In our study both sonourethrogram and RGU could detect 5 patients not having stricture correctly. Thus specificity of sonourethrogram as compared to MCU was 100%. In our study as compared to MCU, the positive predictive value was 100% and negative predictive value was 71.43%. In another study conducted by Ravikumar BR in 2015 and

colleagues specificity, positive predictive and negative predictive values were found to be 100%[4].

According to study performed by Heidenreich A and colleagues, the sensitivity and specificity of SUG in the detection of urethral narrowing were 98% and 96% respectively[46].

In the current study out of 25 patients having stricture intraoperatively, sonourethrography could detect 23 patients. Hence, the sensitivity of sonourethrography was 92%. In our study sonourethrogram could detect 5 patients not having stricture which correlated intra-operatively. Thus specificity of sonourethrogram is 100%. In our study, the positive and negative predictive values of sonourethrogram as compared to intraoperative results were 100% and 71.43% respectively.

In the current study out of 25 patients having stricture intraoperatively, MCU could detect 25 patients. Thus the sensitivity, specificity, positive and negative predictive values of MCU as compared to intraoperative results were 100%.

In the current study, the mean stricture span as detected by MCU was 1.06 (SD 0.56) and by sonourethrogram was 1.70 (SD 0.56) (p value 0.0004). Thus there was significant difference in the stricture length detected by MCU and sonourethrogram.

In this study, the mean stricture length as detected by MCU was 1.06 (SD 0.56) and during surgery was found to be 1.69 (SD 0.55) (p value 0.0003). Thus

there was significant difference in the stricture length detection by MCU and intraoperative results.

On the otherside, according to the current study the mean stricture length as detected by sonourethrogram was 1.70 (SD 0.56) and during surgery the mean length was found to be 1.69 (SD 0.55) (p value 0.93). Thus there was no significant difference in the stricture length detected by sonourethrogram and the intraoperative results.

From the present study, it can be concluded that the stricture length correlated better with sonourethrography as compared to MCU.

In a study conducted by Srinivas K published in 2018 the median stricture length by retrograde urethrogram, sonourethrogram and intraoperative results were 21.0 mm, 30.5 mm and 32.0 mm respectively. Thus their study concluded that there was better correlation of intra-operative stricture length with sonourethrogram findings and there was underestimation of stricture length by retrograde sonourethrogram[47].

In a study conducted by Gupta and colleagues, they compared sonourethrogram and retrograde urethrogram in 30 patients and concluded that sonourethrogram predicted stricture length more accurately and in most of the cases retrograde urethrogram underestimated length of the stricture[48].

In a prospective study conducted by IC Akpayak and colleagues in 2012 on 60 patients there was significant difference in the stricture length by retrograde urethrography and sonourethrography, sonourethrography being superior[9].

Nash PA et al., found a significant difference between stricture length ($p<0.003$), measured by RGU as compared to SUG[49].

In the present study, the most common site of stricture was bulbar urethra (44%) and the next common being bulbomembranous junction (36%). According to another study by Srinivas K, the most common site of stricture was also located in the bulbar urethra. The reason may be due to the fact that penile urethra takes a bent to form the bulbar urethra thus making it prone to both iatrogenic and non-iatrogenic injuries.

In the present study, out of 25 patients having stricture intraoperaively; sonourethrgraphy could detect 23 patients. Among the 23 patients detected by sonourethrography, 01 (4.34%) had mild, 08 (34.78%) had moderate and 14 (60.86%) had severe degree of spongiofibrosis. Among the 25 patients having stricture intraoperatively 02 (8%) had mild, 08 (32%) had moderate and 15 (60%) had severe degree of spongiofibrosis. Sonourethrography findings correlated well with the intra-operative findings of degree of spongiofibrosis except for one case, in which the sonourethrogram predicted as moderate degree spongiofibrosis while intraoperative it was found to be severe. Thus the sensitivity was 92%. According to another study by Srinivas K and colleagues, sonourethrography was 100% sensitive[15].

## CONCLUSION

- Urethral obstructive pathologies are one of the common problems presenting to the urosurgeon.
- Urethral obstructive conditions are divided into those involving anterior and/or posterior urethra.
- Various imaging modalities are available for identification of urethral pathologies.
- Radiographic imaging is the gold standard imaging investigation.
- Other investigations which can be used are sonography, cystoscopy, computed tomography and magnetic resonance imaging.
- The most common location of stricture was found to be bulbar urethra followed by bulbomembranous junction.
- Ascending urethrography has high sensitivity(92%) and specificity(100%) in identification of anterior urethral strictures with a positive and negative predictive values of 100% and 71.43% respectively.
- Sonourethrography has an extra advantage of identifying the extraluminal pathologies like degree of spongiofibrosis and also precisely measures the length of stricture.
- The span of the narrowed segment measured by sonography correlated closely with intraoperative results.
- Thus the study concluded that though radiographic imaging is the best imaging modality available, sonourethrography can also provide similar results with additional benefits like precise measurement of length of

narrowing in the anterior urethra (especially the bulbar urethra) and severity of scarring of corpus spongiosum.

- During the study, some other urethral pathologies like urethral diverticulum and urethral rupture were also indentified by sonourethrography.
- Sonourethrography is a poor imaging modality for identification of strictures involving the posterior urethra.

# SUMMARY

- The study was a prospective observational study.
- Patients presenting to the department of radiology with obstructive voiding symptoms were included in the study.
- 30 cases were included in the study after observing the inclusion and exclusion criteria.
- All patients first underwent retrograde urethrography with identification of strictures.
- Then all the 30 patients also underwent sonourethrography.
- Sensitivity, specificity, positive predictive value and negative predictive value were calculated for both radiographic imaging and sonographic imaging.
- The values were compared between radiographic imaging and sonographic imaging.
- The sensitivity of radiographic imaging (100%) was found to be more than sonographic imaging (92%).
- The specificity of both the procedures was found to be same(100%). Thus concluding that sonourethrography can be used as an effective method in identification of urethral pathology.
- But the other parameters like calculation of length of stricture, especially involving bulbar urethra and degree of scarring are better evaluated by sonographic imaging.

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# ANNEXURE I-CONSENT FORM

## INFORMED CONSENT

**TITLE OF THE STUDY: "ROLE OF SONOURETHROGRAPHY IN THE EVALUATION OF ANTERIOR URETHRAL STRICTURE-A ONE YEAR HOSPITAL BASED OBSERVATIONAL STUDY"**

**PRINCIPAL INVESTIGATOR:** Dr. _____

**INTRODUCTION AND PURPOSE:**

The management of urethral stricture is a challenge to the urologists, thus thoughtful and satisfactory preoperative evaluation remains important to achieve good outcome. One critical parameter to determine the surgical approach is accurate measurement of anterior urethral stricture length.

Radiographic retrograde urethrography has long been the gold standard imaging technique in the evaluation of anterior urethral stricture disease. Its limitations include poor definition of stricture length and periurethral fibrosis. In addition, because radiographic urethrography is 2-dimentional the appearance of the stricture can vary in accordance with the stretch on the penis and the position of the patient during injection of contrast medium. Retrograde urethrogram often requires multiple films, incluiding bilateral oblique views which leads to radiation exposure of 1-2 mSv.

Clearly a 3-dimentional study like sonourethrogram, that can be repeated with minimal radiation exposure would greatly aid in diagnosis and choice of therapy. Sonourethrogram can diagnose anterior urethral stricture, measure it's length and detect presence of complications and extent of spongiofibrosis.

The aim of this study is to compare the efficacy of sonourethrogram in the evaluation of male anterior urethral strictures.

**PROCEDURE:**

I request you to kindly participate in the study titled **"ROLE OF SONOURETHROGRAPHY IN THE EVALUATION OF ANTERIOR URETHRAL STRICTURE-A ONE YEAR HOSPITAL BASED OBSERVATIONAL STUDY"** at Dr. Prabhakar Kore hospital and Medical Research Centre, Belagavi" being conducted by Dr. _____, post graduate in Radiodiagnosis at J. N. Medical College Belagavi.

We request you to participate in this study as you are eligible to be included. During the study you will be asked questions regarding your present and past medical history and you will be required to answer to the best of your knowledge.

If you agree to participate in the study please furnish the details pertaining to the study.

**BENEFITS:**

1. Accurate diagnosis.
2. Non invasive.
3. Short duration of study.
4. Cost effective.

**RISKS:**

1. Radiation hazard with retrograde urethrography. No risk to the patient has been documented from sonourethrography of the urethra conducted earlier.
2. Contrast reaction with retrograde urethrography.

**ALTERNATIVES:**

If patient is not willing to take part in the study, his / her treatment or any other further investigations the patient wants to undergo, in future, in KLE will not be affected by his / her decision

**VOLUNTARY PARTICIPATION/WITHDRAWAL:**

Taking part in this study is voluntary. I may choose not to take part in this study, or if I decide to take part I can later change my mind and withdraw from the study. My decision will not change the present or future health care or other services that I receive. The study doctor or the sponsor may stop my participation in this study. I will tell if any important new findings that may change my willingness to continue to take part. If I choose not to take part in the study I will receive the standard treatment for patients with my condition.

**COSTS:**

NIL (The study is to be conducted on the participants who are advised RGU as an investigation for anterior urethral stricture by the referring consultant and the participants will bear the charges for it.)

**PAYMENT FOR PARTICIPATION:** No incentive will be paid to you for participating in this study.

**COMPENSATION:**

In the event that I become injured as a result of taking part in this study, treatment whatever available at KLE hospital, belagavi, will be offered to me. No reimbursement, compensation or free medical care is given.

**CONFIDENTIALITY:**

All information collected about me during the course of the study will be kept confidential to the extent permitted by the law. The code numbers will identify me in this research record. Information from this study may be published but my identity will be confidential in any publication.

If any enquiries in the future or in case of research related injury illness, you may contact following person.

| **Dr. Roopa Bellad** |
| --- |
| Professor Of Paediatrics<br>Chairperson,<br>J.N. Medical College<br>Institutional Ethical Committee<br>for Human Subjects Research,<br>Belagavi |
| Ph. 0831-2471525<br>Ext- 4032 |

**CONSENT TO PARTICIPATE IN RESEARCH STUDY:**

1. I understand that I am participating in the study, which includes retrograde urethrogram and sonorethrogram.

2. I confirm that I have read and understood the information in the patient information sheet. Procedure is explained to me in detail along with information about the advantages and disadvantages of taking part in the study. I have been given the opportunity to discuss all aspects of the trial, to ask questions and hereby consent to participation in the trial outlined above.

3. I understand that the decision to take part in this study is completely voluntary and I am aware that I can choose to withdraw from the study at any point of time.

4. I consent to the photographing or recording of the procedure to be performed including portions of my body, for medical, scientific or educational purposes provided my identity is not revealed in the pictures or by the descriptive texts accompanying them.

5. I understand that there is no significant risk involved in the test that would be done in this study.

6. No guarantee or assurance has given by anyone as to the results that may be obtained.

7. My signature on this form signifies that I have willingly decided to participate after understanding the above information.

Participant's / legally authorized representatives name_____

Signature _____

Name and signature of witness _____

Investigators name and Signature : …….

Date:

Place: Belagavi

# ANNEXURE II - ETHICAL CLEARANCE LETTER

K.L.E.UNIVERSITY'S
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)
(Accredited 'A' Grade by NAAC)

Website: http//www.jnmc.edu
E-Mail : dome@jnmc.edu

Phone: (+ 91-(0)831 Office : 2471350
Principal: 2471701
Fax No. +91 (0)831 – 2470759

**Ref: MDC/DOME/ 08**

**Date: 22/11/2017**

To,

PG student in Radiodiagnosis,
J.N.Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"ROLE OF SONOURETHROGRAPHY IN THE EVALUATION OF ANTERIOR URETHRAL STRICTURE-A ONE YEAR HOSPITAL BASED OBSERVATIONAL STUDY"**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

**(Dr. Arathi Darshan)**
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

**(Dr. Roopa M Bellad)**
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

# ANNEXURE III -PROFORMA

## PROFORMA FOR DATA COLLECTION

### 1. PATIENT PARTICULARS:

| | | | |
|---|---|---|---|
| **NAME** | | **DATE** | |
| **AGE** | | **SEX** | |
| **ADDRESS AND MOBILE NO** | | **RGU/USG NO** | |

### 1. CHIEF COMPLAINTS:

| | |
|---|---|
| SLOW STREAM | Present/Absent |
| DYSURIA | Present/Absent |
| HEMATURIA | Present/Absent |
| URINARY RETENTION | Present/Absent |
| INCONTINENCE | Present/Absent |

### 2. PAST HISTORY

| | |
|---|---|
| TRAUMA | Present/Absent |
| URETHRAL SURGERY | Present/Absent |
| URETHRITIS | Present/Absent |
| URETHRAL TUMOURS | Present/Absent |
| CATHETERIZATION | Present/Absent |

### 3. INVESTIGATIONS:

| INVESTIGATIONS | LOCATION | LENGTH ( in cm) | SPONGIOFIBROSIS (degree) |
|---|---|---|---|
| RGU FINDINGS | | | |
| SONOURETHROGRAPHY FINDINGS | | | |

# ANNEXURE IV: FIGURES

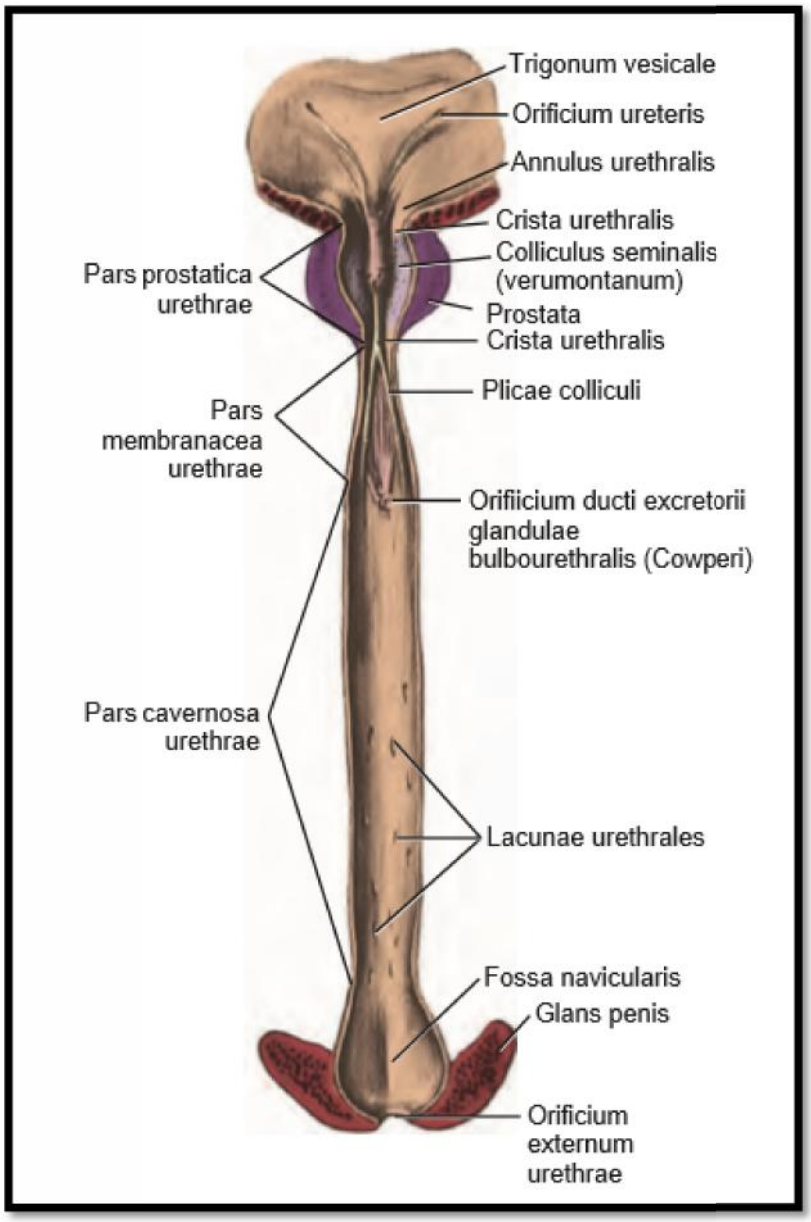


**Fig 1. Parts of urethra (male)[15].**

## NORMAL ANATOMY

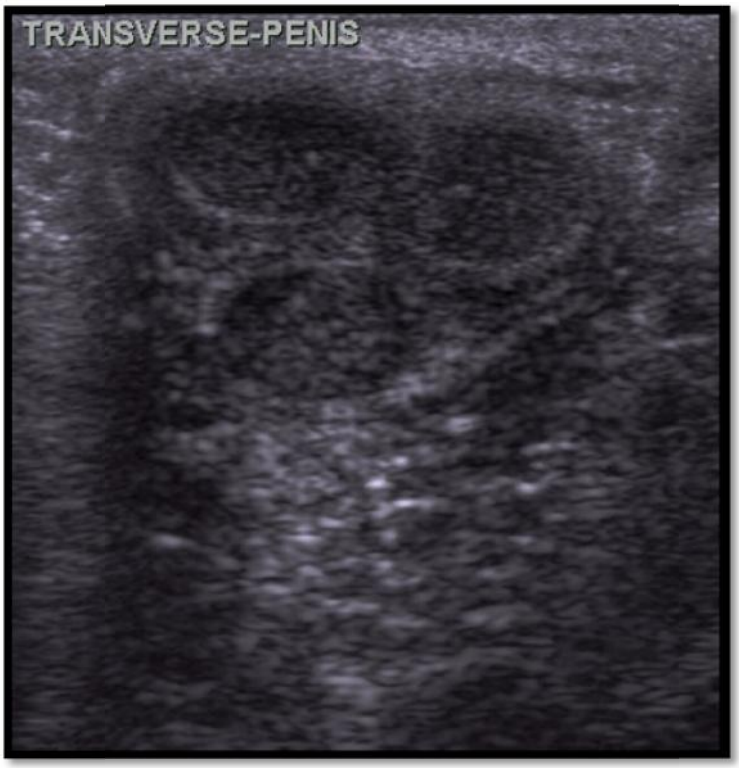


**Fig 2: Normal sonographic anatomy of male penis (transverse view).**

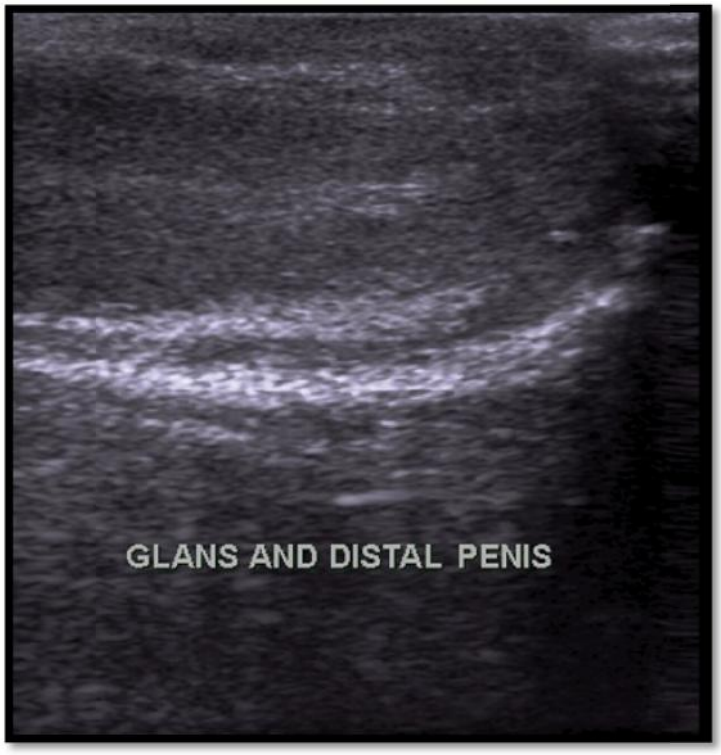


**Fig 3: Normal sonographic anatomy of distal male penis (longitudinal view).**

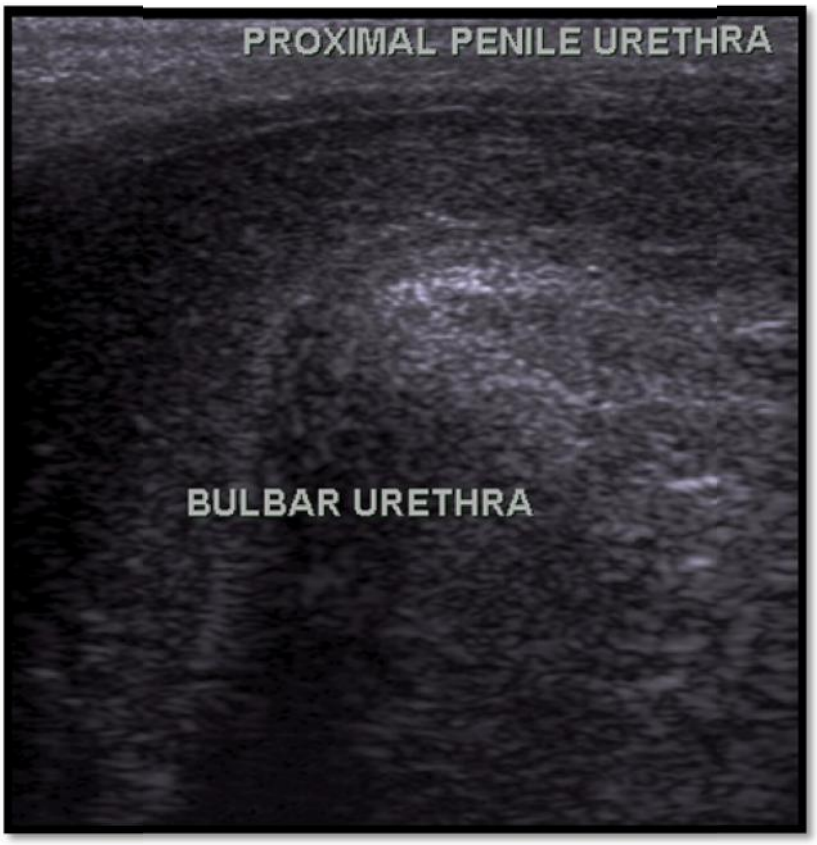


**Fig 4: Normal sonographic anatomy of proximal male penis (longitudinal view).**

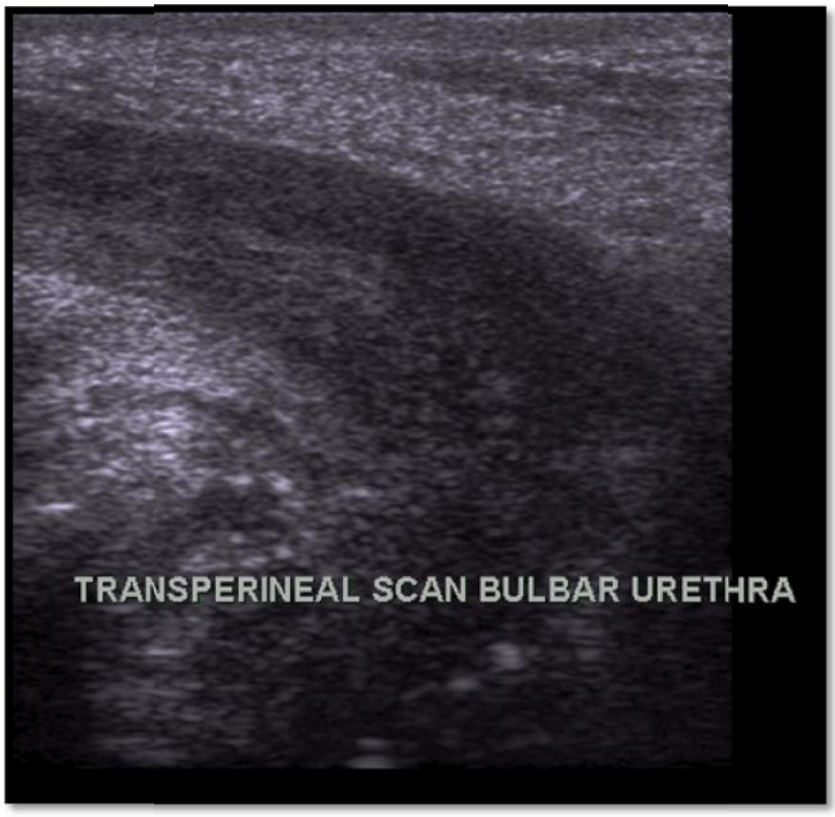


**Fig 5: Normal sonographic anatomy of male perineum (longitudinal view).**

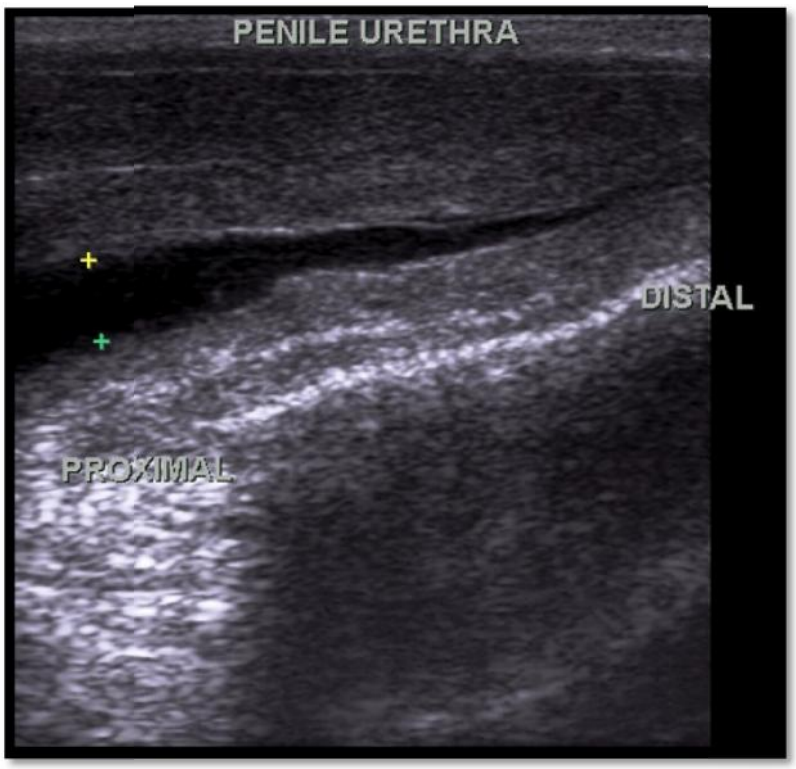


**Fig 6: Normal sonographic anatomy of male penile urethra distended with sterile saline (longitudinal view).**

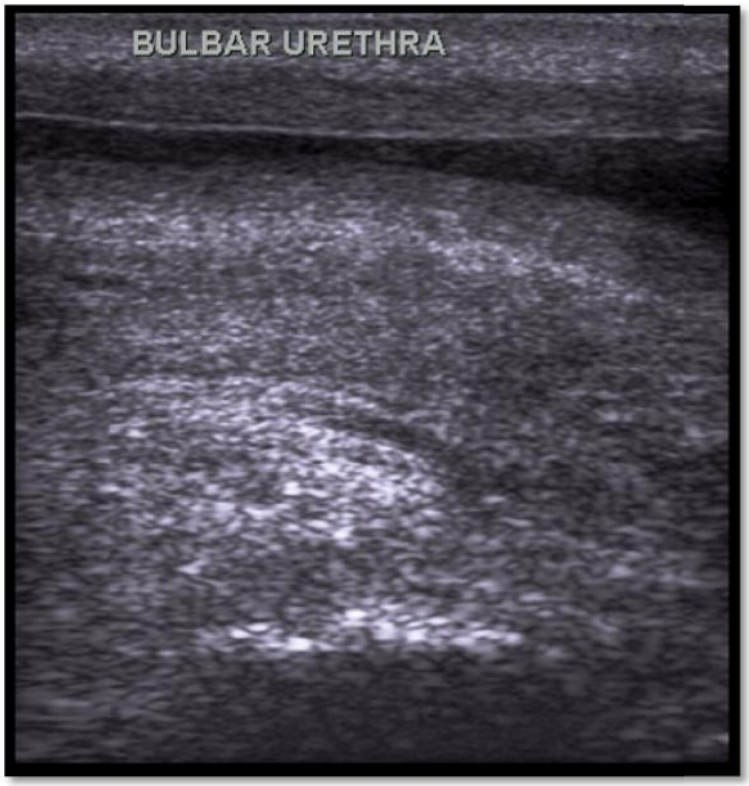


**Fig 7: Normal sonographic anatomy of male bulbar urethra distended with sterile saline (longitudinal view).**

**CASE 1: PENILE URETHRAL STRICTURE**

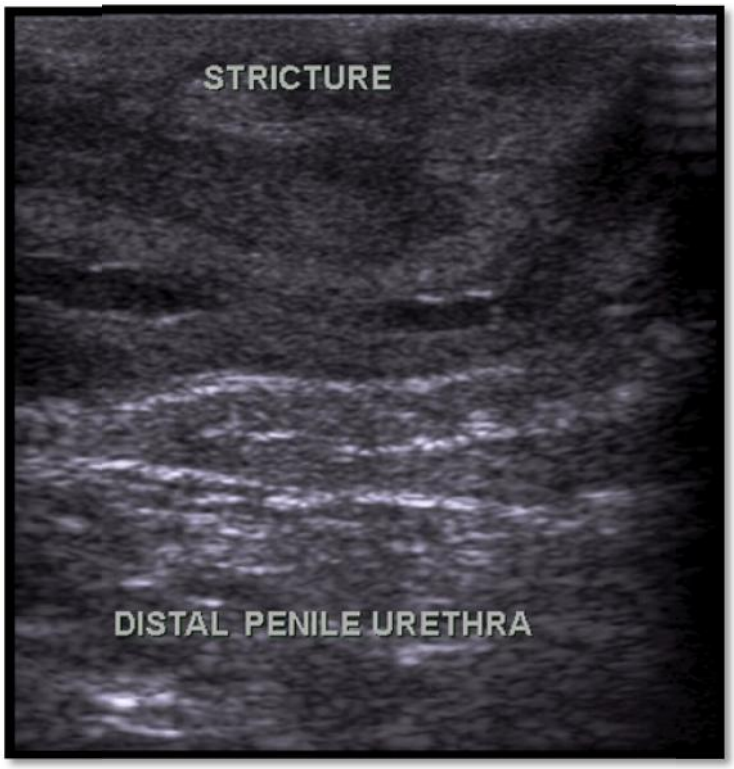


**Fig 8: Sonourethrographic appearance of stricture in distal penile urethra.**

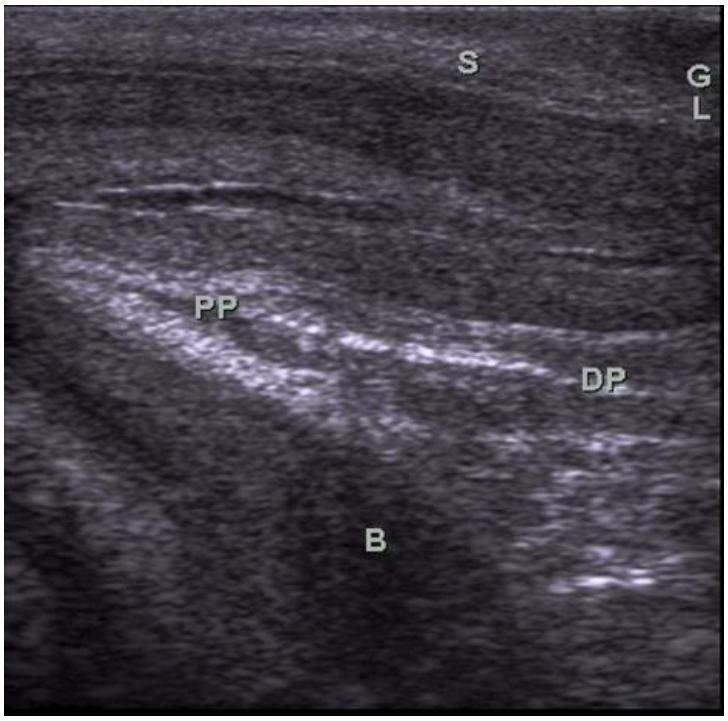


**Fig 9: Sonourethrographic appearance of stricture in distal penile urethra (with labelling).**

**GL- Glans, DP-Distal penile urethra, S-Stricture,**

**PP-Proximal penile urethra, B-Bulbar urethra**

**Table 11: Parameters of penile urethral stricture in three procedures.**

| INVESTIGATION | LOCATION | LENGTH (cms) | SPONGIOFIBROSIS |
|---|---|---|---|
| RETROGRADE URETHROGRAPHY | PENILE URETHRA | 0.75 | CAN NOT COMMENT |
| SONOURETHROGRAPHY | PENILE URETHRA | 1.26 | SEVERE |
| OPERATIVE FINDING | PENILE URETHRA | 1.3 | SEVERE |

## CASE 2: STRICTURE PROXIMAL BULBAR URETHRA

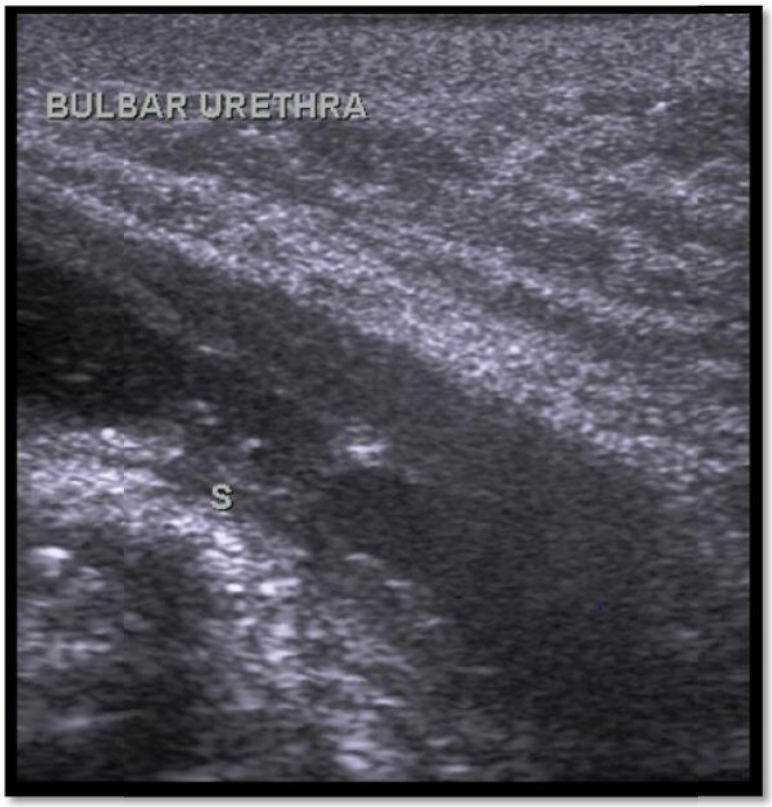


**Fig 10: Sonourethrographic appearance of stricture in proximal bulbar urethra (longitudinal view).**

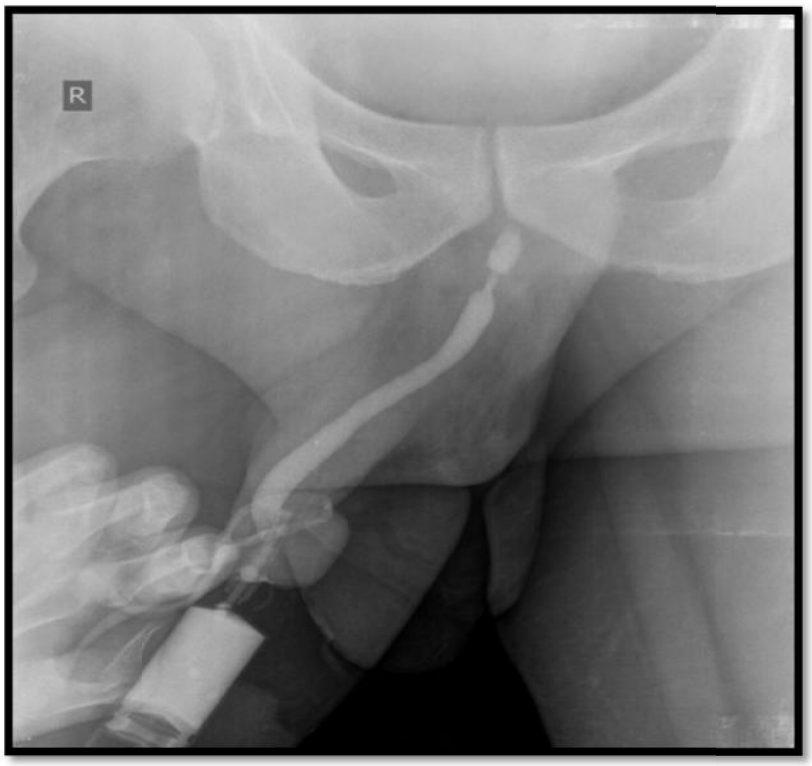


**Fig 11: Ascending urethrographic imaging of stricture in proximal bulbar urethra.**

**Table 12: Parameters of bulbomembranous junction stricture in three procedures.**

| INVESTIGATION | LOCATION | LENGTH (cms) | SPONGIOFIBROSIS |
|---|---|---|---|
| RETROGRADE URETHROGRAPHY | BULBOMEMBRANOUS JUNCTION | 0.76 | CAN NOT COMMENT |
| SONOURETHROGRAPHY | BULBOMEMBRANOUS JUNCTION | 2.08 | SEVERE |
| OPERATIVE FINDING | BULBOMEMBRANOUS JUNCTION | 2.0 | SEVERE |

**CASE 3: STRICTURE IN PROXIMAL BULBAR URETHRA**

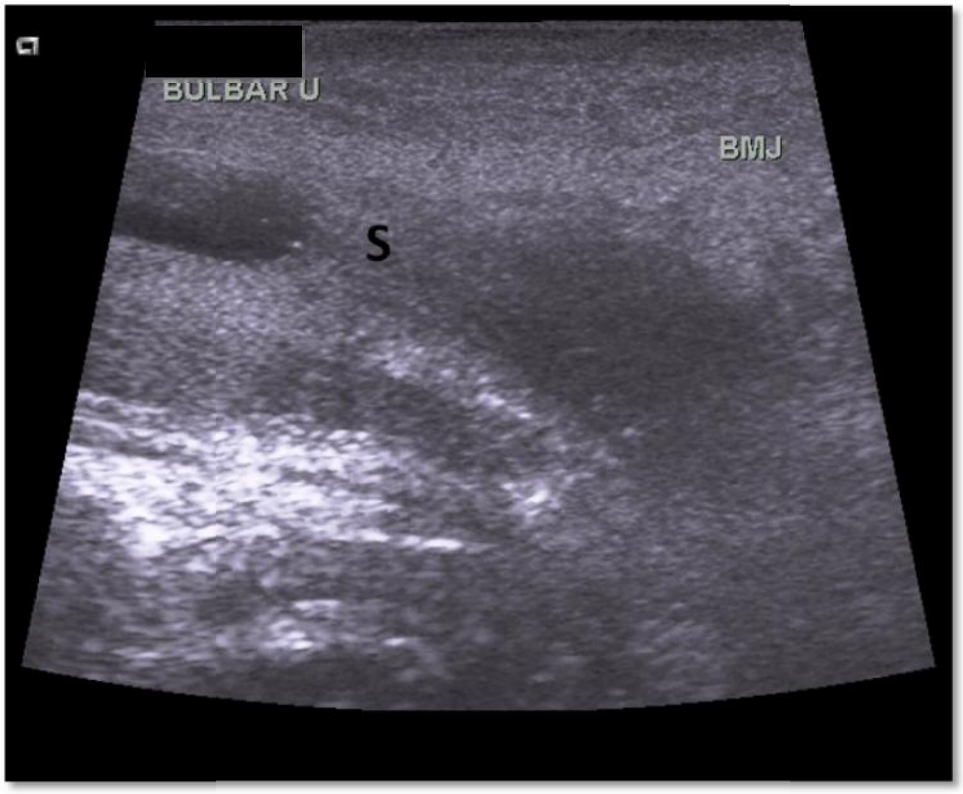


**Fig 12: Sonographic imaging of stricture proximal bulbar urethra**

**CASE 4: URETHRAL DIVERTICULUM**

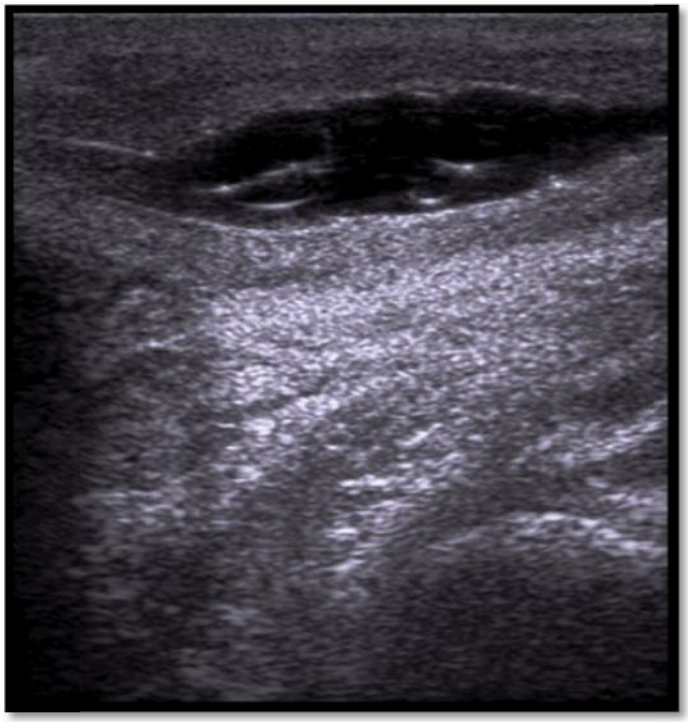

**Fig 13: Sonographic imaging of bulbar urethral diverticulum.**
**CASE 4 (continued):**

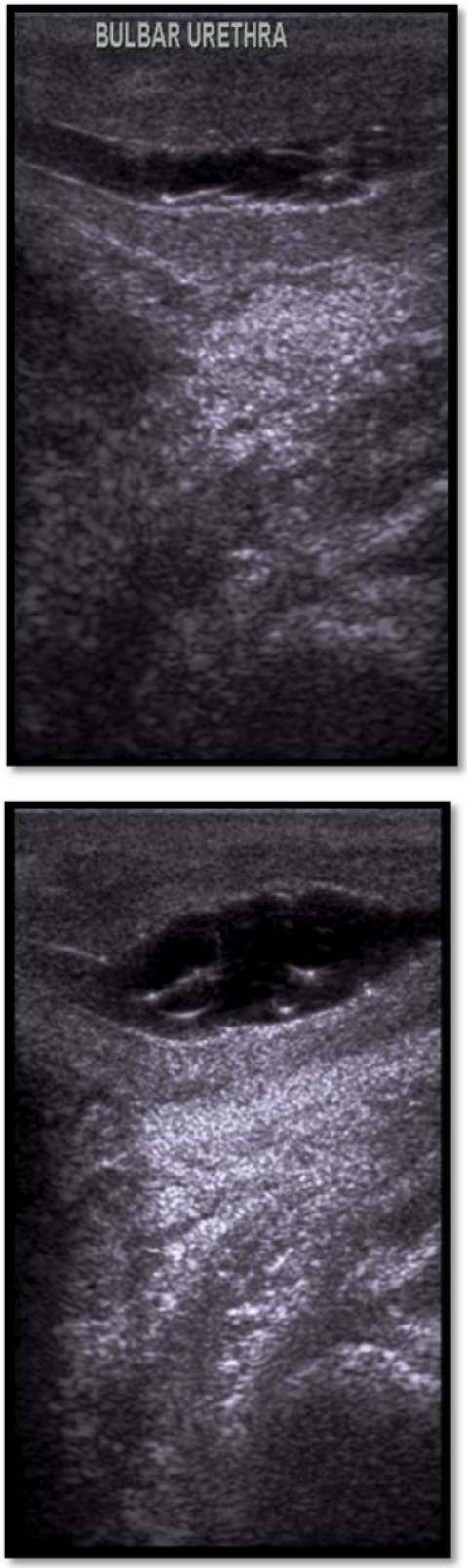


**Fig 14: Sonographic imaging of bulbar urethral diverticulum.**
**A) At the start of distension B) At the peak of distension**

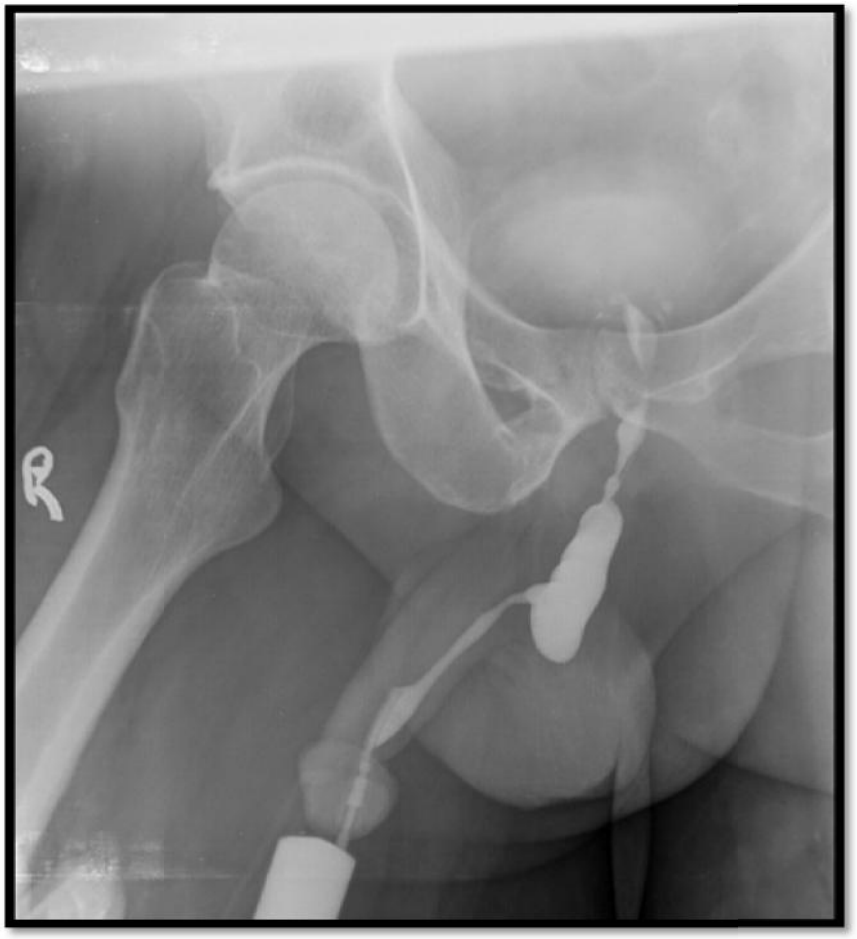


**Fig 15: Ascending urethrographic imaging of proximal bulbar urethral diverticulum.**

## CASE 5: URETHRAL RUPTURE WITH FISTULA FORMATION

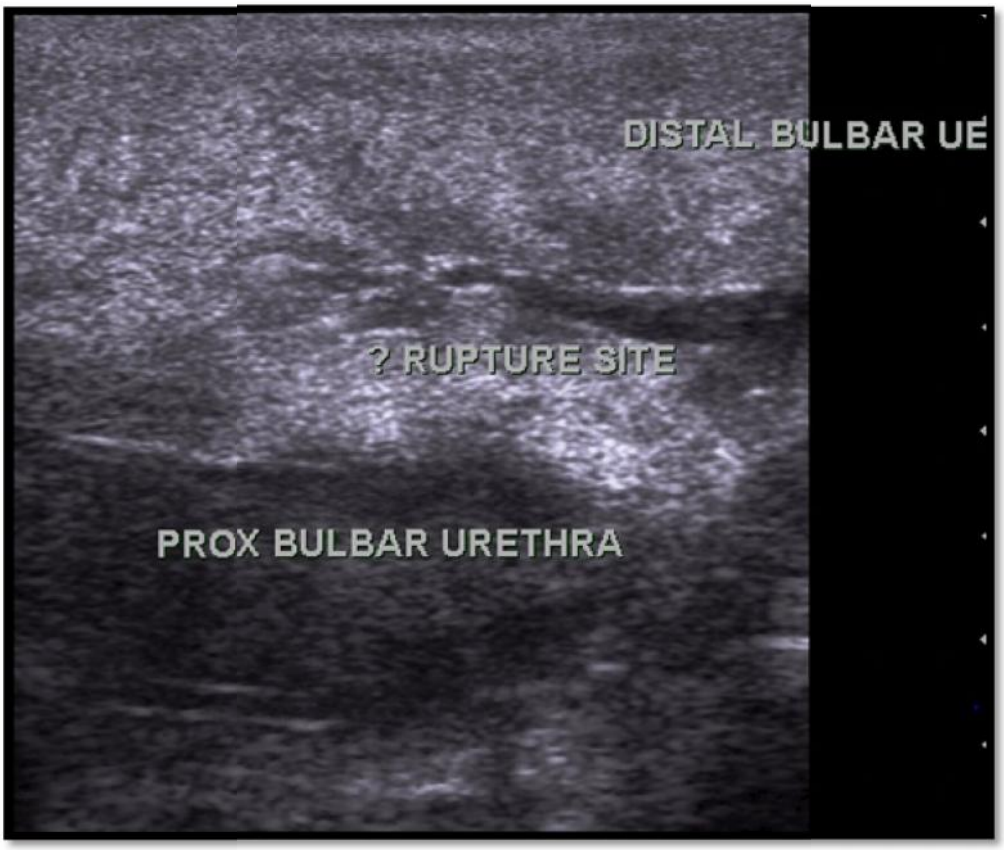


**Fig 16: Sonographic imaging of rupture of bulbar urethra.**

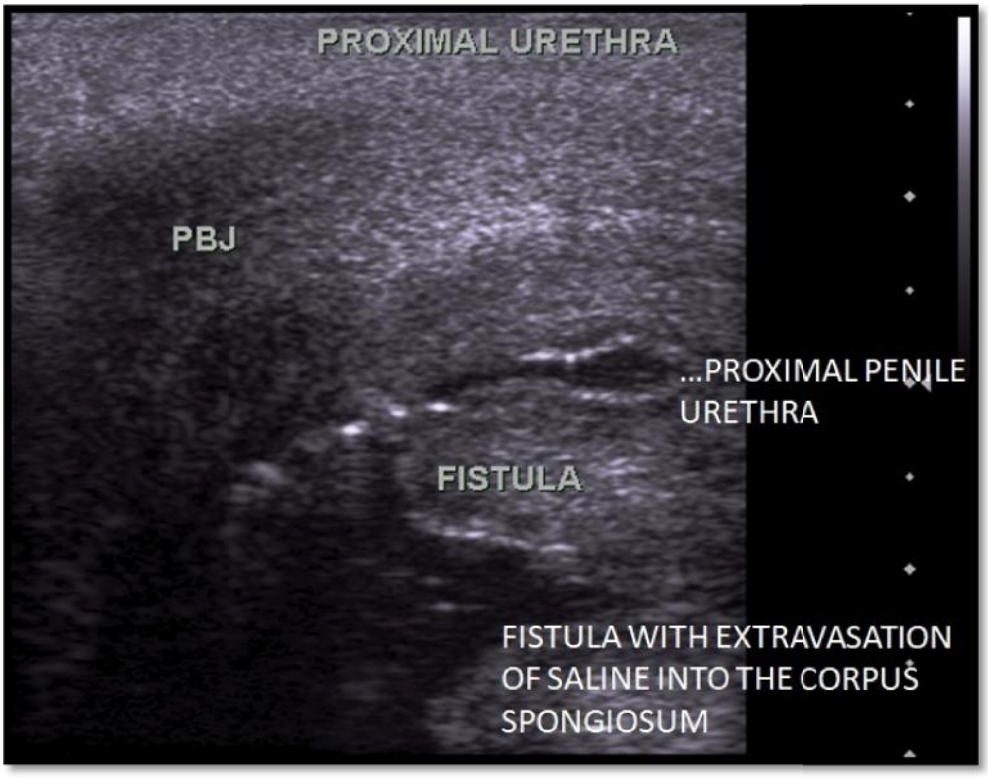


**Fig 17: Sonographic imaging of urethral fistula.**

# ANNEXURE V: KEY TO MASTERCHART

| | |
|---|---|
| **RGU** | **Retrograde urethrogram** |
| **SUG** | **Sonourethrogram** |
| **Yrs** | **Years** |
| **Cms** | **Centimeters** |
| **Sl No.** | **Serial number** |