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ROLE OF RGU AND VCUG IN IMAGING OF MALE URETHRAL STRICTURES

Radiodiagnosis

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ABSTRACT

Introduction: Urethral stricture refers to fibrous scarring of the urethra caused by collagen and fibroblast proliferation.The most common causes are instrumentation, infection, and other iatrogenic causes.Retrograde urethrography (RUG) remains the gold standard technique for evaluating patients with urethral stricture. Additional modalities can be used, including Voiding cystourethrography(VCUG), sonourethrography, Magnetic resonance imaging (MRI), and computerized tomography.

Material and Methods: The present study was conducted in the department of radiodiagnosis, NRI general hospital,chinakakani, Guntur district from 2017 to 2019. A total of 100 patients attended the urology department in the age group between 20 to 70 years with complaints of lower urinary symptoms were studied.All patients underwent RGU, and in a few patients, VCUG,sonourethrography, and MRI were also performed.

Results: Out of the total 100 patients the most common age group of presentation was 41-50 years(38%).Out of 100 patients ,40 patients are negative on RGU (40%),56 patients had urethral strictures(56%),4 patients had other urethral pathologies(4%).Out of 56 patients who presented with urethral strictures, 35 were located in bulbar urethra (62.5%),9 in penile urethra(16%),7 in penoscrotal junction(12.5%) and in 5 patients multiple strictures(8.9%) were noted.Out of 56 patients with urethral strictures,in 33 patients the length of the stricture was less than 2 cm(58.9%),2-4cm was noted in 17 patients(30.3%) and in 6 patients more than 4cm stricture was noted(10.7%).Out of 35 cases of bulbar urethral stricture combined RGU and VCUG was done in 4 patients(11.4%) to evaluate the correct length of the stricture and see the proximal dilatation of the urethra.

Conclusion: Conventional RGU is the gold standard imaging test for anterior urethral stricture.For posterior urethral stricture combined RGU and VCUG is the best imaging test for assessing the length of the stricture.Sonourethrography is best used adjunctively to guide treatment planning in patients with known bulbous urethral strictures.Other investigations like CT and MRI are ancillary imaging modalities.

KEYWORDS

Urethral stricture,Retrograde urethrography,voiding cystourethrography.

INTRODUCTION

Accurate diagnosis and staging is a crucial element for successful surgical outcomes and is particularly relevant in the evaluation of urethral stricture. Multiple options are available for the urologists to thoroughly evaluate urethral stricture, and they can select an appropriate reconstructive procedure to restore normal voiding function. Retrograde urethrography (RUG) remains the gold standard technique for evaluating patients with urethral stricture. Additional modalities can be used, including Voiding cystourethrography (VCUG), sonourethrography, Magnetic resonance imaging (MRI), and computerized tomography. Appropriate selection of investigation for evaluation of patients preoperatively with urethral stricture is crucial in decision making for treatment, and correct utilization of these techniques can optimize patient outcomes.

In this article, we review the anatomy and strictures of the male urethra. We mainly focus on conventional urethrography i.e., RGU and VCUG, with few points about the importance of other modalities in the evaluation of male urethral strictures.

Anatomy of Male Urethra

The male urethra measures about 17.5 to 20 cm in length. It consists of anterior and posterior portions. The anterior urethra extends from the external meatus, coursing through the corpus spongiosum up to the inferior edge of the urogenital diaphragm. The anterior urethra is divided into the penile and bulbous parts at the penoscrotal junction. The penile portion, which is 1–1.5 cm long terminates in the glans penis, to form the fossa navicularis. The proximal dilated portion of the bulbous urethra is called the "sump" and just proximal to the sump; it is conical in shape at the bulbomembranous junction, which is known as the "cone." The periurethral Littré glands are present in the anterior urethra, more at the dorsal aspect of the penile urethra, and also in the sump of the bulbous urethra. On either side of the membranous portion of the posterior urethra, there are Cowper glands that lie within the urogenital diaphragm whose ducts are 2 cm long, and they empty into the bulbous urethral sump.

The posterior urethra is divided into two parts, i.e., prostatic and membranous urethras. The prostatic urethra (3.5 cm long) passes through the prostate anterior to the midline. The urethral crest, which is a longitudinal smooth muscle on the posterior wall, extends from the bladder neck to the membranous urethra. The urethral crest continues into the verumontanum(1 cm long, ovoid mound) that lies in the posterior wall. The prostatic utricle, which is epithelium lined diverticulum of the prostatic urethra, lies in the center of the verumontanum. The openings of the paired ejaculatory ducts are just distal and lateral to the utricle. The prostatic glands empty into the prostatic urethra through the multiple small openings surrounding the verumontanum. The prostatic urethra then tapers into the membranous urethra(1–1.5 cm long) and ends at the inferior portion of the urogenital diaphragm.

The internal urethral sphincter is located at the junction of the urethra with the urinary bladder, and it continues with the detrusor muscle, but anatomically and functionally fully independent from it and has different neurogenic innervation. The external urethral sphincter has both intrinsic and extrinsic components. The "intrinsic" component is a concentric muscular structure that surrounds the membranous urethra. Both the internal and intrinsic sphincters are composed of smooth muscle, and they maintain passive continence. The primary continence is maintained by the intrinsic sphincter and the secondary continence by the internal sphincter. The extrinsic sphincter is a voluntary, striated,paraurethral muscle with contributions from the levator ani complex. The sphincter surrounds the membranous urethra and is involved in active continence.

Retrograde Urethrography(RGU)

The retrograde urethrogram is the gold standard oldest radiographic test for diagnosis and staging of urethral stricture disease(1,2). Initially, a scout film is taken to assess bony structures and look for any calcified urinary tract pathology. Later 20-30 mL of water-soluble iodinated contrast is injected into the urethra, and multiple images are acquired under direct fluoroscopic or radiographic technique. This allows for live assessment of the urethra as the contrast is delivered(3). The retrograde urethrogram should not only independently reported, but it also has to be done along with treating urologists.There will be a significant disparity between independent reporting compared to the interpretation with a urologist.A concordance between the intraoperative measured length of the stricture with the independently reported length is 0.47 compared to the 0.93 when reported along with treating urologist(4). So the treating urologist should also examine the results.

Patient positioning plays a critical role during retrograde urethrogram. The patient is placed in an oblique position, i.e., 35-45 degrees to visualize the bulbar urethra, which can be confirmed by the downward orientation of obturator foramen so that urethra is parallel to the film. If the urethra is placed at an angle to the film, it will result in an underestimation of the urethral stricture(5). Then the penis should be stretched for complete visualization of the urethra. Lubrication with an anesthetic agent can be used to reduce the discomfort, but some studies say that it obscures the image, induce edema, so the benefit is questionable(6). We should visualize the contrast going through the stricture into the membranous urethra to demonstrate the proximal part of the stricture and visualize the full extent of urethral pathology.

The three key features of stricture that an RGU must depict are the location, the length, and associated urethral pathology. In order to do so, the normal anatomy of the urethra is important.

The sensitivity and specificity of RUG for the diagnosis of a urethral stricture are 75-100% and 72-97%, respectively. Positive predictive values are reported from 50-93%, with negative predictive values between 76-100% range(7,8,9). So retrograde urethrography can strongly diagnose stricture and can characterize its length, number, and location with high accuracy.

Retrograde urethrogram also plays a role in traumatic urethral injuries not only in diagnosis and assessment but also in planning reconstructive operations. The degree of urethral distraction and measurement of urethral length can be assessed, which are critical in planning repair(10,11).

If there is severe urethral occlusion, then retrograde urethrogram can be combined with other imaging modalities to fully delineate the stenosis(12)

Though retrograde urethrogram is a minimally invasive test, there are few adverse effects like discomfort to the patient, urinary tract infections, and contrast agent reactions. Another drawback is the radiation exposure which is mainly relevant in young individuals who require multiple urethrograms.

In summary, retrograde urethrogram is a reliable means for establishing the diagnosis of a suspected urethral stricture but also provides accurate staging information with regard to stricture number, length, location, and coexistent urethral pathology. The combination of retrograde urethrogram with other modalities can further improve diagnostic accuracy in the evaluation of urethral stricture, and allow for optimal preoperative assessment and planning.

Voiding cystourethrogram

Voiding cystourethrogram (VCUG) is mainly used to access the posterior urethra. In VCUG, the bladder neck and prostatic urethra are distended. This allows better visualization of an obliterated or near obliterated stricture that cannot be staged by RGU alone. It can indicate the degree of functional impairment caused by the stricture by examining the dilatation of urethra proximal to the stricture(12).

The contrast material is injected into the bladder using a foley catheter under aseptic precautions. After the bladder is filled to its capacity, the patient is asked to void. Some patients will have a suprapubic catheter in situ, which simplifies the procedure. The patient positioning is maintained in the same manner as that of RGU in oblique position as previously described.

MATERIALS AND METHODS

The present study was conducted in the department of radiodiagnosis, NRI general hospital,chinakakani, Guntur district from 2017 to 2019. A total of 100 patients attending the urology department in the age group between 20 to 70 years with complaints of lower urinary symptoms were studied. Informed consent was taken from all the patients regarding the procedures to be performed. All patients underwent RGU, and in a few patients, VCUG,sonourethrography, and MRI were also performed.

INCLUSION CRITERIA

Male patients with lower urinary tract symptoms
The age group of patients between 20-70 years

EXCLUSION CRITERIA

Male patients with active genitourinary infections
Age group less than 20 years and more than 70 years.

Study parameters being monitored

Incidence of strictures among the sample of the study
Percentage distribution of age group of urethral stricture
Percentage distribution of the location of the stricture
Percentage distribution of length of the stricture
Percentage distribution of combined RGU and VCUG

Brief procedure

The patients were explained about the procedure, its indications, benefits, and adverse effects in detail. The privacy of the patient was ensured.

In all the patients complaining of lower urinary tract symptoms, retrograde urethrography using 300mA Allengers conventional X-ray machine was done initially. Initially, 5 to 10ml of 2% lignocaine jelly was instilled per urethra to prevent the reflex spasm of the external urethral sphincter. Then 15-20ml of iodinated contrast (Urografin, 76%) was instilled using a sterile plastic syringe. Spot films were taken with the patient in 45 degrees oblique position using moderate penile traction with the operator holding the tip of the penis between fingers to avoid contrast spillage. Technical factors were set at 60-70 kVp and 10-12 mAs with an FFD of 1 meter.Then the RGU is evaluated for location, length, and the number of strictures. In a few cases, MCUG,sonourethrography, and MRI were also done.

RESULTS

A total of 100 patients attending urology between the age group of 20-70 with complaints of lower urinary tract symptoms were included in the study.

Out of the total 100 patients the most common age group of presentation was 41-50 years(38%) followed by 51-60years(28%).

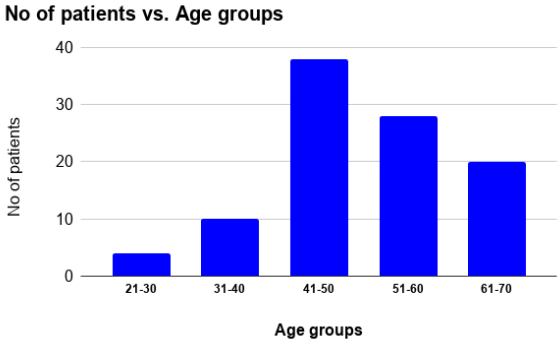

Table:1- Percentage distribution of age among patients studied.

Out of 100 patients ,40 patients are negative on RGU (40%),56 patients had urethral strictures(56%),4 patients had other urethral pathologies(4%).

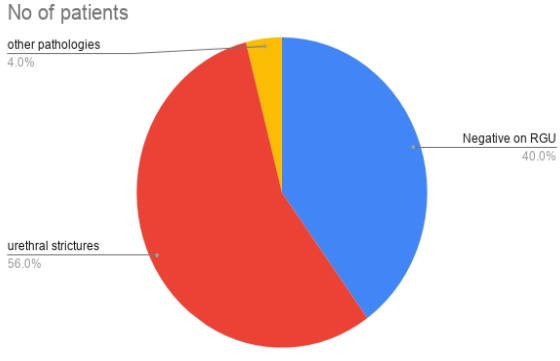

Table:2- Percentage distribution of cases

Out of 56 patients who presented with urethral strictures, 35 were located in bulbar urethra (62.5%),9 in penile urethra(16%),7 in penoscrotal junction(12.5%) and in 5 patients multiple strictures (8.9%) were noted.

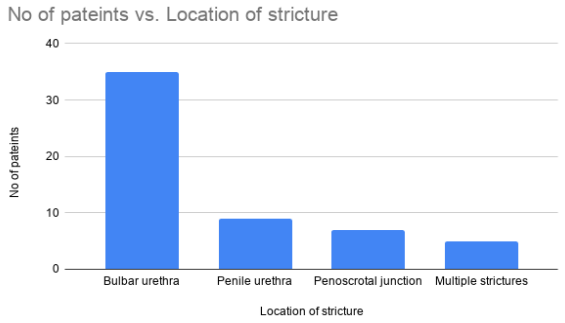

Table:3- Percentage distribution of location of stricture

Out of 56 patients with urethral strictures,in 33 patients the length of the stricture was less than 2 cm(58.9%),2-4cm was noted in 17 patients(30.3%) and in 6 patients more than 4cm stricture was noted(10.7%).

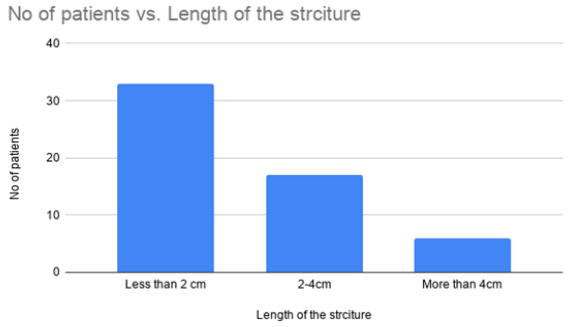

Table:4- Percentage distribution of length of the stricture

Out of 35 cases of bulbar urethral stricture combined RGU and VCUG was done in 4 patients(11.4%) to evaluate the correct length of the stricture and see the proximal dilatation of the urethra.

Sonourethrography was done in 2 patients to evaluate the length of stricture,periurethral soft tissue involved and to evaluate the tunical layer injury in case of trauma.

MRI was done in 2 patients with history of trauma.They complained of pain and were not willing for any other investigation.MRI was done to evaluate the urethral involvement and tunical layer injury in trauma.
In our study the most common age group of presentation is 41-50 years.The most common pathology of urethra is urethral strictures.The most common location is bulbar urethra.The most common length of stricture is less than 2cm.

There were no complications encountered during the study.

DISCUSSION

Urethral stricture refers to fibrous scarring of the urethra caused by collagen and fibroblast proliferation(5,13). The associated scar formed in the surrounding corpus spongiosum is called spongiofibrosis. This scarring process can extend through the tissue of the corpus spongiosum and also into adjacent structures. When the scar contracts, the width of the urethral lumen decreases. The causes of anterior urethral strictures are congenital, traumatic(iatrogenic instrumentation, straddle injury), or inflammatory (e.g., infectious urethritis, balanitis xerotica obliterans).

The most common causes are instrumentation, infection, and other iatrogenic causes. Straddle injury is the most common external cause. Though gonococcus is the most common sexually transmitted disease, inflammatory strictures caused by gonococcal urethritis have become less. Pressure necrosis in the urethra from indwelling catheters can result in iatrogenic trauma. Instrumentation-related strictures are more common at the bulbomembranous region and are less common at the penoscrotal junction.

Posterior urethral strictures occur as a result of distraction or disruption of the urethra, which is caused by either surgery or trauma. Posterior urethral strictures due to trauma are associated with displacement of the urethral axis that results in obliteration from intervening fibrosis. Transurethral resection of the prostate or open radical prostatectomy can cause iatrogenic stricture of the prostatic urethra(Bladder neck contracture)(14).

Retrograde urethrography(RGU) is the primary method used to image anterior urethral stricture(5). It helps to define the length, location, degree, and the number of strictures and also the periurethral abnormality, which are important factors for deciding appropriate treatment. Sometimes, the length of the stricture can be underestimated when the patient is not placed in the correct oblique position for RGU. More than one projection may be needed to completely visualize the stricture.

Sonourethrography is used adjunctively to guide treatment planning in patients with known bulbous urethral strictures. It can accurately estimate the length of the urethral strictures(5,13). Periurethral fibrosis appears as thickened, irregular, nondistensible tissue extending into the anechoic urethral lumen. Spongiofibrosis is considered to be severe when sonourethrography shows posterior shadowing and a lumen diameter of less than 3 mm, which is nondistensible. Surgical resection is the best treatment for spongiofibrosis. In posterior urethral strictures following blunt trauma, combined voiding cystourethrography and retrograde urethrography are required to determine the length of the urethral defect.

MR imaging is the best ancillary imaging modality for assessing posttraumatic pelvic anatomy(15). T2-weighted MR imaging can help assess the position of the prostate and the amount of pelvic fibrosis. It also helps to determine the length of the prostatomembranous defect, i.e., measurement of the distance between the urethral insertion into the proximal corpus spongiosum and prostatic apex(15).

CONCLUSION

Conventional RGU is the gold standard imaging test for anterior urethral stricture disease even in the present day era of CT and MRI.

For posterior urethral stricture combined RGU and VCUG is the best imaging test for assessing the length of the stricture by examining the dilatation of urethra proximal to the stricture.

Sonourethrography is best used adjunctively to guide treatment planning in patients with known bulbous urethral strictures.Other investigations like CT and MRI are ancillary imaging modalities.

Representative cases:

CASE-1

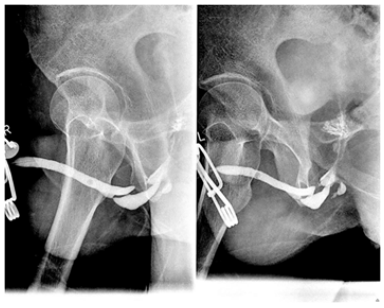

Figure:1 Retrograde urethrogram(RGU) showing complete stricture of bulbar urethra with false passage

CASE-2

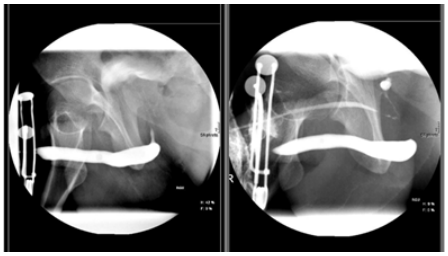

Figure:2 RGU and VCUG showing complete bulbar stricture and double urethra

CASE-3:

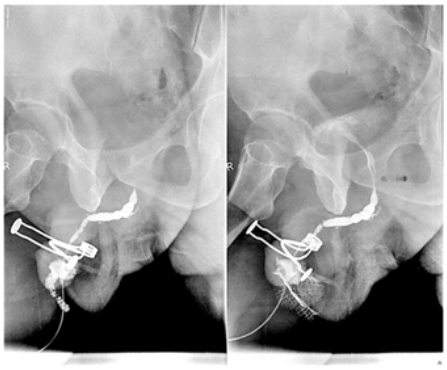

Figure:3 RGU showing multiple penile and bulbar urethral strictures

CASE -4:

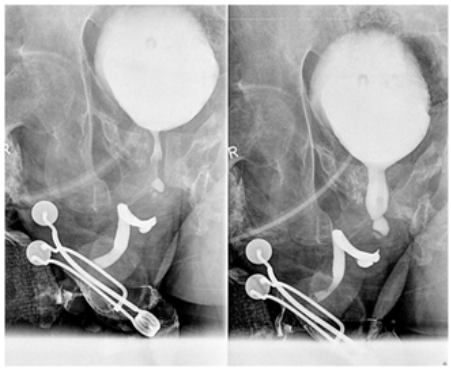

Figure:4 VCUG showing posterior urethral valve, bulbar urethral stricture and bulbar urethral diverticulum

CASE-5:

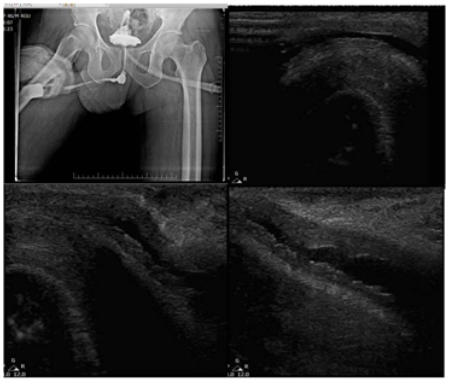

Figure:5 RGU showing long segment penile stricture and Sonourethrogram showing irregular penile stricture with mucosal outline and periurethral soft tissue.

CASE-6 :

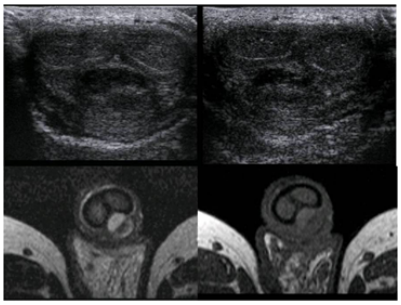

Figure:6 Ultrasound and MR images showing injury to the tunical layer of spongiosa with urethral involvement.

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