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"Comparative Study on SONO-Urethrography (SUG) Versus Urethrography (RGU) In Uretheral Stricture"

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I. Introduction

Trauma can have devastating effects on all organ systems. Injury to the urethra looks very simple but its complications are so devastating that one may be crippled for whole life. According to Morison (1930) "Rupture of urethra is one of the most serious accident and our skill can prevent the development of stricture. You are presiding at the opening of a life long tragedy". This is true even today.

In 1933 Clifford Morson stated that "I know of no case where the urethra has been completely torn across, in which the patient has been restored to perfect health. There may be a long interval between the date of injury and the onset of some lesion in the urinary tract directly attributable to the damage done to the urethra."
The above saying are testimony to the enigma of urethral injury. Once a patient suffers from urethral tear, he may perhaps suffer from a life long morbidity in the form of recurrent stricture; requiring urethrotomy and regular dilatations, rather making them a uretharal disabled. Patient is forced to accept the disability as a part of this life.

Injuries to the urethra have several causes. The first is external blunt trauma, which includes straddle injuries to the anterior urethra in the bulbous urethral area and injuries to the membranous and prostatic urethra resulting from crushing injuries to the pelvic bones. The second type of injury is penetrating injury, usually resulting from gunshot or less commonly, stab wounds. Third are those injuries occurring at he time of operative or diagnostic procedures on the lower urinary tract and the fourth type are self inflected injuries to the urethra either as a result of sexual experimentation, or for some other psychosexual reasons.

In females the urethra is seldom damaged. Occasionally protected second stage labour or the application of forces can produce injuries to urethra.

In male, urethra consists of posterior part which includes prostatic urethra and membranous urethra and anterior part, which includes pencil urethra including bulbous part (practically this division of urethra is not clearly defined). Injuries can occur at the triangular ligament with refraction of the torn ends both above and below the urogenital diaphragm.

The terms used in urethral injury are complete, partial or contusion. Complete indicates transaction of the urethra with no trace of continuity the two ends. In partial rupture there is full thickness tear of the wall of the urethra but some mucosa remains bridging the gap. Contusion of the urethra refers to any injury which is not full thickness tear. In other words a contusion may denote more than a mucosal damage but the hole does not perforate the urethra wall. So the urine cannot extravasate. If the urethra is only contused, some of perineal haematoma may be noted. A large haematoma may require drainage. Mild stricture may result due to fibrosis.
The type of urethral injuries to (1) Membranous (2) Bulbous, and (3) Pendulous urethra
(1) Membranous urethra is usually injured near the apex of prostate. The membranous urethra, Cowper's glands and most of the external urinary sphincter are enclosed by the urogenital diaphragm (i.e. the triangular ligament). This ligament is firmly attached with the pubic bone. This ligament may be torn in pelvic fractures, shearing off the prostate from the membranous urethra and also the bladder may be lacerated, and extravastion of urine may occur leading to necrotizing phlegmon which may become infected.
(2) Bulbous urethra usually is injured just distal to the urogenital diaphragm caused by instrumentation, but are more commonly due to falling astride over an object.
(3) Pendulous urethral injuries from blows are not common except during errection. Pendulous urethra may also sustain injury from penetrating wound in which case some periurethral bleeding may occur but this is usually absorbed.

Many author advocated the use of a radiopaque medium introduced retrogradely into the urethra but nearly all have admitted that this method has its limitations. Macrea was the first to suggest urethrography in

1940, admitted that it was frequently impossible to differentiate between an extra peritoneal rupture of the bladder and rupture of the posterior urethra. Weans (1946) described that cystourethrogram was of help in the diagnosis whereas Veigapieres and Elebute (1967) admitted that urethrography should not be done for early diagnosis owing to the risk of infection and further damage.

The human urethra has been assessed using radiographic techniques for many years, with retrograde urethrography (RUG) being the standard. This method has been limitations e.g. radiation exposure to the testes, inaccurate evaluation of urethral stricture disease and no outlining of per urethral structures. To circumvent these problems, urethral Ultrasonography (sonourethrography, SUG) has been suggested as a method for evaluating the anterior male urethra. Although the usefulness of SUG for evaluating the anterior male urethra has been well documented, there are limited data on the accuracy of SUG for predicting spongiofibrosis and its comparison with the histopathological study of the stricture. In the present study we evaluated disease comparing the finding with those of RGU and at evaluated disease comparing the findings with those of RGU and at surgery, not for the length of stricture but also the degree of spongiofibrosis, which would be more informative in making decisions about the appropriate management.

SUG has added advantages in that it delineates associated pathologies like false tract, stone, diverticulum etc in the present study all these pathologies were indentified on SUG and those missed by RUG. SUG is a safe procedure with minimum reported complication and also very comfortable for the patient. It takes only a mean of 12 minutes times.

II. Aims And Objectives

1. Accurate evaluation of anterior urethra, its pathology like urethral stricture, spongiofibrosis, stone in urethra, fistula.
2. To know the incidence of urethral injury.
3. To know the prognosis of urethral stricture.
4. Accurate surgical management of urethral stricture.

III. Materials And Methods

The present study of "Comparative study on sono-urethrography (SUG) versus urethrography (RUG) in urethral stricture" was carried out on patients admitted in Rajendra Institute of Medical Sciences, Ranchi, through surgical emergency and O.P.D. during the period July 2007 to September 2008, Those urethral strictures amenable to do dilation were excluded from the study at the very outset. The cases where result of repeated dilation was poor or having false passage periourehral abscesses, or fistula were subjected to urethroplasties. Follow up done from six months to one year. The results of all the cases were satisfactory and good.

A protocol as mentioned below was followed in each patient.

Identification of patient

- Name
- Age and Sex
- Address
- Occupation
- Socio –economic status

Mode of presentation

Complain with duration (in chronological order) :

- Thinning of urinary stream
- Burning micturition
- Split of urinary stream
- Urinary flow increase / decrease of straining
- Urethral discharge
- Frequency of micturition both day and night
- Retention of urine
- Fever with or without rigor

History of present illness

- Mode of onset – gradual/sudden
- Traumatic or non-traumatic
- Duration
- Increase of decrease in flow with straining

Past History of
- Gonorrhea
- Trauma
- Latrogenic
- Time elapsed since initial lesion
- Any other disease like T.B., malignancy
- Other venereal disease

Clinical examination
General examination includes :
- Consciousness
- General health
- Pallor
- State of hydration and nutrition
- Pulse
- Temperature
- Blood sugar
- Feature of uremia
- Hiccup, vomiting, condition of tongue

Urological examination
Inspection of penis:
- Presence of balanitis or metal stenosis
- Discharge character
- Syphilitic stigma noted
- Inspection of stratum perineum for any abnormal opening

Polpation :
Urethra examination for
- Induration
- Nodularity
- Tenderness
- Swelling and fistula

Act of micturition :- The patient is asked to pass urine. The flow of urinary stream and effect of straining will be noted.
Per abdomen examination
- State of bladder
- Kidney

Per rectum examination – For prostatic enlargement and pelvic tenderness. Chest and cardiovascular system examination were done

INVESTIGATIONS
(A) Routine examination
- Routine examination of blood – TC & DC of WBC, BT & CT, HB%, Blood urea, Blood sugar
- Serum creatinine
- Serum acid phosphatase
- Serum alkaline phosphatase
- Routine examination of urine
- Urine culture and sensitivity

(B) Radiological investigation
- Plain X-ray of abdomen and pelvis for KUB calculus
- RGU for –location, length, nature, number of strictures, any diverticulum, false passage, fistula of urethra
- Voiding Micturating Cysto-urethrogram (MCU) – See the bladder neck and posterior urethra and its pathology
- USG of anterior urethra
- Intravenous urogram (I.V.U)
- Sono –urethrogram (SUG) – For correct length of urethral stricture and periurethral disease

(C) Urethral calibration / urethroscopy

RETROGRADE URETHROGRAM (RUG)

Dey used Conray 280.

It was done routinely to ascertain :

- Location
- Length
- Nature
- Number of stricture
- Any diverticulum
- False passage
- Fistula

Position of the Patient

The patient is asked to empty the bladder and to lie on X-ray table with his left leg and thigh flexed. The other leg and thigh remaining extended. The pelvis was tilted to the left at an angle of 40 degree.

Technique

With aseptic and antiseptic care the prepuce was retracted and glans and external meatus were cleaned with antiseptic. The conray 280 one ampoule was taken in a disposable syringe. The nozzle of syringe was lubricated with 2% xylocaine felly. The penis was grasped with left hand and pulled to straighten it. The dye injected with moderate pressure with 15 ml of dye gone in the urethra. The X-ray film was exposed while the process of injection of the dye continued.

SONO-URETHROGRAM (SUG)

SUG was done using a standard ultrasound scanner (HDI, 4000, Philips, The Netherlands) using a 7.5 MHz linear-array transducer.

Technique:

With the patient supine, the glans disinfected and a truncated 8 F infant feeding tube was introduced into the urethra. The penis was then cranially extended over the lower abdomen and the ultrasonic transducer was placed on the ventral surface of the penis. Sterile 0.9% normal saline was injected continuously (50-250 ml) via the feeding tube, after taking care to exclude air bubbles, while the penile urethra was visualized to the penoscrotal junction. Subsequently the transducer was repositioned to visualize the proximal penile and bulbar urethra trans-scrotally and transperineally.

During SUG, on saline injection, the urethra distended and appeared as a homogenous echo-free band of 8-10 mm in diameter. Below the urethra, there was an echogenic band that was produced by dorsal acoustic enhancement and reflection from the tunica albuginea. Strictures were located as segments of reduced distensibility on injection with saline. In cases where the proximal extent of the stricture was unclear, the patients were asked to strain with a full bladder, which helped to delineate the proximal limit of stricture.

The same variables as assessed on RGU were recorded during SUG, and stricture length was determined using electronic calipers. An additional variable recorded on SUG was spongiofibrosis, graded as mind, moderate or severe, based on the extent of encroachment on the lumen, as suggested by McAninch et al. The duration of SUG was 10-15 minutes.

The variable assessed by RUG and SUG were compared with the findings at surgery, as the reference standard. During surgery the stricture length was determined by using the ureteric catheter, and the extent of spongiofibrosis was assessed by the variables as follows:

Method	**Degree**		
	1,mid	**2,moderate**	**3,severe**
SUG (encroachment of lumen)	< 33%	33-50%	>50%

The statistical differences among RUG, SUG and surgical findings were analysed and degree of accuracy for predicting the length and spongiofibrosis calculated.

IV. Observation

In the present study of 25 cases of urethral injury, the cases were divided into two groups.

Group A – The patient who reported to the department of surgery, Rajendra Institute of Medical Sciences without having any previous urological intervention (16 cases).

TABLE – 1
NUMBER OF CASES IN GROUP – A & GROUP – B (n=25)

Group		No. of cases	Percentage
A	Patients who reported to RIMS, Ranchi at first hand	16	64
B	Patients with some previous urological intervention	9	36

The above table shows that 16 cases (64%) reported to RIMS, Ranchi without any previous urological intervention while 9 cases (36%) had some previous urological intervention.

TABLE – 2 METHOD OF PREVIOUS UROLOGICAK INTERVENTION IN GROUP – B CASES (n=9)

Method of previous intervention	No. of cases	Percentage
Trial of urethral catheterization	6	66.6
Suprapubic systostomy	3	33.3

Urethral catheterization was attempted in 6 cases (66.6%) while 3 cases (33.3%) came with previous suprapubic cystostomy.

TABLE -3
AGE INCIDENCE

Age group (years)	No. of cases	Percentage
0-10	0	0
11-20	6	24
21-30	10	40
31-40	5	20
41-50	3	12
Above 50	1	4
Total	25	100

Maximum number of cases seen in the age group of 21-30 years (40%). None of the urethral cases was below 11 years.

TABLE -4
SEX INCIDENCE

Sex	No. of cases	Percentage
Male	25	100
Female	0	0

All the patients were male.

TABLE – 5
MODE OF TRAUMA TO THE URETHRAL STRICTURE

Mode of injury	No. of cases	Percentage
Road traffic accident	20	80
Fall from height	3	12
Direct blow in perineum	2	8
Total	25	100

The most common cause in 20 (80%) patients was trauma (RTA), 3 (12%) patients being fall from height and 2 (8%) patients being direct blow in perineum.

TABLE – 6
PRESENTING SYMPTOM

Complaints	No. of cases	Percentage
Thin stream of urine	15	60
Dribbling of urine	4	16
Retention of urine	6	24
Total	25	100

The most common complaint at presentation was a thin stream of urine in 15 patients (60%).The mean duration of the symptoms at presentation was 7.6 months.

TABLE – 7
STRICTURE LOCATION

Method	Location			Complete block
	Bulbar	Bulbar + Penile	Posterior urethra	
RUG	19	8	6	13
SUG	19	10	4	13

In RUG of all 19 patients found bulbar urethra stricture but 8 patients had bulbar penile urethra stricture. In SUG all 19 patients found bulbar stricture but 10 patients from the 25 patients found bulbo-penile urethral stricture. Posterior urethra was detected by RUG in 6 patients but SUG did not accurately delineated the proximal extent of stricture involving the proximal urethra in two of six patients.

RUG consistency underestimated the length of the stricture. The mean stricture length as measured on SUG was closer to that measured during surgery than was the estimate from RUG. In 4 patients due to severe occlusion by the stricture, RUG was unable to detect the entire length of the stricture. In these patients, SUG done while asking the patients to strain with a full bladder showed the extent of the stricture.

TABLE – 8
COMPLICATION OF RUG

Complication	RUG	SUG	%
Local pain	5	No such complication with SUG	20
Intravasation of contrast	2	No such complication with SUG	8
Systemic reaction to contrast	0	No such complication with SUG	0

The complications during RUG were local pain during the procedure in 5 (20%) of patients, which subsides within a few hours and intravasation of contrast medium in two (8%). However, no patients with intravasation of the contrast medium had any adverse systemic reaction. There was no complication during SUG, and the duration for the procedure was 10-15 minutes.

TABLE – 9
SPONGIOFIBROSIS IN SUG OF URETHRA

Disease	No. of cases	Percentage
Spongiofibrosis	10	40

There were 10 cases (40%) of spongiofibrosis seen in SUG of urethra. During well – reorganized limitations, conventional RUG has been the standard imaging technique for the anterior urethra (Merkle E, et al,1996). The limitations include variation in the appearance of the stricture with the position of the patient and the degree of stretch of the penis. Also, it simply delineates the primary stricture with no accurate determination of site, length or diameter of the stricture, or the presence of associated complications like, stone, fistula etc besides having the disadvantage of radiation exposure to the testes.

The use of ultrasonography to evaluate anterior urethra strictures was first first reported by McAninch et al in 1988 and gave a more accurate estimate of stricture length than RUG. Initially using a 5 MHz linear array transducer applied over the dorsum of the penis, the contemporary technique involves the use of a 7.5 MHz linear array transducer applied directly to the ventrum of the penis, scrotum and perineum.

In accordance with the findings of other investigators, the present study showed SUG to have a greater sensitivity in estimating stricture length, with a better correlation with operative findings (Nash PA et al 1995; Gluck CO et al, 1988; Gupta S et al,1993).This was especially true for the bulbar urethra. The reason cited is that in SUG, the hand-held transducer is positioned directly perpendicular to the distal urethral segment. However, in RUG, the pelvis is aligned obliquely to the anteroposterior X-ray beam and the bulbar portion of the urethra is fixed in the same axis as the pelvis (Morey AF et al, 1997). Thus the radiographic image is an 'end-on-view' which reduces the apparent stricture length.

An accurate estimate of stricture length is important, as it helps to determine the most appropriate surgery. RUG finding was recommended that excision end-to-end anastomosis should be used only in strictures of 1 cm (Webster GD et al, 1985).As SUG estimates are more accurate, new ultrasonographic criteria were proposed for this treatment for strictures measuring up to 2.5 cm (Gluck CD et al, 1988). Similarly, by delineating focally severe area before surgery, SUG helps in determining the uretheral segments that might best be excised at the of substitution urethroplasty. It was further suggested that SUG could also be used during surgery to monitor the site, extent and depth of urethrotomy (Gluck CD et al, 1988), which could lead to a more adequate incision of scar tissue during visual internal urethrotomy (VIU), and thus avoid recurrence (Klosterman PW et al,1989). SUG is particularly useful for a high-grade stenosis when the entire stricture

segment cannot be filled adequately for standard radiographic techniques. In such a case the patient can be advised to strain with a full bladder at the same time of SUG, which could also distend the urethra proximal to the stricture and thus define the full extent of the stricture.

Spongiofibrosis is another critical determinant of appropriate treatment and ultimate prognosis (Jordan CH et al, 1998). Excessive fibrosis leads to high recurrence rates (Merkle W et al, 1988), especially after VIU (visual internal urethrotomy). This was shown in a study conducted at our institute where 25 patients with short bulbar strictures were assessed for the percentage of luminal narrowing at the stricture site on RUG. 3 patients then VIU. Thus RUG might help in selecting patients who are likely to have a better outcome after VIU (Mandhani A et al,2005), but as the standard RUG does not show morphological periurethral changes, because they do not always cause a reduction in luminal diameter, it is not the method for grading spongiofibrosis . However, the dynamic nature of SUG delineates the degree of spongiofibrosis by forming an echogenic shadow along the urethra, resulting from the high collagen content (Morey AF et al, 2000). This is particularly important, as only gross spongiofibrosis change can be recognized visually, whereas SUG can be used to directly visualize the fibrosis deep to the area of stricture and its extent beyond it. In the present study SUG revealed spongiofibrosis in 10 patients with an overall accuracy of 40% and this accuracy was directly proportional to the severity of spongiofibrosis. Although SUG was unreliable for predicting the depth of spongiofibrosis, the accuracy of SUG for predicting the severity of fibrosis was not assessed.

SUG has added adventages in that it delineates associated pathologies like false tract, stone, diverticulum etc (Gluck CD et al, 1988). All these pathologies are identified on SUG and missed by RUG. SUG is a safe procedure with minimal reported complication (Gluck CD et al, 1988; Heidenreich A et al, 1994) and there were none in the present study. It is also very comfortable for the patient, with no rapid over-distension of the urethra, and takes only a mean of 12 minute.

Limitation of SUG for imaging the posterior urethra were reported (McAninch JW, 1988; morey AF et al, 1997), but in the present study SUG did not accurately delineate the proximal extent of stricture in 2 of 6 patients. Thus SUG should be used as an adjunct and not as an alternative to RUG, which should precede SUG.

As with any other ultrasonographic technique, SUG also has a limitation of that SUG should ideally be done by the treating urologist or with their assistance.

V. Summary

- 25 cases of urethral injuries have been studied of which 16 patients directly came to Surgery Department of RIMS, 3 patients came with cystostomy.
- The most common involved age group was between 21 to 30 years (40%). The youngest patient was of 14 years of age and the oldest of 54 years.
- No female case was encountered. All patients studied were male.
- Road traffic accident was the commonest cause of urethral injury (80%). The second commonest cause was fall from height (12%), followed by direct blow on the perineum (8%).
- Most of the cases came with symptom of him stream of urine (60%), dribbling of urine (16%) and retention of urine (24%).
- In RUG of all 25 patients, in 19 patients bulbar urethra stricture was found. Out of these 19 patients, 8 patients had bulbo-penile urethra stricture. In SUG of 25 patients, in 19 patients had bulbar stricture and 10 patients from these 19 patients had bulbo-penile urethra stricture. Posterior urethral stricture by RUG in 6 patients, but SUG did not accurately delineate the proximal extent of stricture involving the proximal urethra in two out of six patients.
- So most common site of stricture is bulbar part of urethra (76%).
- RUG consistently underestimated the length of stricture (mean stricture length 2 cm). SUG stricture was closer to measuring during surgery (mean stricture length 3.5 cm).
- 13 patients (52%) seen complete block in both RUG and SUG investigation.
- The complication during RUG were local pain during the procedure in 5 (20%) of patients, which subsided within a few hours and intravasationof contrast medium in two (8%).
- There were no complications during SUG.

VI. Conclusion

In conclusion, SUG is simple, safe and effective for evaluating the male anterior urethra. By contrast with RUG, this dynamic study is more accurate for evaluating stricture length, and it provides a better characterization of the stricture in term of the presence of calculi, false tract and degree of spongiofibrosis. Thus when used as an adjunct to RUG it helps in the better management of anterior urethral strictures by determining the type of surgery best suited for the patient.

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