



ST PAUL'S HOSPITAL MILLENIUM MEDICAL COLLEGE

SONOURETHROGRAPHY&RETROGRADE URETHROGRAPHY FINDINGS OF PATIENTS SUSPECTED TO HAVE URETHRAL STRICTURES AT SPHMMC, ADDIS ABABA, ETHIOPIA

BY

SISAY MENNA (MD., radiology resident)

A RESEARCH THESIS SUBMITTED TO SPHMMC DEPARTMENT OF RADIOLOGY,
SPHMMC IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR A
SPECIALTY CERTIFICATE IN RADIOLOGY

AUGUST, 2017

Sonourethrography & Retrograde Urethrography findings of patients suspected to have Urethral Strictures at SPHMMC, Addis Ababa, Ethiopia

BY

SISAY MENNA (MD., radiology resident)

**Advisors- EteneshTewolde (MD.,Radiologist)
Yosef Worku (MD., MPH)**

RESEARCH THESIS SUBMITTED TO SPHMMC DEPARTMENT OF RADIOLOGY,
SPHMMC IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR A
SPECIALTY CERTIFICATE IN RADIOLOGY

AUGUST, 2017

Abstract

Background; Urethral strictures are abnormal narrowing's of the urethra resulting from fibrous scar tissue. They may involve the entire urethra or only a small portion. Abrupt, short-segment strictures are usually traumatic. Long-segment strictures may be either traumatic or inflammatory. Stricture urethra in Males is a common problem encountered by the urologists.

Besides history and physical examination, ascending urethrogram remained the Gold Standard for evaluating male urethral stricture. It has a Sensitivity of 91% and specificity of 72% for diagnosing anterior urethral strictures. Sonourethrography (SUG) is better than retrograde urethrography (RUG) as it gives a more accurate estimate of stricture length and periurethral pathology along with additional information about periurethral fibrosis. It also has an advantage of no exposure to radiation.

Objective; The objective of this study was to compare the efficacy of Sono-urethrogram with Ascending urethrogram in the evaluation of Male anterior urethral strictures.

Methods ; This study was conducted in the department of radiology, St. Paul's Hospital, Addis Ababa, between March 1, 2017 to June 30, 2017. All Male Patients presenting with obstructing voiding symptoms suggestive of stricture urethra were selected.

Data was compiled and analyzed using the computer software (SPSS version 21) and presented using numbers, odds ratio and tables. Comparison was made between sonourethrography and RUG.

RESULT ;

In our study, total of 41 patients underwent the study, out of whom ten patients are found to be normal. Remaining 30 patients had findings of varying type on both modalities. Out of these 30 patients, 28 patients had stricture and two patients without stricture. Bulbar urethral strictures were the commonest found in 17 patients with both the modalities.

Total seven penile strictures were diagnosed on both the modalities. One membranous urethra stricture was not visualized on SUG.

Out of 28 patients, 20 patients had short segment strictures, 4 patients had long segment strictures and 4 patients had complex strictures. Out of the 20 short segment strictures, 16 were bulbar (Figure 4) while 4 were penile short segment strictures. In long segment strictures, total four patients were identified, three penile (Figure 5) and one was bulbar. Out of 28 patients with diagnosis of urethral stricture diseases, sonourethrography revealed periurethral fibrosis in 14 (50 %) patients.

Discussion and conclusion

Characterization of urethral stricture based on location, multiplicity and length matched well on both modalities, but in diagnosing other periurethral pathologies, SUG showed upper hand. This finding correlates well with previous similar studies. In the present study, we have found sonourethrography to be a multiphasic, easily available and cost-effective technique for evaluating the male anterior urethra without radiation exposure. When compared with conventional RUG, sonourethrography is equally efficacious in detecting anterior urethral stricture diseases.

ACKNOWLEDGEMENT

I would like to extend my heartily felt gratitude to my advisors Dr. Etenesh Tewolde and Dr.yoseph worku for their contribution, advice and consistent guidance throughout the preparation of this thesis.

Table of Contents	Page
Abstract	I
Acknowledgements.....	II
Table of contents.....	III
List of Tables	IV
Acronyms and Abbreviations	V
Chapter One: Introduction	1
1.1-Background.....	1
1.2-Statement of the Problem	2
1.3 significance of the study.....	3
Chapter Two: Literature Review	4
Literature Review.....	4
Chapter Three: Objectives	8
3.1- General Objective	8
3.2- Specific Objectives	8
Chapter Four: Methods and Materials	9
4.1 – Study setting.....	9
4.2 study period.....	9
4.3- Study Design.....	9
4.4– Population	9
4.4.1 –Source Population	9
4.4.2 –Study Population/ Sample population.....	9
4.5- Sample size and Sampling technique	10
4.6- Measurement	10
4.6.1 Variables	10

4.6.2-instruments.....	11
4.7-plan for data collection	11
4.8 Data quality control	12
4.9 Plan for Data processing and analysis	12
4.10-Ethical considerations.....	12
4.11- Operational Definitions	13
Chapter five: RESULTS	14
Chapter six: DISCUSSION.....	21
LIMITAION OF THE STUDY	22
CONCULION AND RECOMMMENTATION	23
References	24
Annex I Questionnier	25

LIST OF TABLES AND FIGURES

Table 1: Distribution of study participants according to their age (Yr.), marital status and past history SPHMMC, 2017.....	14
Figure 1: Age distribution of study participants attending SPHMMC, 2017.....	15
Figure 2 sonourethrographic appearance of short segment penile urethral stricture of participant attending SPHMMC, 2017.....	16
Figure 3 sonourethrographic appearance of short segment bulbuar urethral stricture with proximal urethral stone of participant attending SPHMMC, 2017.....	16
Figure 4 Sonourethrography and RUG appearace of long segent stricture penile urethra of participants attending SPHMMC, 2017.....	17
Table 2: Distribution of study participants based on Location of of participants attending SPHMMC, 2017.....	16
Table 3: Distribution of study participants based on number of stricture of participants attending SPHMMC, 2017.....	16
Table 4: Distribution of study participants based on length of strictur of participants attending SPHMMC, 2017.....	17
Table 5: Grades of spongiofibrosis in relation to stricture on SUG of participants attending SPHMMC, 2017.....	17
Table 6: Distribution of study participants based on periurethral findings of participants attending SPHMMC, 2017.....	18
Table 7: The statistical evaluation of study of participants attending SPHMMC, 2017...	18

ABBREVIATIONS

AUG: Ascending urethrography

BMJ: bulbomembraneous junction

OPD;out patient department

RGU:Retrogradeurethrography

SUG:sonourethrography

SPHMMC; st paul hospital millennium medical collage

TURP; Transurethral resection of the prostate

CHAPTER ONE

INTRODUCTION

1.1 Background

Urethral pathologies, especially strictures are common problem affecting young adult males and are one of the major cause of morbidity.

Urethral strictures are abnormal narrowing's of the urethra resulting from fibrous scar tissue (1). They may involve the entire urethra or only a small portion. Abrupt, short-segment strictures are usually traumatic. Long-segment strictures may be either traumatic or inflammatory. Causes of traumatic urethral strictures include instrumentation, indwelling catheters, prostatectomy procedures, chemical injury (podophyllin), saddle injuries (usually of the bulbous urethra), and pelvic fractures. Most inflammatory strictures are attributable to gonorrhea. Bacteria become sequestered in the glands of Littre and incite the formation of granulation tissue and fibrosis. Additional etiologies include chlamydia, mycoplasma, tuberculosis, and schistosomiasis.

Complications of urethral strictures include the following: Periurethral abscess: usually develops on the ventral surface and may drain into the lumen or onto the skin, creating a periurethral fistula. False passage is the most common complication of urethral stricture. It is usually iatrogenic because of attempted passage of catheters or instruments past the obstruction. Stasis and infection may cause disease of the more proximal urinary tracts including hydronephrosis, bladder hypertrophy, calculi, and chronic inflammation

The etiology of a urethral stricture is best determined from the clinical history and the patient's age. Retrograde urethrography is the imaging study of choice for the evaluation of urethral strictures. The purpose of the radiographic evaluation is to assess the length, location, multiplicity, and severity of the urethral stricture, and to identify concomitant lesions that may complicate urethral obstruction (2).

The male urethral imaging and pathology is not widespread in the radiology literature because this part of the urinary tract is easily studied by urologists with clinical or endoscopic examinations. However, imaging has an important role to play in the study of the stricture diseases of the male urethra since it can detect pathology not visible on urethroscopy. Thus Anterior urethra is routinely assessed by retrograde urethrography and is considered as gold standard for urethral pathology until the advent of sonourethrography.(3)

1.2 Statement of the problem

Stricture urethra in Males is a common problem encountered by the urologists. Besides history and physical examination, ascending urethrogram remained the Gold Standard for evaluating male urethral Stricture (4-5). In one study it has a Sensitivity of 91% and specificity of 72% for diagnosing anterior urethral strictures (6)

Diagnostic imaging of the male urethra has depended on these techniques, which involve the use of radiation and intra-urethral injection of contrast medium to visualize luminal anatomy. Limitations of RCU in accurate evaluation of anterior urethral stricture diseases include variation in the appearance of strictures with position of the patient and the degree of stretch of the penis during the study. It also provides limited information about periurethral structures.

In 1988 a new technique for imaging the male anterior urethra with high-resolution ultrasound (sonourethrography). The initial technique involved the use of a 5 MHz linear array transducer applied to the dorsal surface of the penis. Images were obtained during retrograde instillation of normal saline. As the normal urethral wall and spongiosum are elastic they are compressible on saline injection. When altered by stricture disease the corpus spongiosum loses its elasticity due to higher collagen content and is not compressible, causing a reduction in the inner diameter of the urethra.(4)

On sonourethrography, a stricture is identified as narrowed segment of urethral lumen with irregularity and thickening of wall. The location, degree of narrowing and length can be determined accurately. Dilatation of lumen proximal to stricture is well identified. Sonourethrography also detect degree of spongiofibrosis which appears as echogenic tissue distorting surrounding corporeal parenchyma. Identification of spongiofibrosis is important to determine the choice of surgical procedure [7].Sonourethrography also lacks radiation exposure and so it is especially useful in follow up studies where multiple examinations are required.

An ideal study should be able to indicate the type of surgical procedure suitable for the patient. This includes accurate determination of the site, length and diameter of strictures. Complete preoperative knowledge of complicating conditions like urethral calculi, fistulae, false tracts, diverticula and polyps facilitate favorable urethroplasty outcomes.

As a dynamic, study, which can be repeated without radiation exposure, sonourethrography (SUG)offers important technical advantages compared with RGU.

Though urethral stricture is common problem in Ethiopia there are few published studies in this field and no experience on sonourethrography.

Thus the information we get from this fill the gap and encourage further study on this field It also will help to develop new approach on the imaging of urethral stricture.

This study was undertaken to explore the of high-resolution ultrasound findings in evaluating stricture disease of the male anterior urethra and comparing it with RGU.

1.3 significance of the study

Proper selection of imaging modality for pre-operative evaluation of urethral strictures is of paramount importance in planning treatment. Retrograde urethrography (RUG) is a conventional imaging technique and is regarded as a standard modality. It has certain limitations like variation in stricture length due to inadequate patient positioning and penile traction and it does not delineate periurethral fibrosis apart from the well-known disadvantage of radiation exposure to gonads. SUG is better than RUG as it gives a more accurate estimate of stricture length and periurethral pathology along with additional information about periurethral fibrosis. It also has an advantage of no exposure to radiation.

As a dynamic, study, which can be repeated without radiation exposure, sonourethrography (SUG) offers important technical advantages compared with RUG.

So this study will determine sonourethrographic findings of patients suspected of urethral stricture and compare it with RUG.

Thus, the information we get from this study will encourage further study on this field

It also will help to develop new approach on the imaging of urethral stricture.

CHAPTER TWO

LITERATURE REVIEW

There are considerable numbers of patients with urethral problems and many of them are required to undergo surgical procedures for the treatment of their diseases. Thus preoperative investigation, which would accurately demonstrate and locate the urethral pathology, becomes a prerequisite for successful treatment. If such an investigation is radiation free and able to suggest the mode of treatment, then it virtually becomes indispensable. Sonourethrography is one such investigation

A comparative study of ascending urethrogram and sono-urethrogram in the evaluation of stricture urethra study conducted in the department of urology, JSS hospital, Mysore Among 40 patients who were diagnosed as having stricture urethra by Ascending urethrogram, 5 were found to be normal in Sono--urethrogram. The findings were confirmed later by cystoscopy. One patient who had evidence of posterior urethral stricture in AUG had normal urethra in cystoscopy. The assessment of stricture was incomplete in 2 patients due to posterior location. These patients subsequently required MCUG for complete stricture evaluation. Average stricture length in AUG group was 9.3 mm. Stricture length could not be assessed correctly in 5 patients in AUG group due to complete cut- off. Average stricture length in SUG group was 14.1 mm. Mean difference between 2 groups was 4.8 mm (P value- <0.01). The cystoscopic and intra-operative findings correlated well with the findings of SUG. Average diameter of stricture in AUG group was 0.9 mm. Average diameter of stricture in SUG group was 1.1 mm. Mean difference between 2 modalities was 0.2 mm (P-value- <0.01). Spongiofibrosis was demonstrated in 12 patients with traumatic strictures, 4 patients with inflammatory strictures, 7 patients with BXO and in 1 patient with Post- operative (TURP) stricture. The findings of SUG correlated well with intra-op findings who underwent open surgery. Ascending urethrogram did not identify spongiofibrosis in any patient. In Ascending urethrogram group, 3 patients had False tracts, 2 patients had urethral calculi and 4 patients had urethral diverticulum. In Sono-urethrogram group, 3 patients had False tracts, 3 patients had urethral calculi, 5 patients had urethral diverticulum and 2 patients had Periurethral abscesses.

Minor bleeding was seen in 5 patients, Intravasation of contrast in 6 patients and Dysuria in 6 patients in ascending urethrogram group. In SUG group, Minor bleeding was seen in 2 patients and Dysuria in 4 patients. None of the patients developed procedure related infection(8).

Conclusion of the study was Sono-urethrogram is a highly sensitive and specific investigation in the diagnosis of anterior urethral strictures. Sono-urethrogram is not ideal for the evaluation of posterior strictures. Stricture length can be estimated more precisely with Sono-urethrogram compared to Ascending urethrogram. Spongiofibrosis- The thickness and length can be appreciated by Sono-urethrogram, which is not possible with Ascending urethrogram. Associated findings such as diverticulum and peri-urethral abscess can be detected with higher sensitivity by Sono-urethrogram.

Other Comparative Study of Sonourethrography and Retrograde Urethrography in Evaluation of Anterior Male Urethral Strictures was conducted in the department of Radio-diagnosis, NSCB Medical College; Jabalpur study was carried out to evaluate the abnormalities of male anterior urethra with using high resolution ultrasound, to compare the findings of SUG to that of RGU. In patient with urethral structure & assess periurethral changes in anterior urethral pathology. 40 patients were collected from the department of surgery OPD with complaints of difficulties in micturition and clinically suspected to have stricture in age group of up to 65 years for examination. All the cases of RGU & SUG were confirmed by intra-operative finding. In this study majority of the cases was in the age group of 40 to 50 year (55%) and the most common etiology of stricture was previous surgery. Other cases were previous history of urethritis and history of trauma in (7 cases). No cause was indentified in 25 cases (25%).

The most common presenting complaint was thin stream of urine in 36 cases (90%) other complaints were straining of micturition (60%) and pain during micturition (4%). In majority of patient in present study duration of symptoms was more than 1 year (60%).

In the study the most common pathology was identified as stricture in 87.5% cases other pathology were calculi in 5% and diverticuli in 5% and benign tumor pathology in 1% cases. The most common site involved in the study was Bulbar urethra (47.5 %) other site was penile (27.5%) and diffuses in (12.5%) In majority of patient in the study length of urethral stricture was less than 4 cm. (72.5%). In majority of patient diameter of urethral stricture was less than 4 mm. (67.5%) The sensitivity of SUG in present study in detection of urethral pathology was (97.5%) and specificity in detection was (97.5%).

The Sensitivity & specificity of RGU in detection of urethral pathology were (95%) of each thus conclusion is that the specificity and sensitivity is better than RGU. The sensitivity and specificity of SUG in detecting site of stricture were (100%) and Sensitivity and specificity of RGU is detecting site were lower than SUG. The sensitivity and specificity of SUG in detecting length of stricture were (100%) and of RGU when lower than SUG. The Sensitivity and specificity of SUG in detecting diameter of stricture were (100%) and of RGU is lower. The sensitivity and specificity in detecting calculi were (100%) in both SUG and RGU. The Sensitivity and specificity of SUG in detecting diverticula were (100%) in SUG and of RGU Sensitivity is (50%) and specificity (100%). The Sensitivity of SUG in detection of tumor was more than the sensitivity of RGU. In detection of fistulous tract SUG is more sensitive and specific than RGU. (9)

Another Comparative Study of Sonourethrography and Retrograde Urethrography in Evaluation of Anterior Male Urethral Strictures study was carried out in the Department of Radiology, Indira Gandhi Government Medical College and Mayo Hospital, Nagpur

Out of 60 patients, the average age was 36.33 year. Maximum number of patients belonged to 2nd and 3rd decade. All patients with clinical diagnosis of urethral obstruction were studied with sonourethrography. These findings were compared with retrograde urethrography, which is time proven 'gold standard'. Urethrography ruled out any urethral obstructive lesion in 11 patients and those were reported to be having normal study. Remaining 49 patients had definite signs of urethral obstruction of varying type. Out of these 49 patients, 44 patients had stricture and five patients without stricture were as follows, 3 with diverticula including syringocele type-2 one with false tract and one with urethrocuteaneus fistula.

Total 53 strictures were demonstrated in 44 patients. Total 51 strictures were diagnosed on SUG and 53 on RGU. One bulbar and two membranous urethra strictures were missed on SUG and diagnosed on RGU. One penile stricture was diagnosed on SUG but missed on RGU.

These strictures were further characterized as per location, number, length, periurethral fibrosis and other findings. Bulbar urethral strictures were the commonest found in 26 patients with both the modalities. One extra bulbar stricture was diagnosed on RGU however it was missed on SUG. Total eight penile strictures were diagnosed on both the modalities. One extra penile stricture diagnosed on SUG was not seen on RGU. Two penile strictures categorized as pure penile were actually complex strictures involving penile and membranous urethra as membranous strictures were not visualized on SUG.

Seven complex strictures visualized on both the modalities all were penile and bulbar urethral complex strictures; however two complex strictures involving penile and membranous urethra were visualized only on RGU. Both the modalities diagnosed 30 single strictures. One additional single bulbar and single penile stricture diagnosed by SUG and RGU respectively. 13 complex strictures were diagnosed with equal accuracy on both the modalities. Out of 44 patients, 28 patients had short segment strictures, 3 patients had long segment strictures and 13 patients had complex strictures. Out of the 28 short segment strictures, 22 were bulbar while six were penile short segment strictures. In long segment strictures total three patients were identified, two were penile and one was bulbar stricture found on SUG which were categorized in short segment category on RGU. Out of 44 patients with diagnosis of urethral stricture diseases, sonourethrography revealed periurethral fibrosis in 34 (56.7%) patients.

Other findings such as periurethral hematoma, periurethral abscesses, diverticula and false passages were well seen on sonourethrography. Four patients had periurethral abscesses two of them were opening in the urethra and one opening outside. Two patients with trauma had associated periurethral hematoma and collection. However these periurethral hematoma and periurethral abscesses were missed on RGU. Total 4 cases of diverticula diagnosed on sonography. Out of these two were wide-mouthed diverticula and one shallow penile urethra diverticulum. Case of Syringocele type-2 also considered under the heading of diverticula as it is described under same heading, supposed to be congenital and have tendency to open in the urethral lumen to give appearance as diverticulum.^{6,7} False passages were seen in 16 patients with one patient having urethrocuteaneus fistula.⁽¹⁰⁾

Comparison of sonourethrography and RUG in the evaluation of anterior urethral stricture was done in South Africa in randomly selected 22 patients, of the 22 patients examined with both RUG and SUG, 19 had stricture length longer on SUG than RUG. In 2 patients the length was longer on SUG and only in 1 patient the results of the ultrasound were comparable with the standard imaging technique. Five patients demonstrated mucosal hypertrophy and debris, had urethral polyps, 1 showed a urethral stone, 1 demonstrated a diverticulum and a sinus tract, and peri-urethral fibrosis was seen in 1 patient.

In general, the correlation between radiographic and sonographic studies was poor. RUG underestimated the stricture length and provided no information on periurethral fibrosis and intraluminal abnormalities. (11)

Though urethral stricture is common problem in Ethiopia, there are few studies done in the urethra stricture

The study done on the endoscopic treatment of urethral strictures in Mekelle, Ethiopia Most patients (82.4%) had strictures followed infections. Others were due to trauma (10.5%), urethral catheter, (8.7%) and TURP (1.1%). About 68.4% of the strictures were in the bulbar urethra and other sites were in the penile (19.3%), bulbo penile (7.0%) and in the membranous (5.3%) part of the urethra. The length of the strictures ranged from 2 mm to 20 mm (mean 16 mm) and had an estimated diameter from 1-2 mm. Direct vision cold knife urethrotomy was successfully done in 50 patients accounting for (87.2%) after one adequate urethrotomy. Seven patients had failed DVU after one adequate attempt accounting for (2.3%). Of those successful direct vision internal urethrotomies, three had later come with severe recurrent strictures accounting for (6.0%) and had undergone urethroplasty.

Another study done in Gondar university on Urethral Stricture and HIV: Unusual Presentations and Treatment Challenge consecutive patients with urethral stricture who presented to the University Hospital of Gondar, North-West Ethiopia, were enrolled in the study from October 2007 to September 2008.

There were 25 post-traumatic and 15 post-gonococcal urethral strictures. All posttraumatic and 5 of the post-gonococcal urethral stricture patients were HIV negative. All 10 HIV positive patients had longer and denser urethral strictures than expected. The time between gonococcal infection and urethral stricture development was 3-5 years in HIV positive patients. The treatment of post-traumatic stricture included progressive perineal anastomotic urethroplasty and a good outcome was seen in more than 95%. However, the surgical treatment of patients with HIV infection was a challenge

Chapter 3

Objectives

3.1 General objective

To describe and compare the findings of Sono-urethrogram and retrograde urethrography in the evaluation of male-urethral strictures.

3.2 Specific objectives

- To determine types (anatomic sites) of urethral strictures in retrograde urethrography and sonourethrography
- To determine retrograde urethrography and Sono-urethrography findings in assessing length of the urethral strictures
- To determine retrograde urethrography and sono-urethrography findings in detection of other periurethral pathologies

Chapter 4

MATERIALS AND METHODS

4.1 Study setting

This study was conducted in the department of radiology, St. Paul hospital, Addis Ababa. The SPH is a tertiary teaching and referral hospital. SPH has a radiology department staffed by radiology consultants, radiology technicians and registrars. The department offers X-ray services including general X-ray for chest, musculoskeletal system and fluoroscopic investigations like barium swallow, barium meal and ascending/ micturating cystourethrography and General Ultrasound/Doppler, MRI scan and CT scan are other services offered in the center. The fluoroscopic unit including retrograde urethrography is staffed by two senior radiologists and three residents and two radiographic technicians who work for a month alternatively.

4.2 study period

The study was conducted between march 1, 2017 to June 30 2017.

4.3 Study design

Descriptive and analytic cross-sectional study design was done

4.4 Population

4.4.1 Source Population

All Male Patients referred for CUG to the department in the study period

4.4.2 Study population

All Male Patients referred for CUG to the department in the study period who fulfil the inclusion and exclusion criterion.

Inclusion and Exclusion Criteria.

Inclusion Criteria-

All Male Patients referred for CUG to the department during the study period

Exclusion Criteria

Those with symptoms suggestive of acute urethritis

History of recent traumatic catheterization is another excluding criteria.

4.5 Sample size and sampling technique

The sample size calculation was not done. This was because of the time and fluoroscopic machine problems, which was not functional intermittently during half of study time.

All Male Patients referred for CUG to the department in the study period which is march 1, 2017 to June 30 2017 who fulfil the inclusion and exclusion criterion are enrolled in the study.

4.6 measurements

4.6.1 Variables

Dependent variable

SUG findings: -

- stricture location
- Stricture length,
- Spongiofibrosis

Independent Variables

Age,
Marital status,
Educational status
Clinical data
RUG findings

4.6.2 Instruments

Data check list sheet that include patient demographic, clinical and imaging information was used. fluoroscopy machine and Samsung ultrasound machine which are available in st paul hospital were used.

4.7 Plan for data collection

A verbal consent was taken from all the patients before subjecting to the study. Structured questionnaire was used for data collection. Some content of the questionnaire including socio demographic variables asked directly from the patient and others like clinical data from the request form which were filled by the junior radiology resident attaching the fluoroscopy. Supervision was made during data collection and the collected data was checked on each day of the activity to ensure that information is properly collected and recorded.

All the patients after having RUG will – went sono-urethrogram.

The principal investigator was blinded to the findings of ascending urethrogram.

The same person did all the sono--urethrograms.

The findings of sono urethrogram & ascending urethrogram were compared

TECHNIQUE

Aseptic catheterization technique:

1st – sonourethrogram

Remove the water injected

2nd – RUG using same catheter

RUG: retrograde urethrogram under aseptic precautions.

20 mL of contrast medium (urograffin 76%) will be injected into the urethra using 20 ml syringe and spot films will be taken.

The following data will be recorded

- Stricture location, length and diameter will be measured using a scale and any complications

Sono-Urethrogram:

Will be done using Samsung ultrasound 10 MHz frequency linear array transducer. Normal saline (20-30 ml) injected using 20 ml syringe taking care not to inject air bubble. The urethra will be screened up to BMJ-using trans-scrotal and trans-perineal approach.

Longitudinal and transverse images & Cine will be obtained & stored for each patient.

The following data will be recorded on daily basis by the principal investigator

- The stricture location, diameter, length, spongiofibrosis.
- Other peri-urethral pathology and Complications.

4.8 Data quality control

The prepared questionnaire was pre tested before it is administered to the actual study group.

The principal investigator supervised the completeness and relevance of the data collected daily on data collection days.

4.9 Plan for Data Analysis

All data was recorded on separate data collection form for each patient. It was entered into the computer software SPSS program me (version 21) and was cleaned before subjected to analysis.. Data are tabulated and expressed in percentages. Comparisons of RUG and sonourethrography were carried out.

The strength of agreement between RUG and sonourethrography was calculated using kappa statistics, whereby a kappa value of, 0.2 indicated a poor agreement, and 0.21-0.40 indicated a fair agreement; 0.41-0.60, moderate agreement; 0.61-0.80, good agreement; 0.81-1.00, very good agreement

4.10 Ethical Considerations

Before official commencement of the procedure, ethical clearance was obtained from the ethical committee of SPMMC public health department. Every participant in the study asked for his/her willingness to be involved in the study and consent was obtained based on free will. The information collected from participants remain confidential

4.11 Operational Definitions

Stricture: is abnormal narrowing's of the urethra resulting from fibrous scar tissue

Penile urethra-part of anterior urethra which extends from external meatus to the penoscrotal junction inferiorly and to the suspensory ligament superiorly

Bulbar urethra –second part of anterior urethra which extends from the penoscrotal junction to the inferior fascia of the urogenital diaphragm.

Spongiofibrosis: regions of greater echogenicity in corpus spongiosum on ultrasound

Minimal, moderate and extensive spongiosal tissue involvement ,was graded as mild (involving $<1/3$ of corpus spongiosum thickness), moderate ($1/3-1/2$) and severe ($>1/2$)

Clinical data-is the data filled by the clinicians on the radiology request form which they get from patients history and physical examination

STRICTURE LENGTH Stricture length as short strictures less than 2.5 cm in length and long Strictures, more than 2.5 cm in length

Diameter of stricture; Mild (encroachment on less than one third of the lumen), moderate (encroachment on one third to half) and severe (encroachment on more than half

CHAPTER five

RESULTS

In our study total of 41 patients underwent the study. All patients with clinical diagnosis of urethral stricture were studied with sonourethrography. These findings were compared with retrograde urethrography, which is time proven 'gold standard' (Figure 2). Majority of patients are married 25(61%) and patients with positive clinical data majority 15 (36.6) had STI/urethral discharge history (table 1)

Out of 41 patients both modalities ruled out any urethral obstructive lesion in 10 patients and those were reported to be having normal study. One patient with short segment membranous urethral stricture on RUG was found to be normal finding on sonourethrography. Since sonourethrography doesn't assess posterior stricture this patient excluded from comparative study. Remaining 30 patients had findings of varying type on both modalities. Out of these 30 patients, 28 patients had stricture and two patients without stricture were as follows, 1 periurethral abscess and one with per urethral hematoma. These strictures were further characterized as per location, number, length, periurethral fibrosis and other findings.

Table 1: Distribution of study participants according to their age (Yr.), marital status and past history attending SPHMMC, 2017 (N=41)

	Frequency (N)	Percent (%)
Age (Year)		
<20	0	0.0
21-30	6	14.6
31-40	12	29.3
41-50	10	24.4
51-60	7	17.1
>60	6	14.6
Marital Status		
Married	25	61.0
Single	9	22.0
Divorced	3	7.3
Widowed	4	9.8
Past History (N=41)		
Pelvic Trauma	3	7.3
Catheterization	5	12.2
STI/Urethral Discharge	15	36.6
Surgery	1	2.4
Pelvic Trauma and Catheterization	1	2.4
Catheterization and Surgery	1	2.4
No Past History	15	36.6

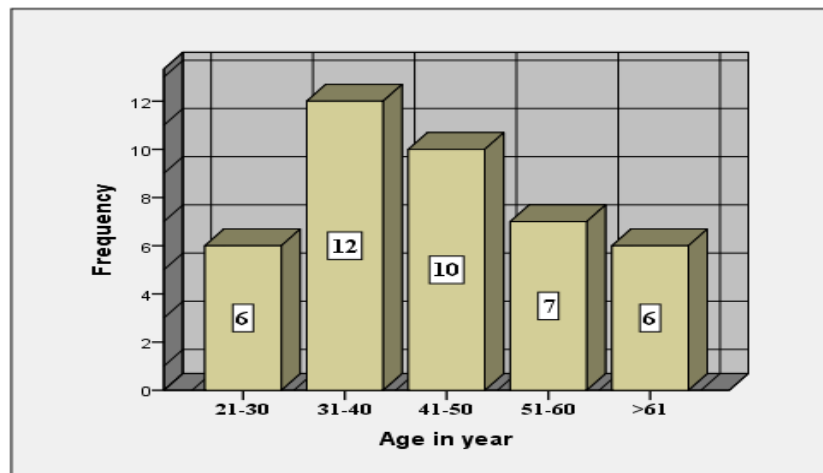


Figure 1: Age distribution of study participants attending SPHMMC, 2017 (N=41)

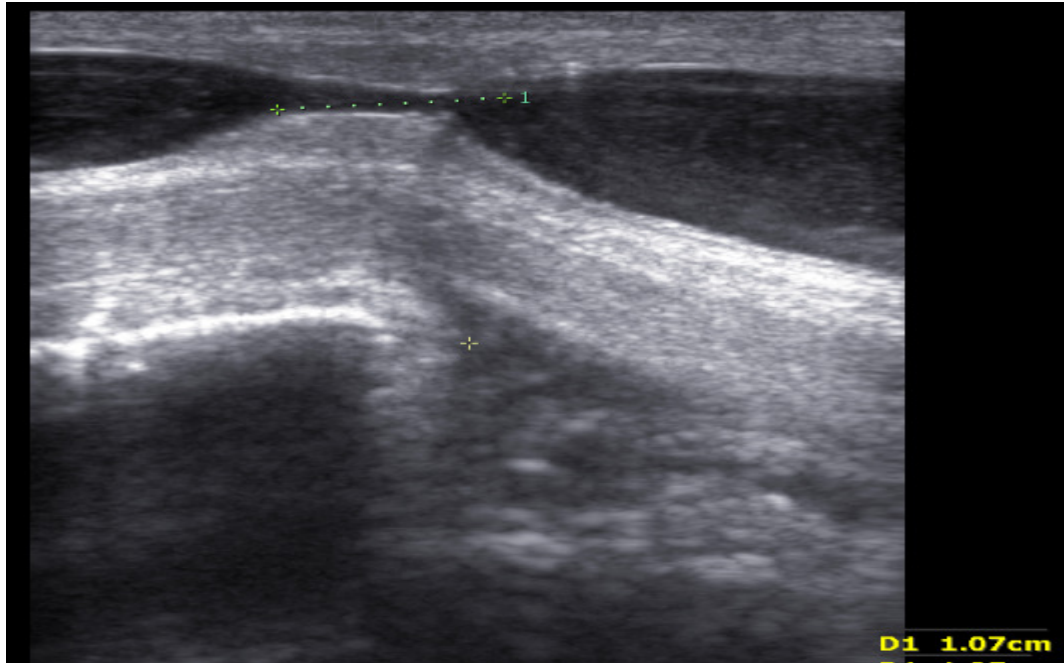


Figure 2: Sonourethrographic appearance of short segment penile urethral stricture of participants attending SPHMMC, 2017

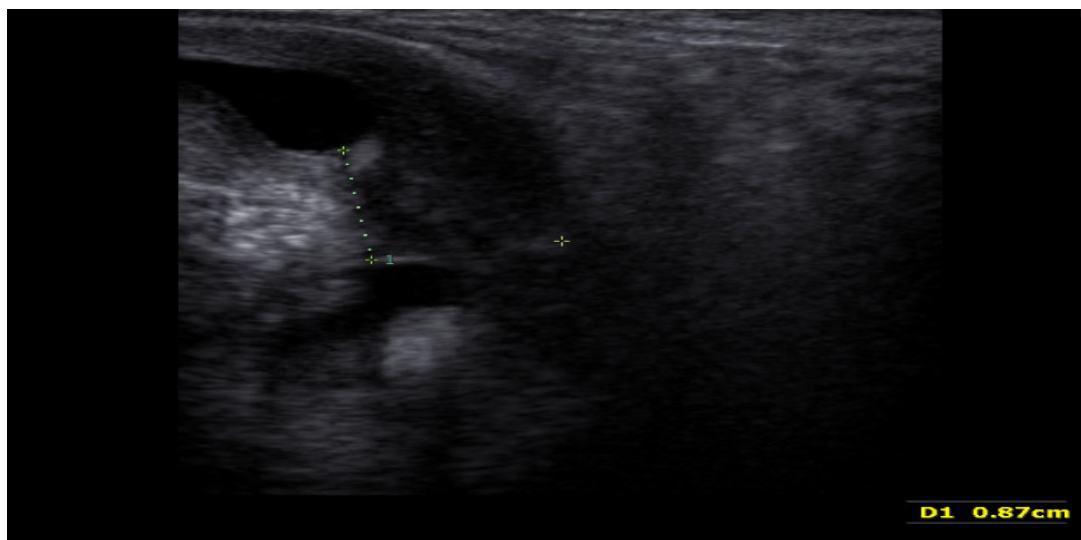


Figure 3: Sonourethrographic appearance of short segment bulbular urethral stricture with proximal urethral stone of participant attending SPHMMC, 2017

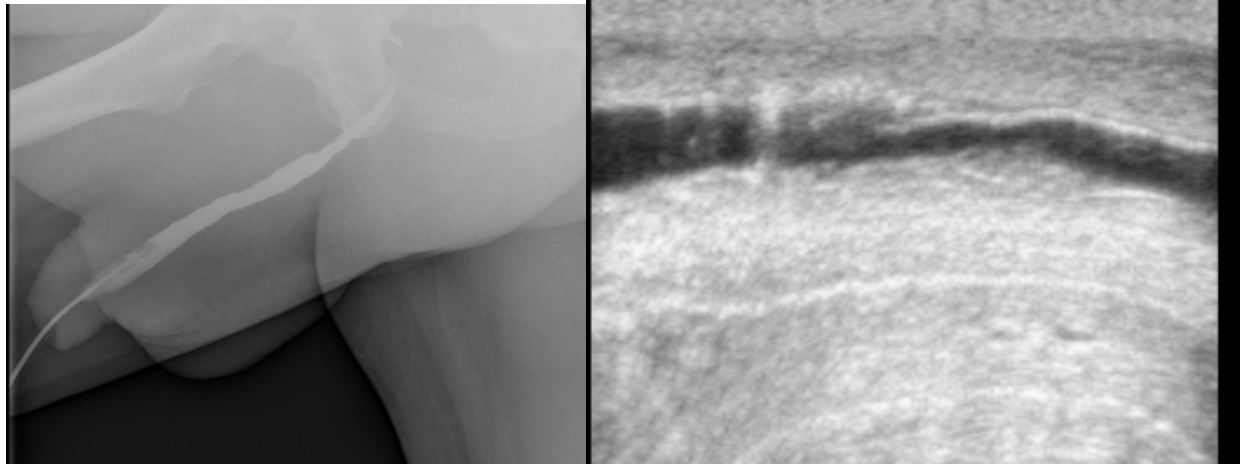


Figure 4: Sonourethrography and retrograde urethrography appearance of long segment penile urethral stricture of participant attending SPHMMC, 2017

Location of Strictures

As tabulated in table 2, bulbar urethral strictures were the commonest found in 17 patients with both the modalities.

Total seven penile strictures were diagnosed on both the modalities. One membranous urethra stricture was not visualized on SUG. Four complex strictures visualized on both the modalities all were penile and bulbar urethral complex strictures.

Table 2: Distribution of study participants based on Location of stricture of participants attending SPHMMC, 2017.

Methods		RUG				Total
		Bulbar	Penile	Complex	Normal	
SUG	Bulbar	17(100.0)	0 (0.0)	0 (0.0)	0 (0.0)	17(100.0)
	Penile	0 (0.0)	7(100.0)	0 (0.0)	0 (0.0)	7(100.0)
	Complex	0 (0.0)	0 (0.0)	4(100.0)	0 (0.0)	4(100.0)
	Normal	0 (0.0)	0 (0.0)	0 (0.0)	12(100.0)	12(100.0)
Total		17 (41.5)	7 (17.1)	4 (9.8)	12 (29.3)	40(100.0)

Number of Strictures

Both the modalities diagnosed 24 single strictures. Four complex/multiple strictures were diagnosed with equal accuracy on both modalities (table 3).

Table 3: Distribution of study participants based on number of stricture of participants attending SPHMMC, 2017.

Methods		RUG			Total N (%)
		Single N (%)	Multiple N (%)	Normal N (%)	
SUG	Single	24 (96.3)	0	0 (0.0)	24 (100.0)
	Multiple	0 (0.0)	4 (100.0)	0 (0.0)	4 (100.0)
	Normal	0	0 (0.0)	12 (92.3)	12
Total N (%)		24 (65.9)	4(4.9)	12 (29.3)	40 (100.0)

Length of Strictures

Out of 28 patients, 20 patients had short segment strictures, 4 patients had long segment strictures and 4 patients had complex strictures. Out of the 20 short segment strictures, 16 were bulbar (Figure 4) while 4 were penile short segment strictures. In long segment strictures total four patients were identified, three penile (Figure 5) and one was bulbar (Table 4).

Table 4: Distribution of study participants based on length of stricture of participants attending SPHMMC, 2017.

Methods		RUG				Total
		Short	Long	Complex	Normal	
SUG	Short	20 (95.8)	0 (0.0)	0	0 (0.0)	20 (100.0)
	Long	0 (0.0)	4(100.0)	0 (0.0)	0 (0.0)	4 (100.0)
	Complex	0 (0.0)	0 (0.0)	4 (100.0)	0 (0.0)	4(100.0)
	Normal	0(0.0)	0 (0.0)	0 (0.0)	12 (90.0)	12 (100.0)
Total		20 (56.1)	4 (9.8)	4(4.9)	12 (29.3)	40 (100.0)

Periurethral Fibrosis

Out of 28 patients with diagnosis of urethral stricture diseases, sonourethrography revealed periurethral fibrosis in 14 (50 %) patients (Table 5).

Table 5: Grades of spongiofibrosis in relation to stricture on SUG of participants attending SPHMMC, 2017.

Spongio-fibrosis	Frequency (N)	Percent (%)
Mild	4	9.8
Moderate	9	22.0
Severe	1	2.4
No Fibrosis	27	65.9
Total	41	100.0

Other Periurethral Findings

Other findings such as periurethral hematoma, periurethral abscesses, diverticula and false passages were well seen on sonourethrography. Two patients with urethral stone are seen on both modalities. One patients with trauma had associated periurethral hematoma and another patient with small periurethral abscess are seen on SUG. However, these periurethral hematoma and periurethral abscesses were missed on RGU (Table 6).

One cases of false passages /urethra-cutaneous fistula and another case of small urethral diverticula were diagnosed on both modalities.

Table 6: Distribution of study participants based on periurethral findings of participants attending SPHMMC, 2017.

RUG-finding	Frequency (N)	Percent (%)
Bulbar urethral stone	2	2.4
Small bulbar urethral diverticula	1	2.4
Urethro-cutaneous fistula	1	2.4
No other finding	36	90.2
SUG-finding		
Bulbar urethral stone	2	2.4
Small bulbar urethral diverticula	1	2.4
Urethro-cutaneous fistula	1	4.9
Periurethral hematoma	1	4.8
Periurethral abscess	1	2.4
No other finding	34	80.5

Table 7: The agreement of SUG and RUG among the study participants attending SPHMMC, 2017.

S. No	Character	Kappa value	Agreement
1	Location of Stricture	0.890	Very Strong
2	Number of Stricture	0.907	Very strong
3	Length of Stricture	0.922	Very strong
4	Diverticula	1.000	Very strong
5	Other per urethral Pathologies	0.034	Very poor

CHAPTER SIX

DISCUSSION

For this study, the sonourethrographic imaging was performed with the urethra distended by normal saline as a negative contrast agent.

Despite the penile urethra appearing in the extreme near field, we found that ventral approach was preferable with the penis extended along the lower abdomen. This enabled the longitudinal scans to be accomplished in a single rapid sweep. Near field artifact was abolished by using a high frequency probe (10 MHz).

We used digital panoramic reconstruction of the ultrasound images to facilitate comparison of SUG with RGU. Out of 41 patients studied most patients belonged to 3rd decade (Table 1, Figure 1).

Locations of the strictures were categorized as penile, bulbar and membranous. One patient with membranous stricture was diagnosed only on RGU and not seen on SUG. In the rest of the stricture locations matched perfectly in both the modalities studies. Similar study in the department of Urology, University of California School of Medicine, San Francisco⁴ had similar problem regarding the posterior urethra (membranous and prostatic), which is difficult to evaluate with SUG owing to its inability to scan the urethra in a perpendicular fashion.. Strength of agreement between these two methods by kappa statistic for location of strictures was found to be 0.890 , which means very strong agreement.(Table 7).

Out of 28 patients with strictures, 24 single strictures and 4 complex/multiple strictures were diagnosed with equal accuracy on both modalities.

Kappa value for number of stricture was 0.907 meaning very good agreement between SUG & RGU. (Table 7). There was good correlation of the complex strictures in both the techniques. All the previous studies showed good correlation of both the modalities regarding stricture number or multiplicity.^{4,8,9,10,12}

Out of 28 patients, 20 patients had short segment strictures, 4 patients had long segment strictures and 4 patients had complex strictures. Out of the 20 short segment strictures, 16 were bulbar (Figure 3) while 4 were penile short segment strictures (figure 2). In long segment strictures total four patients were identified, three penile (Figure 4) and one was bulbar.

Kappa value for length of stricture was 0.922, which signifies very good agreement between SUG and RGU (Table 7). When strictures were grouped according to anatomical sites, both techniques were equally sensitive in length estimation in the penile urethra. However, there was underestimation of bulbar stricture length in spite of radiographic magnification with RGU. Most previous studies show consistently poor correlation between RGU and SUG in estimating stricture length, especially for bulbar urethral strictures.

The study was conducted in the department of urology, JSS hospital, Mysore *Karnataka, India*⁸ and another study in diagnostic radiology department, medical university of south Africa¹¹ found similar result the was poor correlation on the length of stricture on both modalities, underestimation of stricture length on RUG.

Out of 28 patients with diagnosis of urethral stricture diseases, sonourethrography revealed periurethral fibrosis in 14 (50 %) patients. Identification of spongiofibrosis is important to determine the choice of surgical procedure [7]

Other Periurethral Findings such as periurethral hematoma, periurethral abscesses, urethral stone, diverticula and false passages were well seen on sonourethrography. However periurethral hematoma and periurethral abscesses were missed on RGU. Diverticula and stone and false passage were diagnosed by both modalities equally (Table 6). the kappa value for other periurethral pathologies was 0.034 which shows poor agreement between the two studies in diagnosing other periurethral pathologies which is similar to the findings in the previous studies^{8,9}. Sonourethrography definitely have upper hand in evaluation of periurethral pathologies.

Limitation of the study; the study took more time than expected time and the sample size is not calculated. This was because of the FLOUROSCOPIC machine, which was not functional intermittently during half of study time.

CONCLUSION AND RECOMMENDATIONS

In the present study, we have found sonourethrography to be a multiplanner, easily available and cost effective technique for evaluating the male anterior urethra without radiation exposure. It is an effective combination of high-resolution sonography and normal saline as a negative Contrast agent. When compared with conventional RGU, sonourethrography is equally efficacious in detecting anterior urethral stricture diseases. However, further characterization of strictures in terms of length, periurethral pathologies like periurethral fibrosis, diverticula, abscesses, fistulas and false tracts can be performed with relatively greater sensitivity using the sonourethrography. Ability of sonourethrography to diagnose periurethral pathologies and length of stricture especially in bulbar urethra helps surgeon to plan proper surgical procedure. In conclusion, sonourethrography in experienced hand can prove to be highly effective modality for diagnosis of anterior urethral obstructive pathologies like strictures. so we need additional study in this topic specially study that involve intraoperative finding and it is recommended to start the practice it in our institution.

REFERENCES

1. Kawashima A, Sandler CM, Wasserman NF, et al. Imaging of urethral disease: a pictorial review. *Radiographics* 2004;24: S195 – S216.
2. *Fundamentals of Diagnostic Radiology, 4th Edition p 835-836*
3. Pavlica P, Barozzi L, Menchi I. Imaging of male urethra. *EurRadiol.* 2003; 13 (7): 1583-96
4. McAninch JW, Laing FC, Jeffrey RB Jr. Sonourethrography in the evaluation of urethral strictures: a preliminary report. *J Urol.* 1988;139:294-7.
5. Cunningham JH. The diagnosis of stricture of the urethra by Roentgenrays. *Trans Am Assoc Genitourinary Surg* 1910; 369.
6. Mahmud SM, El KS, Rana AM, Zaidi Z. Is ascending urethrogram mandatory for all urethral strictures? *J Pak Med Assoc.* 2008;58:429-31
7. Amis ES, Jr, Newhouse JH, Cronan JJ. Radiology of male periurethral structures. *AJR Am J Roentgenol* 1988; 151:321-324.
8. Ravikumar BR, Tejus C, Madappa KM, Prashant D, Dhayanand GS. A comparative study of ascending urethrogram and sono-urethrogram in the evaluation of stricture urethra. *IBJU* 2015;41:388-92
9. Rahul Mishra^A, Archana Bhatnagar^B A Comparative Study of Sonourethrography and Retrograde Urethrography in Evaluation of Anterior Male Urethral Strictures
National Journal of Medical and Dental Research, July-September 2015: Volume-3, Issue-4, Page 201-205
10. Anand Hatgaonkar¹ A Comparative Study of Sonourethrography and Retrograde Urethrography in Evaluation of Anterior Male Urethral Strictures
International Journal of Scientific Study | May 2014 | Vol 2 page 6-81
11. Khan N, Modishi HM, Tsatsi LD, Khaloon A, Seogone A. Comparison of sonourethrography and retrograde urethrography in the evaluation of anterior urethral strictures. *S Afr J Rad* 2004;8:6-9.
12. Akano AO. Evaluation of male anterior urethral strictures by ultrasonography compared with retrograde urethrography. *West African journal of medicine* 2007;26(2):102-5.

ANNEX-I

Checklist for a research on Sonourethrography & Retrograde Urethrography findings

This is a checklist i use for this study which have consists of five components sociodemographic data,clinical data,past history,findings on RUG and findings on sonourethrography

1. Socio-demographic data

a. Address

b. age

c. Marital status

A. Married

B. Single

C.Divorced

D.Widowed

2.Clinical data;

3. past history

a. Pelvic Trauma

b. catheterization

c. STI/urethral discharge

d. surgery

4. Findings on RUG

Location of stricture

Length of stricture

Diameter of stricture

Other RUG findings

5.Findings on sonourethrography

Location of stricture

Length of stricture

Diameter of stricture

Spongiofibrosis

Other findings on SUG

