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Research Article

PROSPECTIVE STUDY OF ROLE OF MRI IN PELVIC FRACTURE URETHRAL INJURIES

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A B S T R A C T

Introduction: MRI is accurate in demonstrating the distraction defect length and displacement & dislocation of the prostate apex in Pelvic fracture urethral injuries. The soft tissue details by MRI determine the avulsion of the corpus cavernosa which can indicate these patients will develop permanent impotence. The purpose of our study was to evaluate the role of MRI in the management of post traumatic posterior urethral distraction defects.

Materials and methods: The study conducted from December 2017 to February 2020 at Government kilapauk medical college Hospital and Government Royapettah Hospital, Chennai. Thirty eight patients (mean age 24 years; range, 16-42 years) with posttraumatic posterior urethral defect underwent MR imaging before planned definitive surgery. These patients were evaluated using conventional RGU combined with VCUG prior to MR imaging. The interval between the original trauma and the MR imaging, varied from 3 to 8 months (mean, 4.7 months).

Results and Observations: On the basis of the MRI findings, when the distraction defect is 1 to 2.5 cm, primary anastomotic urethroplasty was performed though a perineal approach. The patients who had a long distraction defect 2.5 to 5 cms on MR images underwent progressive perineal anastomotic urethroplasty. In 4 cases the defect was more than 5cms with presence of extensive scar tissue around the prostatic apex, we did urethroplasty through transpubic approach. The surgical findings were correlated with MRI findings. The MRI findings changed the surgical procedure in 12 out of the 38 patients; the surgical procedure which was planned on the basis of the finding from combined RGU / MCUG.

Conclusions: MR urethrography could accurately measure the stricture length in T2 sagittal, coronal views of reconstruction. It also judges the extent of spongiofibrosis, prostatic apex dislocation, which will aid the surgeon to perform appropriate surgical procedure.

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INTRODUCTION

Pelvic fractures in males are associated with injuries to the posterior urethra, especially when there is pubic symphysis diastasis or there are displaced inferomedial pubic bone fractures. The term "prostatomembranous disruption" indicates that the transection occurs at the junction of the prostatic and membranous portions of the posterior urethra. There can be proximal or distal extension, but the injury generally remains distal to the verumontanum of the prostate.
The classic sign of urethral injury in a patient with a pelvic fracture is blood at the urethral meatus. Other symptoms include bladder distension, inability to void, and perineal hematoma .

The treatment options for these injuries include progressive perineal anastamotic urethroplasty and transpubic urethroplasty.

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Selection of the appropriate procedure can be anticipated by using certain preoperative information. A number of variables appear to be important, such as the defect length, the extent of the periurethral fibrosis, presence of true urethral stricture versus distraction defect, and the status of the anterior urethra. The preoperative evaluation includes- rectal examination with combined RGU/ MCUG to determine the length of the urethral defect. This evaluation provides limited information on the actual length of the distraction defect, the position of the prostate, and the extent of the fibrosis.

Magnetic resonance imaging has been found to be accurate in demonstrating the defect length and displacement of the prostate apex.

The Sagittal views determine the prostatic dislocation in anteroposterior and superoinferior direction, while the coronal images determine the right to left dislocation. T2 weighted images can differentiate between soft tissue edema, fibrosis and hematoma. The soft tissue details by MRI determine the

avulsion of the corpus cavernosa which can indicate that these patients will develop permanent impotence in future. The purpose of our study is to evaluate the role of MRI in the management of pelvic fracture urethral injuries.

MATERIALS AND METHODS

The study conducted from December 2017 to February 2020 at Government kilapauk medical college Hospital and Government Royapettah Hospital, Chennai. Thirty eight patients (mean age 24 years; range, 16-42 years) with posttraumatic posterior urethral defect underwent MR imaging before planned definitive surgery. These patients were evaluated using conventional RGU combined with VCUG prior to MR imaging. The interval between the original trauma and the MR imaging, varied from 3 to 8 months (mean, 4.7 months). The institutional review board at our medical center approved the study and informed consent was obtained from all patients.

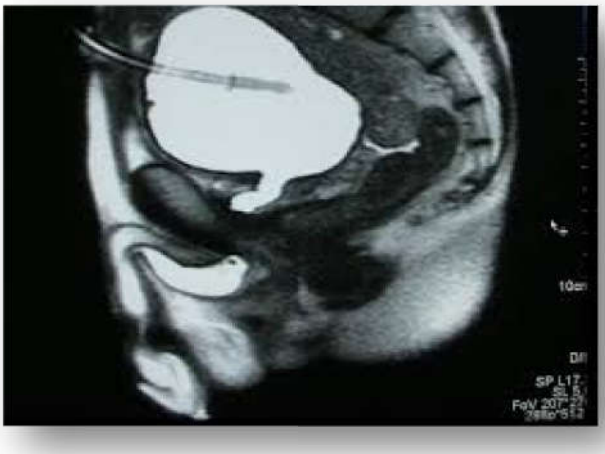
Imaging

RGU combined with VCUG is done in all patients

Magnetic Resonance imaging: Magnetic Resonance imaging is performed with 1.5 T signal unit with transaxial T1-weighted imaging. The T2 weighted transaxial, sagittal, and coronal imaging done.

The Magnetic Resonance Imaging is performed after RGU (Retrograde Urethrogram) combined with VCUG (Voiding cystourethrogram), and the time between performance of MR imaging and RGU combined with VCUG imaging ranged from 4 to 10 days. Before MR imaging, the penis was positioned anteriorly in the supine position and taped to the abdominal wall beneath the surface coil. MR images were obtained by using a 1.5 Tesla MR imaging device. The MR imaging protocol consisted of a sagittal T2-weighted fast spin-echo sequence and a transverse T2-weighted fast spin-echo sequence. Immediately after completion of the MR imaging and while the patient was on the table of the MR imager, 150-300 mL of normal saline was injected slowly into the emptied bladder through the suprapubic cystostomy catheter until the patient felt the need to void. The sterile lubricating jelly with 10 m1 syringe was instilled into the anterior urethra until resistance was felt and some of the lubricating jelly overflowed from the urethral meatus.

Image Analysis: The Magnetic Resonance imaging findings evaluated were (a) length of defect, as measured by the distance between the prostatic apex and the bulb of the penis on sagittal MR images, (b) displacement of the prostate gland in superior inferior, antero posterior and lateral planes, (c) Pelvic bone fractures, (d) Penile injuries like avlusion of corpus cavernosa from ischium, separation of corpus cavernosum from corpus spongisum, and corporal body fracture. The Anteroposteior displacement of prostate was measured between the prostatic apex and urethral insertion in the roof of the penile bulb. The Superior inferior displacement of the prostate was measured as a distance greater than 1 cm between the prostatic apex and the inferior pubic ramus. The lateral displacement was measured as the distance between the prostatic apex and the bulbous urethra on the coronal image.



The MRI findings that suggested the transpubic approach were (a) presence of prostatic displacement of more than 3cms, (b) length of distraction defect > 5cms and (c) presence of extensive scar tissue around the prostatic apex.

Statistical Analysis

Linear regression analysis was performed to correlate the imaging and surgical measurements of urethral defect length in each imaging method. The measurement errors between the imaging and surgical values of defect length were calculated in each imaging method and compared. P value <0.05 was considered to indicate a significant difference.

RESULTS

On the basis of the MR imaging findings, when the defect length was 1to 2.5 cm, primary anastomotic urethroplasty was performed with a perineal approach. The patients who had a defect length 2.5 to 5cms on MR images underwent progressive perineal anastomotic urethroplasty. In 4 cases the defect length was more than 5cms, they underwent urethroplasty through transpubic approach. The MRI findings changed the surgical procedure in 12 out of the 38 patients; the surgical procedure which was planned on the basis of the finding from combined RGU / MCUG.

MR Imaging Findings: The length of urethral defect allowing for 0.5cm discrepancy is seen in 34 of 38 patients (90%) .The displacement of prostatic apex was noted in 34 of 38 patients (90%). MRI findings prompted a change in the clinically planned surgical approach in 12 out of 38 patients (31%). The MR findings correctly indicated the need for the transpubic approach in 4 of 38 patients (10.5%) . Regarding surgical approach made on the basis of RGU / MCUG vs MR imaging data approached significant p value. The MRI findings correlated with impotence in patients having avulsion of the corpus cavernosum with significant p value (positive predictive value 100%).

Both the avulsion of corpous cavernosum and superior & lateral displacements are correlated in patients with traumatic impotence (95%).

On T2 weighted sagittal, coronal and axial images.
Defect length was 1.5 to 5cms

Deviation of the prostatic apex

Superior - 6
Inferior -26
Posterior - 32
Anterior - 6
Lateral deviation - 36
Corpora cavernosa avulsion -4

Prostatic dislocation: The degree and direction of prostatic dislocation correlated with operative findings. Twenty patients had posterior dislocation of 1 to 4 cm and the rest of patients had no dislocation in the anteroposterior direction. The prostatic apex was shifted to the right of the midline in 18 cases (1 to 3 cm) and to the left of the midline in rest of the patients (1 to 2 cm). The patency of the urethral lumen was not seen but the length of the prostatomembranous defect could be accurately determined by measuring the distance between the prostatic apex and the urethral insertion into the proximal corpus spongiosum.

Erectile dysfunction: Out of 38 patients, 2 patients had permanent impotence. These patients were evaluated and followed up for a period of 6 months to 28 months since the event of injury. The MRI findings in these 2 patients were avulsion of the corpus cavernosum and fibrosis of the corpus cavernosum.

Surgery: All 38 patients underwent definitive Surgery. Out of 38 cases, 4 cases required transpubic repair, 8 cases underwent progressive perineal urethroplasty along with inferior pubectomy. In rest of the cases we performed excision of the scar tissue, bulbar urethral mobilization and primary anastomosis.

The MRI findings helped to change the decision in 12 cases. Inferior pubectomy in 8 cases and transpubic repair in 4 cases. The fibrotic stricture segments that were excised from the patients who underwent anastomotic urethroplasty were measured by using a centimeter ruler. The measurement of surgical results were compared with MRI findings. In most of the cases, the MRI findings were correlated with surgical findings.

Sl . No	Procedure	Defect length	No. of cases
1	PERINEAL APPROACH – Primary anastomotic urethroplasty	1 to 2.5cms	26
2	PERINEAL APPROACH - Progressive perineal anastomotic urethroplasty (Inferior pubectomy)	2.5 to 5cms	8
3	TRANSPUBIC APPROACH	>5cms	4

DISCUSSION

Conventional RGU combined with VCUG is the method traditionally used for the planning of a urethral reconstruction. This imaging modality cannot provide an accurate determination of the defect length because of the poor prostatic urethral filling and it provides little information on the extent of fibrosis of the corpora spongiosum or the prostatic displacement. The defect length may be grossly overestimated if the bladder neck does not relax. Both the proximal and distal extents of the defect can be demonstrated if the patient can open the bladder neck. It is rarely possible, to demonstrate the proximal limit of the defect because patients often have a diminished bladder capacity after months of suprapubic diversion and are unable to tolerate bladder distention sufficient to open the bladder neck voluntarily. A failure to demonstrate the prostatic urethra does not necessarily indicate a bladder neck obstruction or a defect all the way up to the bladder neck [1-4].

The defect length can be underestimated if the patient is not placed in a steep oblique position for RGU. An underestimation of defect length, as shown on the conventional RGU / MCUG image, can also occur as a result of a urinoma cavity that overlaps or is continuous with the prostatic urethra. The cavity then may be mistaken for the proximal urethral segment and be incorrectly anastomosed to the bulbar urethra. Magnetic Resonance imaging is likely the best imaging modality for assessing the posttraumatic pelvic anatomy and provides a noninvasive method for measuring defect length with none of the problems associated with the conventional radiographic technique. In addition, MR imaging clearly shows the extent of the scar tissue, as well as the degree and direction of the prostatic displacement, which aids in preoperative decision making.

We have compared our study results with available literature. Yoshifumi Narumi *et al*. [7], performed the MR imaging study in 27 patients who required definitive urethroplasty procedure. The study results revealed the length of urethral defect in 23 out of 27 patients (85%) and displacement of the prostatic apex in 19 of 21 (90%) are correlated with the surgical findings with a significant p value .

In a study done by Christopher M. Dixon *et al*. [8], 18 patients underwent MR imaging before open urethroplasty, the surgical results are correlated with the MRI findings with a significant p value (1992).

In a study done by Deuk Jae Sung *et al*. [5], 12 patients with oblitrative stricture underwent MR imaging before surgery, the mean measurement error at MR imaging (mean, 0.31 cms) was significantly lower ($P < 0.05$) than the findings of conventional RGU/ MCUG (mean, 1.69cm). Linear regression analysis showed a stronger linear relationship between the MRI and the surgical measurements ($P < 0.001$) (2005).

Yasser Osman *et al*. [6] studied 20 men who are requiring surgery for Pelvic fracture urethral injuries, the accuracy of MR urethrography regarding diagnosis is more than 85%. The MR findings are correlated with surgical findings in most of the cases with a significant p value (2006).

Nurenberg P *et al*. [10] conducted a study in 18 patients who are requiring definitive urethroplasty. The MRI findings are correlated with surgical findings in most of the cases with a significant p value (1997).

Noel A Armenakas *et al*. [9] conducted a study in 15 patients of prostatomembranous defect in whom MR imaging was performed before surgery. The MR findings are correlated with surgical findings in most of the cases with a significant p value (1993).

This study gives an idea with the experience of others in regard to the degree of dislocation in patients with Pelvic fracture urethral injuries with sagittal and coronal views of MRI reconstruction.

Comparison of our study with available literature - Correlation with surgical findings with significant p value

Sl. No	Study group	No. Of patients
1	Yoshifumi Narumi, *et al*,	23/27 (85%)
2	Christopher M. Dixon, *et al*,	18/18 (100%)
3	Deuk Jae Sung, *et al*.	12/12 (100%)
4	Yasser Osman, *et al*.	17/20 (85%)
5	Nurenberg P, *et al*.,	18/18 (100%)
6	Noel A Armenakas, *et al*.,	15/15 (100%)
7	Our Study	34/38 (89.47%)

CONCLUSION

MRI could accurately measure the defect length in T2 sagittal and coronal views of reconstruction. It is a non invasive multiplanar imaging modality without any radiation. It also judges the extent of spongiofibrosis and prostatic apex dislocation, which will aid the surgeon to perform appropriate surgical procedure.

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