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Correlation of Sonourethrogram with Retrograde Urethrogram in Evaluation of Anterior Urethral Abnormalities

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ABSTRACT

Background: The evaluation of male anterior urethral lesions has traditionally relied on retrograde urethrography, a technique that has served as the gold standard for many years. However, with the advent of sonourethrography, there arises a potential for a more efficient and possibly safer method of assessment. This study aims to explore the utility of sonourethrography in this domain and to benchmark its diagnostic performance parameters, such as sensitivity, specificity, and predictive values, against the established retrograde urethrography.

Methods: Ethical clearance was acquired for 49 male patients referred from the Department of Urology and General Surgery due to complaints related to anterior urethral abnormalities. Each patient underwent a sonourethrogram procedure using the Philips HD 15/Philips Affiniti 50G machines, followed by the conventional retrograde urethrography.

Results & Interpretation: When compared to the gold standard retrograde method, sonourethrography boasted a sensitivity of 83%, specificity of 94%, positive predictive value of 96%, and a negative predictive value of 78%. Notably, sonourethrography is quicker and simpler to administer than retrograde urethrography, eliminates the need for iodinated contrast material, and removes radiation risks. Given its three-dimensional nature and its safety for repeated use, incorporating sonourethrogram into daily medical practice offers a convenient and side-effect-free solution.

Conclusion: Sonourethrography emerges as a highly efficient, safe, and faster alternative to the conventional retrograde urethrography for assessing anterior urethral lesions. With its high sensitivity, specificity, and predictive values, coupled with its advantages such as no radiation exposure and the elimination of iodinated contrast materials, sonourethrography is poised to become a preferred choice in clinical settings. Its three-dimensional capabilities and the absence of side effects further accentuate its value, making a compelling case for its broader adoption in everyday medical practice.

Key Words: *Sonourethrography, Retrograde Urethrography, Anterior Urethral Lesions, Predictive Value, Radiation Risks*

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INTRODUCTION

The urethra, the last passageway of the lower urinary system, is impacted by a number of disorders. Numerous sexually and non-sexually transmitted illnesses cause urethritis in this organ. It frequently develops strictures from infections, trauma, or iatrogenic causes. Despite being rare, congenital defects can nevertheless occur. Urethral diseases can also be caused by pathologies of exterior structures like the bulbo-urethral glands of Littre and Cowper's glands.

Up until recently, the standard studies for the anterior urethra included conventional retrograde urethrography, antegrade urethrography, and voiding cysto-urethrography. However, their shortcomings in providing an appropriate assessment of urethral illnesses are well known. They are unable to specify the depth at which scar formation occurs

and can only imperfectly quantify the length of the stricture [1]. They don't mention the periurethral structures or the degree of periurethral fibrosis; they simply give information about the luminal anatomy.

Ultrasonography has significantly improved over the past ten years and is now frequently utilised for imaging the prostate, scrotum, urinary bladder, and kidneys [1]. Recently, only a few reports from the west about the use of ultrasonography in the diagnosis of urethral stricture disease from other nations as well as from India. They have verified its benefits. However, there are not many reports about its usefulness in treating other urethral problems, and it is not frequently utilized.

Sonourethrography, or ultrasound of the anterior urethra, provides a dynamic, three-dimensional investigation that is easily repeatable without damaging the gonads. It also promises to define the status of peri-urethral structures in addition to the stricture[1]. With this new method, it is simpler to choose the best surgical strategy.

The goal of the current study, "sonographic evaluation of male anterior urethral anomalies," is to assess the use of sonourethrography in the examination of these conditions.

AIMS & OBJECTIVES

1) To determine the role of sonourethrography in the evaluation of male anterior urethral lesions.
2) To determine sensitivity, specificity, positive predictive value and negative predictive values of sonourethrography in comparison with retrograde urethrography, in detection of anterior urethral lesions.

MATERIALS AND METHODS

Source of data:

Patients referred from Department of Urology and General Surgery to Department of Radiodiagnosis in Vydehi Institute of Medical Sciences and Research Center for retrograde urethrogram from March 2021 to August 2022.The ethical committee of VIMS & RC gave the ethical clearance and informed consent was obtained from all thepatients.

Procedure:

Patients were subjected to sonouretehrogram first under strict aseptic precautions. Using 5fr infant feeding tube urethra was cannulated and 10-15 cc of normal saline was injected into the urethra. High-frequency linear array transducer (frequency 7.5-10 MHz) of Philips HD 15/Philips Affiniti 50G followed sagittal and axial images were acquired.

Following which patient was subjected to conventional retrograde urethrography. Using 5fr infant feeding tube urethra was cannulated and 10-15 cc of non-iodinated contrast media was was injected by 20 cc disposable syringe. Right anterior oblique and left anterior oblique views were taken. Findings of SUG were compared with findings of RGU and were depicted in a tabular column.

SAMPLE SIZE: 49 Patients

Inclusion criteria:

- All patients with referred with symptoms pertaining to anterior urethral abnormalities.
- Age > 18 years of age.

Exclusion criteria:

- Patients with posterior urethral stricture.
- Patients presenting with symptoms pertaining to benign prostate hyperplasia, prostatic carcinoma, fournier's gangrene and penile carcinoma.

Statistical Analysis:

- Data was entered in MS Excel and analyzed using SPSS version 21.
- The sensitivity, specificity, Positive Predictive Value and Negative Predictive value was calculated for correlation of sonourethrogram findings with retrograde urethrogram findings in cases of anterior urethral abnormalities.

RESULTS

Table 1: Number of cases examined

Character	Number
No of cases referred in one year	100
No of cases elected for study	49
No of cases underwent RGU	49
No of cases underwent SUG	49
No of pathologies detected	31
No of normal studies	18

Table 2: Stricture detection rates of RGU and SUG

Character	Number	Percentage
Total strictures detected	18	
Detected on RGU	18	100
Detected on SUG	15	83

Table3: Urethritis detection rates of RGU and SUG

Character	Number	Percentage
Total urethritis detected	10	
Detected on RGU	10	100
Detected on SUG	9	90

Table4: Diverticulae detection rates of RGU and SUG

Character	Number	Percentage
Total diverticulae detected	2	
Detected on RGU	2	100
Detected on SUG	1	50

Table5: Periurethral cysts detection rates of RGU and SUG

Character	Number	Percentage
Total periurethral cysts detected	1	
Detected on RGU	1	100
Detected on SUG	1	100

Table 6: Statistics:

Character	Number
No of normal studies	18
No of pathologies detected on RGU	31
No of pathologies detected correctly on SUG	25
Number of pathologies missed on SUG	5
Pathology Detected on SUG but Not Present	1
True Postive (TP)	25
Fasle Positive (FP)	1
True Negative (TN)	18
Fasle Negative (FN)	5

Calculations:

$$\text{Sensitivity} = \frac{TP}{TP + FN}$$

Sensitivity: 25/25+5=83%

$$\text{Specificity} = \frac{TN}{FP + TN}$$

Specificity: 18/1+18=94%

$$\text{Predictive value of a positive test (PPV)} = \frac{TP}{TP + FP}$$

Positive predictive value: 25/25+1=96%

$$\text{Predictive value of a negative test (NPV)} = \frac{TN}{TN + FN}$$

Negative predictive value: 18/18+5=78%

Chart 1: Diagrammatic representation of cases referred and studied

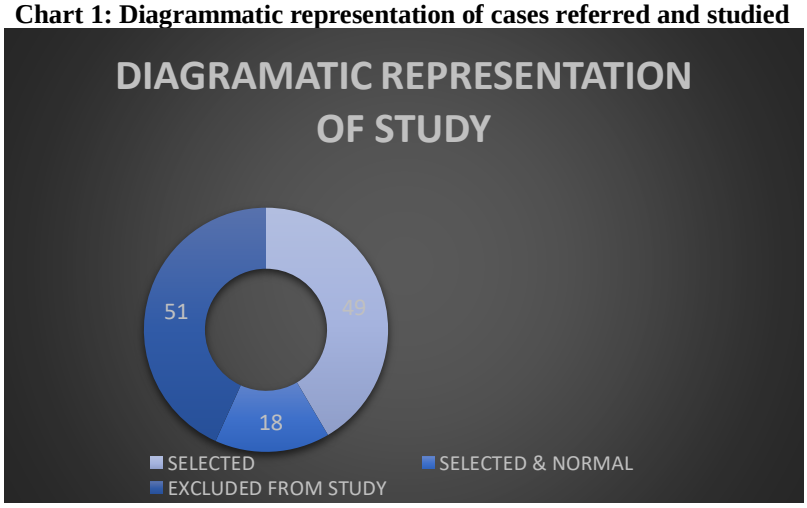


Chart2: Various pathologies detected by Sonourethrogram

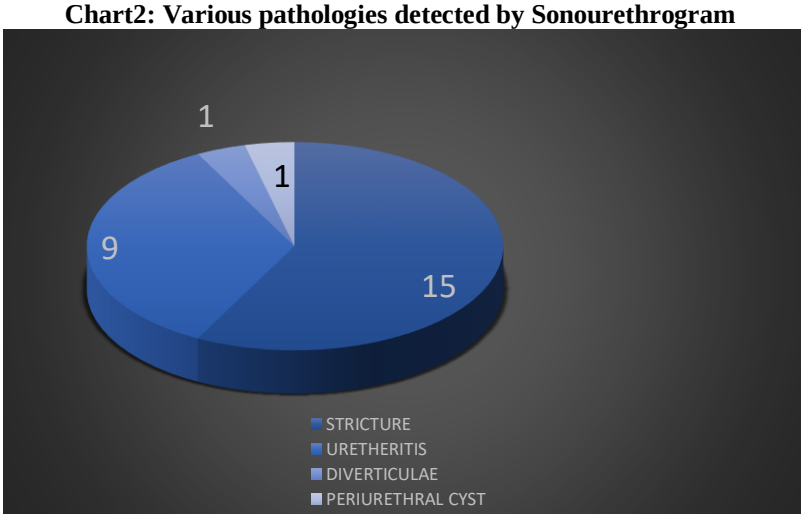


Chart 3: Bar representation of percentage sensitivities of SUG and RGU in detection of various Pathologies

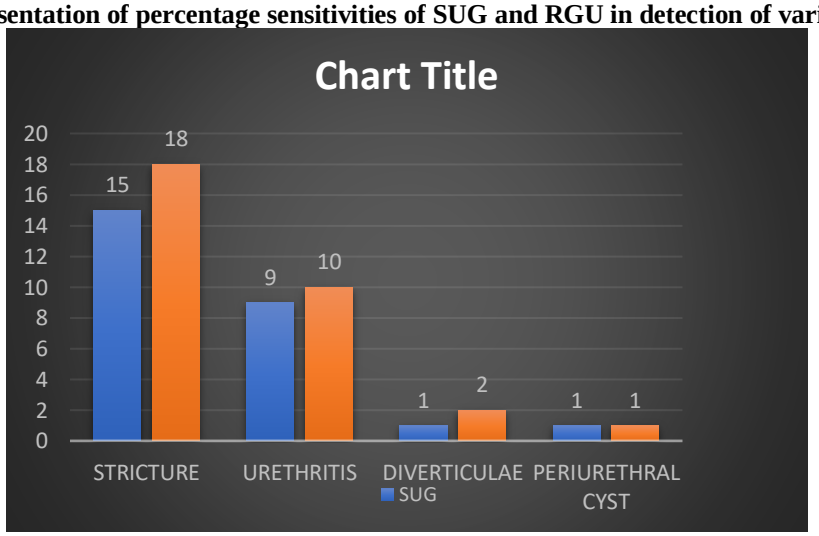


FIG 1: Appearance of normal anterior urethra on Sonourethrogram

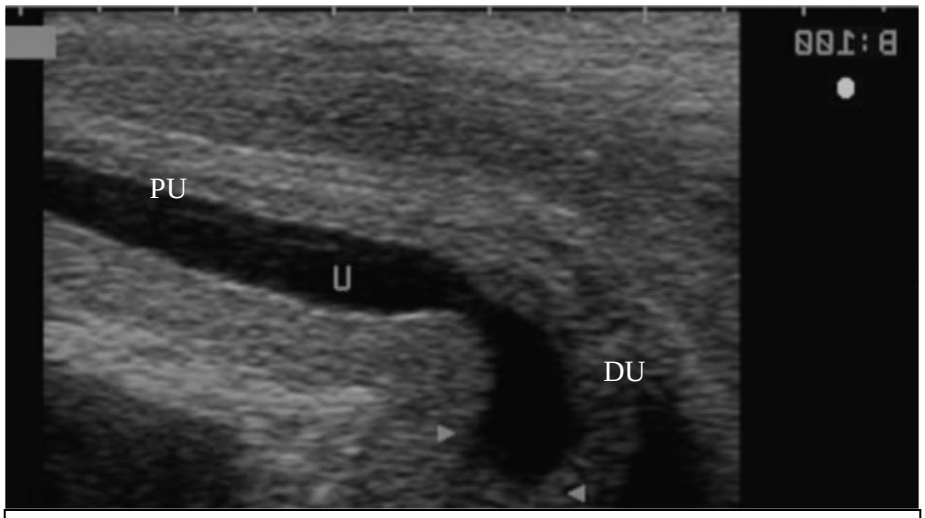
1--- Corpus cavernosum

2---Corpus spongiosum

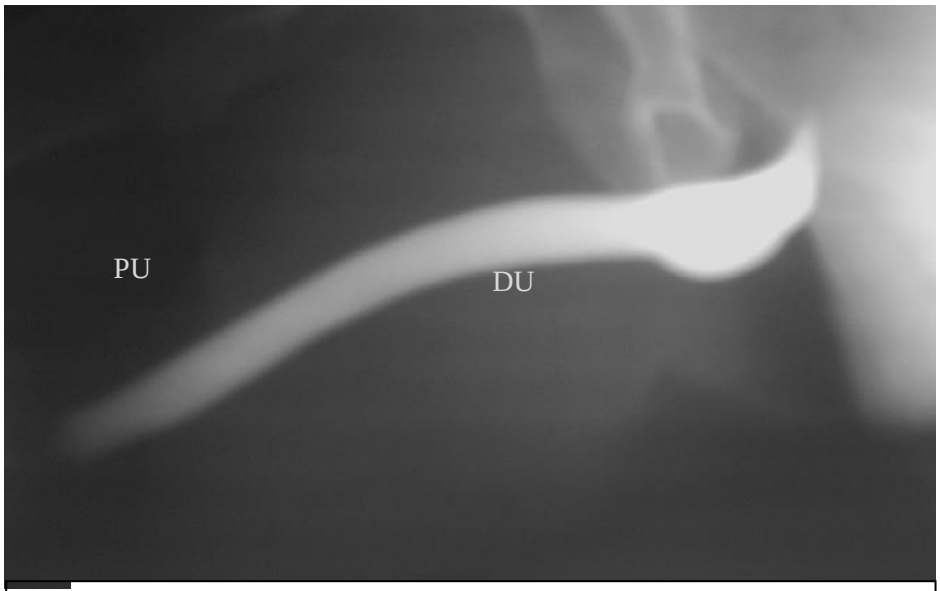
3---Epithelium

4---Urethrallumen

Case 1:

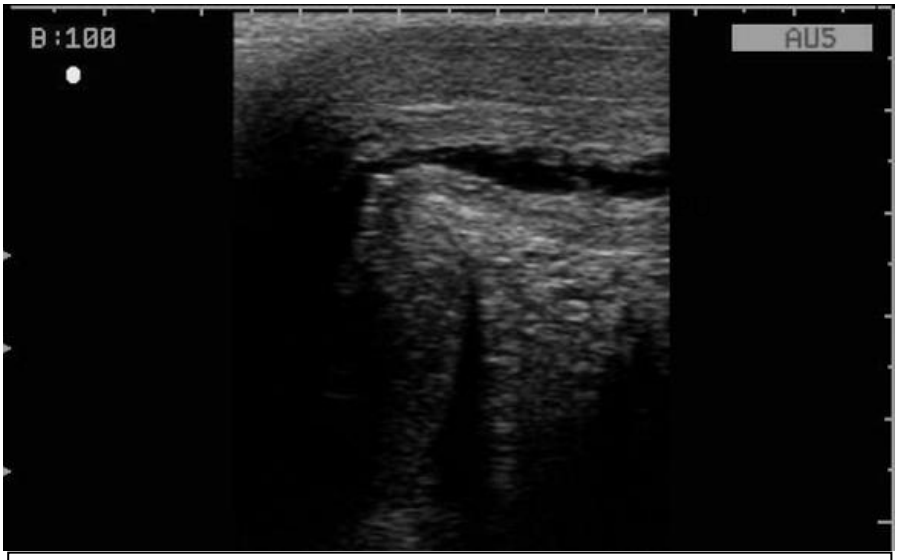


A. Normal anterior urethra on Sonourethrogram (PU-Proximal urethra DU-Distal urethra)

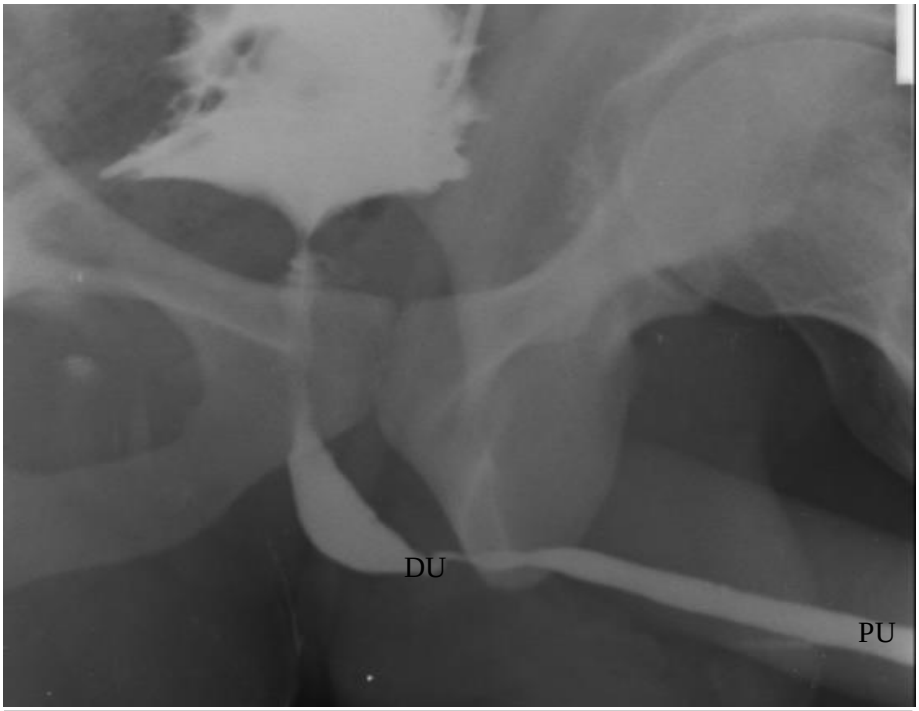


B. Normal anterior urethra on retrograde Urethrogram. (PU-Proximal urethra DU-Distal urethra)

Case 2:



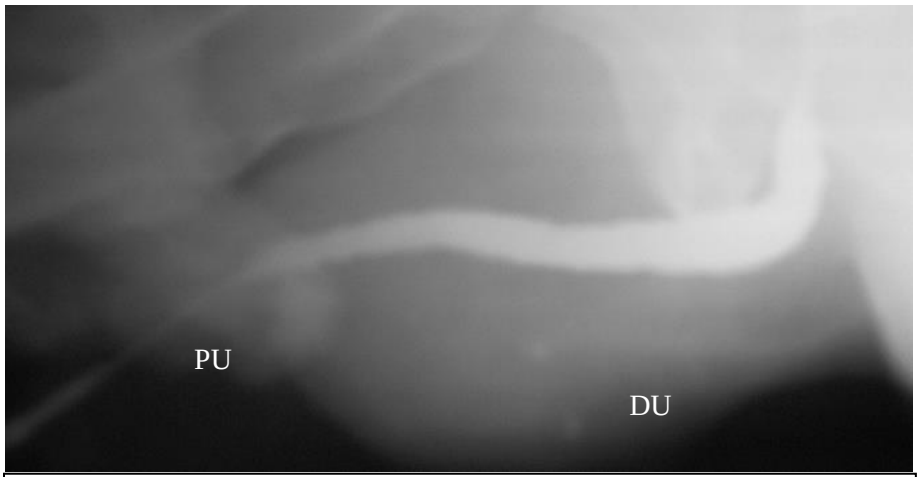
A. Bulbar urethra stricture on Sonourethrogram. (PU-Proximal urethra DU-Distal urethra)



B. Bulbar urethra stricture on retrograde Urethrogram. (PU-Proximal urethra DU-Distal urethra)

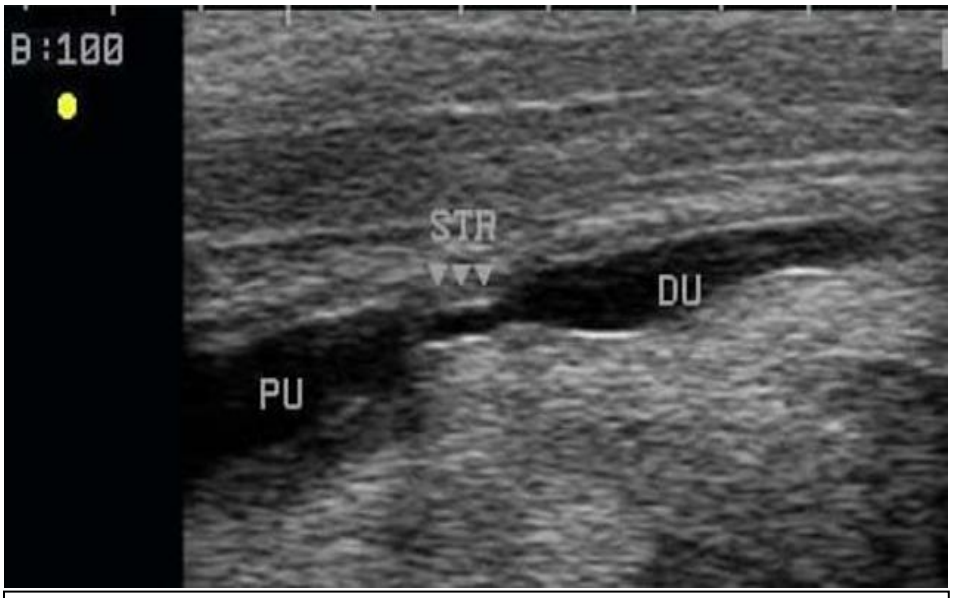
Case 3:

A.Sonourethrogram showing urethritis (Littre's glands and irregular epithelium). (PU-Proximal urethra DU-Distal urethra)

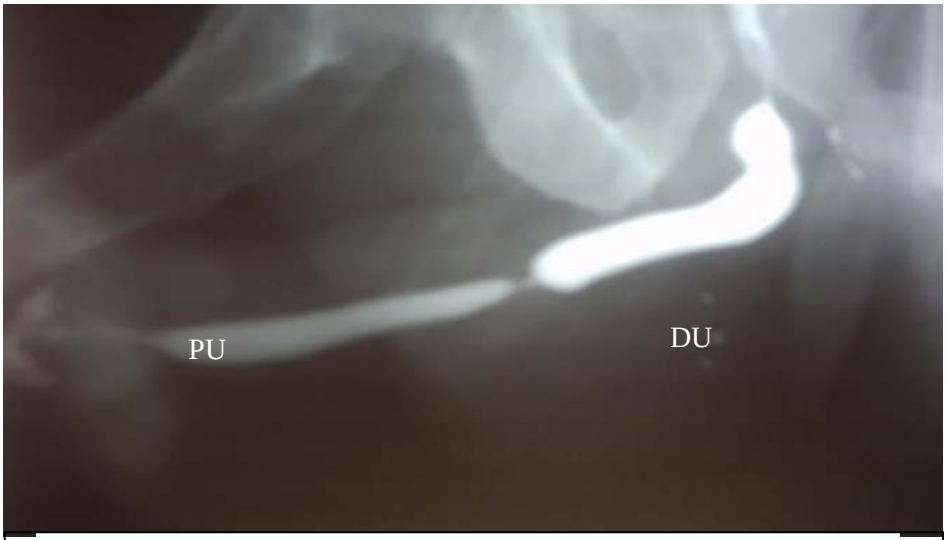


B. Retrograde urethrogram showing urethritis.

Case 4:



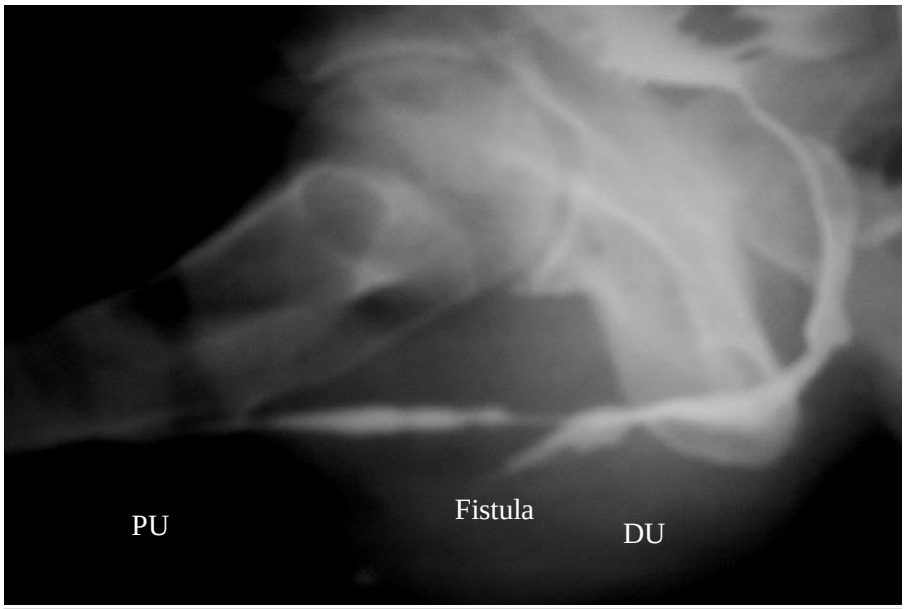
A.Sonourethrogram showing narrow stricture at penile urethra associated with dilated proximal (PU) and distal urethra(DU).



B. Retrograde urethrogram showing penile urethra stricture. (PU-Proximal urethra DU-Distal urethra)

Case 5:

A.Sonourethrogram showing fistula and irregular urethral epithelium(Urethritis)



B. Retrograde urethrogram showing fistula and irregular urethral epithelium.

Results Interpretation:

In this study, the evaluation of male anterior urethral lesions was examined using two primary imaging methods, namely retrograde urethrography (RGU) and sonourethrography (SUG).

Patient Selection and Examination:

From the total of 100 cases referred within a year, 49 cases met the inclusion criteria, which required the presence of symptoms related to anterior urethral abnormalities in patients aged over 18 years. Cases with complications related to posterior urethral stricture, benign prostate hyperplasia, prostatic carcinoma, Fournier's gangrene, and penile carcinoma were excluded from the study. All 49 selected cases underwent both RGU and SUG evaluations.

Evaluation Outcomes:

- Stricture Detection: RGU detected strictures in 100% (18 out of 18) of the cases, whereas SUG detected them in 83% (15 out of 18) of the cases.
- Urethritis Detection: Both RGU and SUG showed high detection rates for urethritis, with RGU detecting it in all 10 cases and SUG in 9 cases, translating to a 90% detection rate for the latter.
- Diverticulae Detection: The detection rate showed a significant difference between the two techniques. While RGU detected diverticulae in both the cases (100% detection rate), SUG only detected it in one case, marking a 50% detection rate.
- Periurethral Cysts Detection: For the single periurethral cyst case, both RGU and SUG managed a 100% detection rate.

Diagnostic Performance of SUG Compared to RGU:

- Sensitivity: The ability of SUG to correctly identify those with the pathology was calculated at 83%.
- Specificity: The capability of SUG to correctly identify those without the pathology was found to be 94%.
- Positive Predictive Value (PPV): The proportion of positive identifications that were actually correct by SUG was 96%.
- Negative Predictive Value (NPV): The proportion of negative identifications that were indeed absence of the pathology by SUG was 78%.

While RGU remains a gold standard with a consistent 100% detection rate across all pathologies, SUG presents as a valuable tool, especially given its high sensitivity and specificity values. However, there is room for improvement in SUG, as evidenced by its lower detection rate in certain pathologies, such as diverticulae. On the other hand, the similar detection rates for urethritis and periurethral cysts between the two methods highlight the potential of SUG as an alternative or supplementary diagnostic tool in the future.

DISCUSSIONS

There are many illnesses that can damage the urethra, which is the lower urinary tract's exit point.Numerous sexually and non-sexually transmitted illnesses cause urethritis in this organ. It frequently develops strictures from infections, trauma, or iatrogenic causes [2]. Despite being rare, congenital defects can nevertheless occur. Urethral diseases can also be caused by pathologies of exterior structures like the bulbo-urethral glands of Littre and Cowper's glands [3]. Up until recently, the standard studies for the anterior urethra were conventional retrograde urethrography, antegrade urethrography, and voiding cysto urethrography [4]. However, their shortcomings in providing an appropriate assessment of urethral illnesses are well known.

They are unable to specify the depth at which scar formation occurs and can only imperfectly quantify the length of the stricture. They don't discuss the periurethral structures or the degree of periurethral fibrosis; they solely provide information on the luminal anatomy. They are linked to radiation dangers because they utilise radiation [5].

In the past ten years, ultrasonography has advanced significantly [1]. Recently, a few publications about the use of ultrasonography in diagnosing urethral stricture disease have been published. They have verified its benefits. However, there aren't many reviews about its usefulness in additional urethral anomalies. The goal of the current study is to assess sonourethrography's utility in detecting male anterior urethral anomalies.

In a study of 50 patients with anterior urethral stricture done in West Bengal by Sumanta Mandal et al in it was found that Sonourethrography is highly sensitive and accurate predictor of anterior urethral stricture for the detection of site and length of stricture for planning surgery and should be the preferred diagnostic procedure. In our research, we discovered that SUG was also sensitive in predicting strictures [6].

A comparative study of ascending urethrogram and sono-urethrogram in the evaluation of stricture urethra was done in Karnataka in 2015 by B.R.Ravikumar at al and it was found that Sonourethrogram is more sensitive and superior in

identifying spongiofibrosis, diameter and length of the strictures of anterior urethra. In our research, we discovered that SUG was aslo sensitive in predicting strictures [7].

A study by V.N.S.Dola et al. in Trinidad and Tobago on 45 patients found that both RUG and SUG proved to be equally efficient in detecting the site of stricture and assessing the length and diameter of the stricture and by including the tapered segments on either side of stricture in RUG, the length measurements were comparable to SUG. The periurethral fibrosis and mucosal abnormalities were well demonstrated by the SUG, which was not evident by the RUG. In our research, we discovered that SUG was aslo sensitive in predicting strictures [8].

Rasheedat Aderinsola Bakare et al. in Nigeria concluded in a study that SUG was found to be equally efficacious in the detection of anterior urethral strictures when compared with RUG. SUG was found to be more reliable and accurate in characterization of anterior urethral strictures in terms of length, width and periurethral abnormalities. In our research, we discovered that SUG was aslo sensitive in predicting strictures [9].

Another comparative study by C. Anil et al in Andhra Pradesh in 2020, SUG gives more accurate information about stricture length and periurethral fibrosis, thus is more useful to determine the suitable operative procedure. In our research, we discovered that SUG was aslo sensitive in predicting strictures.

In an observational study by Bibi Ayesha at in Karnataka in 2020, they found that RGU is the best imaging modality, but SUG also provides similar results with benefits such as precise measurement of stricture length and degree of spongiofibrosis. In our research, we discovered that SUG was aslo sensitive in predicting strictures.

Prospective study was conducted byC. Anil, N. Anil Kumar et al in 2019 on sonourethrography in evaluation of anterior urethral abnormalities and comparison with retrograde urethrogram.31 patients had undergone retrograde urethrogram first and then followed by sonourethrogram. They concluded, the mean length of stricture calculated on sonourethrogram was closer to that of surgery when compared with retrograde urethrogram. The percentage sensitivity and accuracy of sonourethrogram in detecting spongiofibrosis is 94.7%. The accuracy of retrograde urethrogram and sonourethrogram in detecting urethritis is 47% and 94%. In our research, we discovered that SUG was aslo sensitive in predicting strictures and urethritis.

CONCLUSION

The anterior urethra, which is covered by the corpus spongiosum of the penis [2, 3], is susceptible to a number of illnesses. It is also fairly shallow and is simple to access using high-resolution sonography. We did a study to determine the function of ultrasonography in the assessment of anterior urethral anomalies.

We looked at 49 patients who had difficulty in voiding because of their anterior urethra. Both sonourethrography and traditional retrograde urethrography were used to examine every patient. The results of the two modalities were analyzed and contrasted.We learned from this study that sonourethrography is extremely capable and sensitive in identifying up anterior urethral pathologies.

Sonourethrography is simpler to execute, takes less time than radiographic retrograde urethrography, doesn't include iodinated contrast material, and poses no radiation risks. It is a three-dimensional and risk free to repeat. Additionally, it effectively illustrates periurethral disorders including urethritis and periurethral cysts. However the limitation of my study is that, it does not show the full urethra in a single panoramic image and posterior urethral abnormalities could not be assessed completely.

We conclude that routine use of sonourethrography for evaluating anterior urethral anomalies such as strictures and especially in cases having subtle findings of urethritis is beneficial.It is risk free and can be repeated with no risk of radiation. It is a real time 3-dimentional study. Risk of contrast reactions and allergies which is present in retrograde urethrogram are not present in sonourethrogram. We recommend incorporation of sonouretrhogram in our day-to-day practice and it is convenient and has no side effects.

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