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ROLE OF MRI IN POST TRAUMATIC POSTERIOR URETHRAL DISTRACTION DEFECTS IN COMPARISON TO RGU/ MCUG

General Surgery

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ABSTRACT

Introduction: Pelvic fracture urethral injuries are assessed using RGU , MCUG. MR urethrogram is indicated to look for stricture and urethral distraction defects . We aim to compare MRU with RGU/MCUG with the surgical findings of PFUI"s. **Methods:** RGU, MCUG and MR urethrogram was done on 20 male patients presenting with PFUI and evaluated prospectively. The initial management was by SPC. Delayed stricture repair managed by stricture excision and anastomosis, followed-up for 6 months. **Results:** Twelve patients had RTA and 8 direct trauma to perineum or urethra, 50% between21 to 30 years of age. There was a difference of 0.3 to 1.1 cm in the urethral gap measurement between RGU, MCUG and MRU. 03 (15 %) developed early wound infection ,4 (20%) patients had stricture recurrence and 5(20 %) had erectile dysfunction at end of six months. Overall Success rate is 80 %.Correlation between surgical measurements of strictures demonstrates a stronger linear relationship with MRU than between RGU ,MCUG. **Conclusion:** MR urethrography also measures the extent of spongiofibrosis & prostatic apex dislocation .MRU anticipates the complexity of injury & helps to plan the surgical approach thus deciding the need for inferior pubectomy or corporal re routing during Progressive Perineal Urethroplasty.

KEYWORDS

MRI, RGU, MCUG

INTRODUCTION

Stricture urethra in male is a common urological problem causing lower urinary tract symptoms. Pelvic fracture trauma in males is often secondary to motor vehicle trauma or pelvic crush injuries , associated with injuries to the posterior urethra, where there is pubic symphysis diastasis or there are displaced inferomedial pubic bone fractures.

The term"prostatomembranous disruption" is used to describe these injuries, transection occuring at the junction of the prostatic and membranous portions of the posterior urethra(Posterior urethral distraction defects, PFUDDs).[1]

The incidence of posterior urethral injury varies from 1.6% to 25% . The risk factors for urethral injury along with concomitant pelvic fracture are influenced by the sex, age, and the type of pelvic fracture. Males sustain urethral injury commonly due to the longer length, fixed urethra, and the rigid attachments to the pubic bone .[2]

Straddle fractures (fractures of all 4 pubic rami) with or without distraction of the sacro-iliac joint, fractures of the inferior pubic ramus with a widened pubic symphysis and Malgaigne fractures (double pelvic ring break fracture dislocations) are most commonly associated with PFUI. Combined urethral and bladder injury occurs in 1–33% of patients. Bladder injury is more commonly extra-peritoneal (56–85%) than intra-peritoneal (17–39%) but can be both .[3] The classic sign of urethral injury should be suspected with appearence of blood at the meatus (present in 37–93%), difficulty or inability to void, a palpable bladder, a high riding prostate (often unreliable due to the presence of fracture haematoma) or a pelvic fracture with displacement of pubic rami. Butterfly bruising of the perineum due to haematoma confined to Colles fascia is a late finding and indicates rupture of the perineal membrane .[4]

PFUI was considered fatal due to urinary outflow obstruction, extravasation, secondary sepsis and uraemia until Verguin , a surgeon in the naval hospital in Toulon, determined how to perform suprapubic cystostomy with antegrade-retrograde railroading of a perineal catheter into the bladder in 1757 . For the next 150 years, until management of associated injuries and imaging improved, mortality dropped from close to 100% in 1757 and 23% in 1942 . At the initial stage one gentle attempt at urethral catheterisation is reasonable, even if blood is seen at the meatus . The fear that urethral catheterisation may convert a partial tear into a complete tear does not seem realistic, especially as a urethral catheter passes easilyinto the bladder in 50% of patients with partial injuries. If the catheter does not pass with ease or does not drain clear urine ,it should be removed immediately.[5]

Early diagnosis of PFUI and urinary diversion will prevent infection of extravasated blood and urine, which can lead to abscess formation. This may extend along fascial planes and across anatomical compartmental barriers into the abdomen, chest, perineum and medial thighs. This can result in urethrocutaneous fistula, peri-urethral diverticula, necrotising fasciitis and even death . If urethral catheterisation fails, a suprapubic catheter (SPC) should be inserted using ultrasound guidance or via open cystostomy .[6]

The treatment options for PFUDD include progressive perineal anastamotic urethroplasty and transpubic urethroplasty. Selection of the appropriate procedure is essential for a successful result, and the appropriate procedure can be anticipated by using certain preoperative information. A number of variables appear to be important, such as the stricture length, the extent of the periurethral fibrosis, presence of true urethral stricture versus distraction defect, and the normality of the anterior urethra.[7]

The preoperative evaluation includes- rectal examination with combined RGU/ MCUG to determine the length of the urethral defect. Emergency management includes suprapubic tube placement. Subsequent primary realignment to place a urethral catheter remains a controversial topic, but what is not controversial is that when there is the development of a stricture (which is usually obliterative with a distraction defect) after suprapubic tube placement or urethral catheter removal, the standard of care is delayed urethral reconstruction with excision and primary anastomosis.

Accurate imaging of urethral strictures is critical for preoperative staging and planning of reconstruction. The current standard , RGU combined with MCUG allows for morphologic and functional study of the urethra, diagnosis, staging, and delineation of urethral strictures, and remains a cornerstone in the management of urethral stricture disease.

In complex situations, direct visualization of the stricture by retrograde or antegrade cystoscopy, can provide additional information about the location , appearance of stricture and precise location on fluoroscopic imaging.

Limitations of these studies include being invasive, poorly defining the accurate length of the stricture, and differing results between the endoscopic and radiographic appearances of the stricture. Moreover, no information is available about the extent of periurethral fibrosis .

Sonourethrography and magnetic resonance imaging (MRI) are modern tools for evaluating male urethral pathologies with the advantage of lack of exposure to gonads .Owing to multiplanar capability and excellent soft tissue contrast, MRI can provide anatomic details about both the urethra and periurethral tissue with orientation of the lesion in three dimensions .[8]

Cross-sectional imaging in the form of magnetic resonance urethrography provides additional three-dimensional information of anatomic structures and their relations, assessment of stricture length and location, and can be a useful intraoperative assessment tool to better visualize the posterior urethra or complex distraction defects in complex clinical scenarios.

MATERIALS AND METHODS

Material

- Prospective comparative study
- Sample size- 30 male patients with PFUI

Methods

- On presentation with PFUI, patient underwent SPC followed by delayed urethroplasty.
- RGU/MCU and MRU performed at 3 months- Stricture length assessed and compared with surgical findings
- Statistical analysis done using SPSS version 20.

30 men were referred to our institute from 20016 to 2018, for management of urethral injury and stricture. Patients had Road traffic accidents or straddle injuries, followed by posttraumatic strictures. All patients had bleeding per urethra,difficulty in voiding and due to inability to pass a per urethral catheter, patients underwent suprapubic cather placement.

After 3-6 months after initial pelvic fracture urethral injury (PFUI) ,all patients underwent dynamic retrograde urethrography (RGU) ,Micturating cystourethrogram (MCUG) and MR urethrogram prior to the intervention and results were interpreted by the same radiologist.RGU was done with the patient placed in an oblique position, with the dependent hip acutely flexed and the penis extended along the soft tissue of the thigh and as parallel to the tibia as possible. The entire length of urethra was assessed for any narrowing or abnormal fistulous communications.

The MR technique included injection of sterile gel into the urethra, then application of a soft clamp to the penile tip to keep the urethra distended. Then, sagittal high-resolution T2 imaging of the penis and urinary bladder was performed with the following parameters: TR = 4000–6000mscc, TE = 80– 120mscc, slice thickness = 2 mm, interslice gap = 0 mm.

The reformatted images at different axial, coronal, and sagittal oblique planes were obtained to delineate the entire length of the urethra, characterize the surrounding soft tissue with depth and density of periurethral fibrosis, and define stricture length.

In both methods, the total stricture length was measured including the tapered segments on either side of the tight stricture. Strictures with length < 0.5 considered significant.

Image Analysis

Stricture length on conventional RGU or RGU combined with VCUG images was determined by measuring the distance between the proximal end of the distal urethra and the distal end of the open proximal urethra. In MRU , images were analysed and it was focused on the location, length of the stricture and signal intensity.

Measuring of urethral stricture length at ascending urethrography and MRU was done using the Magic View Picture Archiving and Communicating System (PACS; General Electric, Milwaukee, WI) after measurement calibration.

Inclusion Criteria

- Male patients with PFUI, with RGU showing Partial or complete urethral rupture

Exclusion Criteria

- Previous LUTS and urethral surgery
- Urethral catheterization & instrumentation
- Spinal cord injury
- C/I to MRI- Implants, pacemaker, cochlear implants, Claustrophobia.

Radiography- Procedure

1) RGU combined with MCUG [127]
2) MR Urethrography (Schulam et al) [128]

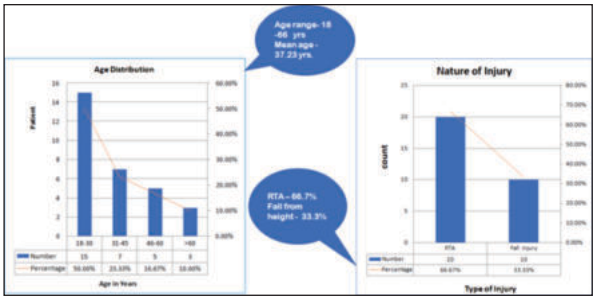
Analysis Of Radiological Findings

RGU/MCUG- The following parameters were measured

- Site of stricture
- Length of stricture
- Extravasation of contrast
- Bladder neck opened / not filling of prostatic urethra

Operative Procedure -progressive Perineal Urethroplasty

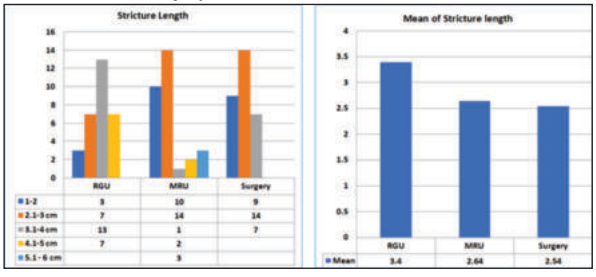
RESULTS:



Graph 1: Comparison Of Age Distribution And Nature Of Injury

Patients age ranged from 18 to 66 years, mean age was 37.23 years.

66.67 % patients sustained injury due to road traffic accidents and 33.33 % sustained injury due to fall.



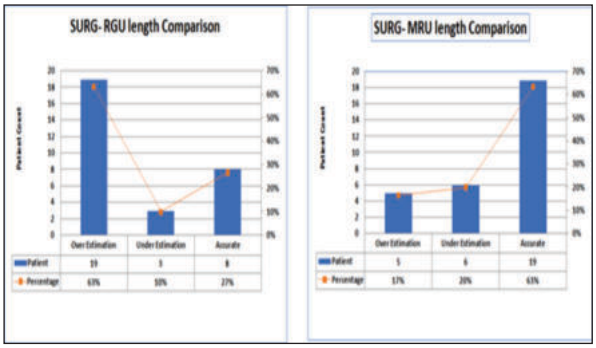
Graph 2: Comparison Of Length Of Defect

The mean length of stricture was 3.4cm, 2.64cm, 2.54 cm on RGU, MRU and on Surgical finding respectively.

Table 1:Paired-T-Test And Correlation Analysis

Parameter	RGU length	Surgery length	mean difference (95% C.I.)	p value
mean ± SD	3.4	2.54	0.86(0.49-1.22)	<0.001*
Parameter	MR length	Surgery length	mean difference (95% C.I.)	p value
mean ± SD	2.64	2.54	0.97(-0.23-0.42)	0.546
Parameter	RGU length	MR length	mean difference (95% C.I.)	p value
mean ± SD	3.4	2.64	0.76 (0.32-1.20)	0.001*

The above table shows the measure of agreement between MRU and surgical length was higher than RGU and surgical length and statistically significant .

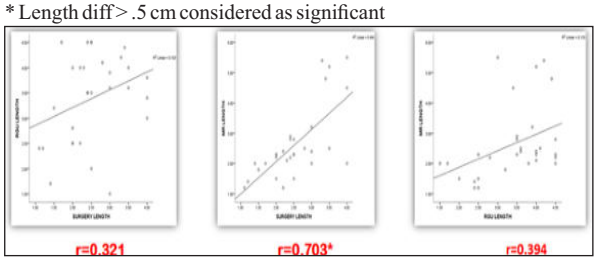


Graph 3: Comparison of Difference of Length Estimation

Comparison of difference of length of defect* between surgery and RGU demonstrates,

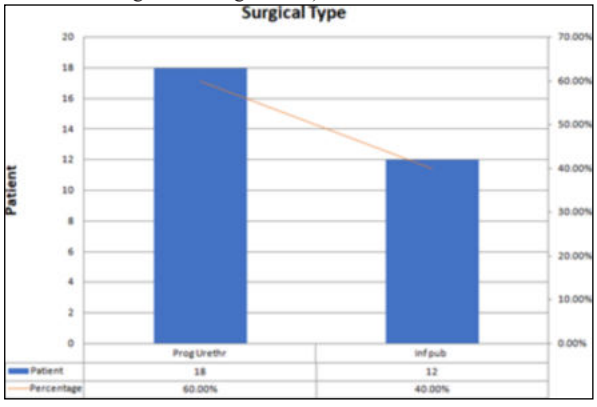
- RGU estimated defect accurately in 8 (26.7%) patients, Overestimated in 19 (63.3%) and underestimated stricture in 3 patients (10%)
- MRU estimated defect accurately in 19 (63.3%) patients, Overestimated in 5 (16.7%) and underestimated stricture in 6 patients (20%)

* Length diff > .5 cm considered as significant



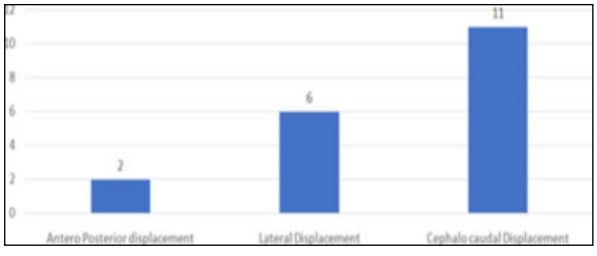
Graph 4: Correlation RGU-MRU-SURGERY

- The scatter diagram shows that MRU length and Surgery length are well correlated(r=0.703)
- Comparing RGU and Surgery / RGU and MRU shows gross difference in length (Pearson's Correlation coefficient - Considering r >0.3 as significant)



Graph 5: Comparison Of Type Of Surgical Procedure

- 18(60%) patients underwent progressive perineal urethroplasty.
- 12(40%) patients required inferior pubectomy.



Graph 6: Additional Findings Seen On MRU

Anteroposterior displacement was seen in 2 patients Lateral displacement was seen in 6 patients Cephalocaudal displacement was seen in 11 patients

DISCUSSION

Table 2: Age Distribution

Parameter	Our study	Rajadoss	Sudhakar et al
Number	30	20	20
Mean (Age)	37.23(18-66)	34(17-61)	30.12(20-65)

Our study included a total of 30 male patients ,with mean age of 37.23 years.

- Studies by Rajadoss and Sudhakar [9], showed study of 20 pts ,mean age 34 years and 30.12 years.

Table 3: Length Of Stricture

Parameter	Our Study	Yasser et al	Sudhakar et al	Koraitim et al
RGU/MCU length	3.4 cm	1.5+/-1.3 cm	3.8 cm	
MRU length	2.64 cm	1.2+/-0.9 cm	2.15 cm	
Surgical length	2.54 cm		1.0 cm	
Sensitivity	100%(both RGU & MRU)	85%(for MRU)		86%(for MRU)
Additional findings				Type of defect-89%, 3 false tracts

The mean length of stricture on RGu/MCU , MRU and Surgical length in our study was 3.4cm,2.64cm and 2.54 cm respectively.

Our study was comparable with study of Sudhakar etal and Yasser etal [10].

Table 4: Co Efficient Of Correlation-comparative Studies

Sl. no	Criteria	Present study	Deukjae 2006	Yasser 2006	Tarek et al 2010
1	correlation MRU/sur	r=0.703 Accuracy-63%	r=0.85	Accuracy MRU-85%	95% accuracy MRU
2	Correlation RGU/sur	r=0.03 Accuracy-8%	r=0.0.03	Accuracy RGU-85%	15% Accuracy RGU
2	Erectile dysfunction	20%	23%		

The coefficient of correlation between MRU and surgery was 0.703 and between RGU and surgery was 0.03. Erectile dysfunction was seen in 20 % 0f our patients.

Our study was comparable with the study by Deukjae etal [11].

Table 5: Accuracy Of Stricture Length
Present Study

Parameter	Under estimated length	Over estimated length	Accuracy
RGU/MCU	10%	63%	27%
MRU	20%	17%	63%

Table 6: Over Estimation Of Stricture Length

Length Overestimation	Our Study	Sung et al
RGU/MCU	63%	60%
MRU	17%	58%

- Compared to Surgical findings ,RGU/MCUG underestimated stricture length in 10%, overestimated in 63%, Accurate in 27% patients.
- MRU underestimated stricture in 20%,overestimated in 17%, accurate in63% patients.
- Our study was comparable with study of Sung etal [12].

Table 7: Correlation Of Difference Of Stricture Length Estimation

Parameter	Our study	Tarek et al
Surgical correlation with MRU	MRU-2.64 cm	MRU-1.32 cm
	RGU-3.4 cm	RGU-1.75 cm
	Surgery-2.54 cm	Surgery-1.29 cm
	Surg-MRU difference in length- 0.97 cm	Surg-MRU difference in length-0.03 cm

The mean difference of stricture length on MRU compared to Surgery in our study was 0.97 cm. Study by Tarek etal showed mean difference of 0.03 cm.

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