Magnetic resonance urethrography versus conventional retrograde urethrography for diagnosis of anterior urethral stricture

Tarek Khalaf Fath El-Bab*, Amr Mohamad Abdelhamid*, Ehab Mohamad Galal* and Mohammed Farghally Amin**

Department of Urology* and Radiology**, Minia University, Minia, Egypt
amrabdelhamid2002@yahoo.com

Abstract: Purpose: The aim of this study is to evaluate the diagnostic capability of magnetic resonance(MR) urethrography in comparison to the conventional retrograde urethrography (RUG) in anterior urethral stricture. **Materials and Methods:** This prospective study was done in the period from January 2009 to March 2012 and included 20 patients(mean age,51± 16 years; range, 19-70 years) with anterior urethral stricture (diagnosed by RUG) .Both fresh and recurrent cases were included regardless the etiology of stricture. All patients were evaluated by conventional RUG and MR urethrography. Data obtained were compared with both endoscopic and operative findings in all patients. **Results:** RUG diagnosed all cases of stricture. But, two cases with short segment stricture were diagnosed falsely as long. It detected one case of urethral diverticulum and provided no data about spongiofibrosis. At MR urethrography, all cases of stricture were diagnosed with accurate measurement of its length. It diagnosed urethral diverticulum in one case and spongiofibrosis in 5 cases. The mean intra-operative stricture length and the mean stricture length as measured by conventional RUG and MR urethrography was 1.29 ± 0.83; 1.75 ±1.02 and 1.32 ± 0.85 respectively. The diagnostic accuracy of MR urethrography and conventional RUG was 95% & 75% respectively.. **Conclusion:** MR urethrography is considered a good, informative and feasible technique for urethral stricture evaluation with better diagnostic accuracy than RUG. It provides accurate measurement of stricture length and adequate data about spongiofibrosis that are crucial for proper selection of treatment modality.

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Abbreviations and Acronyms: (RUG), retrograde urethrography. (MR), Magnetic resonance (MRI) manetic resonance image.(VIU) visual internal urethrotomy.

1. Introduction:

Generally, the term urethral stricture means fibrous scarring of the urethra caused by collagen and fibroblast proliferation [1]. The causes of anterior urethral strictures are mostly inflammatory (infectious urethritis, balanitis xerotica obliterans),traumatic(straddle injury, iatrogenic) and less commonly congenital. [2].

Several diagnostic tools are available for imaging of the urethra, of which RUG is the primary imaging modality for evaluating urethral stricture diseases, however it has certain limitations like being invasive, poorly detecting the accurate length of stricture and the extent of spongiofibrosis [3].

MR urethrography and sonourethrography were introduced in the last decade as newer modalities for imaging male urethra [4]. Sonourethrography has proved to be accurate in diagnosis of anterior urethral stricture ,but it has certain limitations such as its small field of view and difficulty in urethral lumen delineation [5].

On the other hand, MR has the ability to delineate clear anatomical details regarding the urethra and periurethral tissue with three dimensional orientation of the lesion. [6]

The aim of this study is to evaluate the diagnostic capability of MR urethrography in comparison to the conventional RUG in anterior urethral stricture.

2. Materials and Methods:

This prospective study was done in the period from January 2009 to March 2012 and included 20 patients(mean age,51± 16 years; range, 19-70years) with anterior urethral stricture (diagnosed by RUG). Both fresh and recurrent cases were included regardless the etiology of stricture. The study was approved by the hospital ethics committee and patients were informed about the nature of different diagnostic modalities used to diagnose their strictures. All patients gave a written consent for intervention. RUG and MR urethrogram were performed for all patients prior to the intervention and results were interpreted by the same radiologist. RUG was performed with the patient placed in a right or left oblique position, with the underside leg bent from the knee and flexed

toward the abdomen. Penis **was** placed laterally over the proximal thigh with moderate traction. After glands sterilization, urethra was filled by a 50 ml syringe using 25 ml of contrast material (Telebrix **300** Meglumine; Guerbet, Aulnay-sous-Bois, France) mixed with 25 ml of normal saline. Both oblique and A-P films were obtained during maximum urethral distention. The entire length of urethra was assessed for any narrowing or abnormal fistulous communications. MR urethrography was performed 4 to 10 days after RUG. With the patient in supine position, the penis was positioned anteriorly and taped to the abdominal wall beneath the surface coil after injection of sterile gel into the urethra and applying a soft clamp to the penile tip to keep the urethra distended. MR images were obtained by using a 0.2-T MR imaging device (GE Profile 0.2 Tessla) and a pelvic phased-array coil. The MR imaging protocol consisted of a sagittal T2-weighted fast spin-echo sequence (repetition time msec/echo time msec 3000/99) and a transverse T2-weighted fast spin-echo sequence (3200/99; field of view, 24 cm; matrix, 512 x 264; section thickness, 3 mm; and section gap, 0.1 mm). The reformatted images at different axial, coronal, and sagittal oblique planes were obtained to delineate the entire length of the urethra, define stricture length and characterize the surrounding soft tissue with depth and density of periurethral fibrosis. Stricture length was measured including the tapered segments on either side of the stricture. Strictures with length <1.5 cm were considered 'short strictures,'' whereas longer strictures were defined as''long strictures.''

Urthroscopy was done to all patients followed by endoscopic management or open urethroplasty either in the same or another operative setting.. The strictured segments were adequately measured intraoperatively. The radiologic data obtained were compared with endoscopic and operative findings in all patients.Diagnostic accuracy of the two techniques was defined as the sum of true positive and negative cases divided by total number of cases.

Statistical analysis of data was done using SPSS®, version 12.

3. Results:

RUG detected short segment stricture in13 and long segment stricture in 7 patients. MR urethrogram showed short segment stricture in15 and long segment stricture in 5 patients. In addition MRU detected extensive spongiofibrosis in 5 cases (4 cases with short segment and one with long segment stricture).

Urthroscopy under anesthesia was performed to all patients that showed normal urethral lumen with no real narrowing in one patient and definite stricture up to complete obliteration in the other 19 patients. Amoung the 14 patients with short segment stricture, 10 patients (had no spongiofibrosis in MRurethrography) were treated successfully by visual internal urethrotomy (VIU) and 4 patients with extensive spongiofibrosis were managed by open urethroplasty (resection reanastomosis in two, and augmented urethroplasty in the other two patients). On the other hand the remaining 5 patients with long segment stricture were treated by augmented urethroplasty. After both endoscopic and surgical management, the final findings were compared with the radiologic data of both techniques. As regard RUG, it diagnosed all the cases of strictures but; regarding the stricture length, two cases with short segment stricture were diagnosed falsely as long segment (fig.1a&b). It also diagnosed one case of normal caliber as short segment stricture. RUG detected associated urethral diverticulum in one case(fig.2a) and failed to diagnose spongiofibrosis. At MR urethrogram, all of strictures were diagnosed with accurate estimation of its length but there was one case with normal caliber falsely diagnosed as short segment stricture. MR urethrogram detected uretheral diverticulum in one case(fig.2b) and accurately diagnosed associated spongiofibrosis in 5 cases (4 short segment and one long segment) (fig.3). The diagnostic accuracy of MR urethrography and conventional RUG was 95% & 75% respectively.

The mean intra-operative stricture length and the mean stricture length as measured by conventional RUG and MR urethrography was 1.29 $\pm$ 0.83; 1.75 $\pm$1.02 and 1.32 $\pm$ 0.85 respectively.

In comparing the mean intraoperative stricture length with the mean length that was measured by RUG, the difference was found to be statistically significant (p 0.02), while there was no statistically significant difference (p 0.23) between the mean intraoperative stricture length and that was measured by MR urethrography. **(Table 1 and 2).**

Table (1): Comparison between RUG and intraoperative stricture Length in centimeters

Variables	Mean $\pm$ SD	*P*-value
Stricture length in RUG	1.75 $\pm$ 1.02	0.02*
Intraoperative stricture length	1.29 $\pm$ 0.83	

**Significant.*

Table (2): Comparison between MR urethrography and intraoperative stricture Length in centimeters.

Variables	Mean $\pm$ SD	*P*-value
Stricture length in MR urethrography	1.32 $\pm$ 0.85	0.23**
Intraoperative stricture length	1.29 $\pm$ 0.83	

*** Non significant.*

Fig.1a: Anterior RUG of 60 years old male showing about 2 cm stricture of anterior urethra.

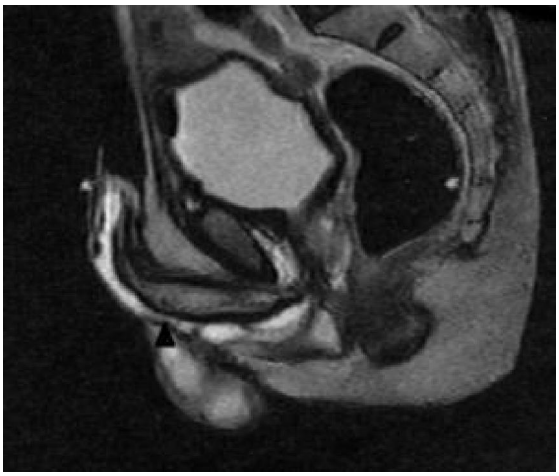

Fig.1b: Sagittal T2-weighted MR image of the same patient demonstrates about1.5 cm anterior urethral stricture (black arrow head) .

Fig.2a : Images obtained in 63-year-old man right anterior oblique RGU long segment anterior urethral stricture. A urethral diverticulum is seen bulging from the membranous urethra.

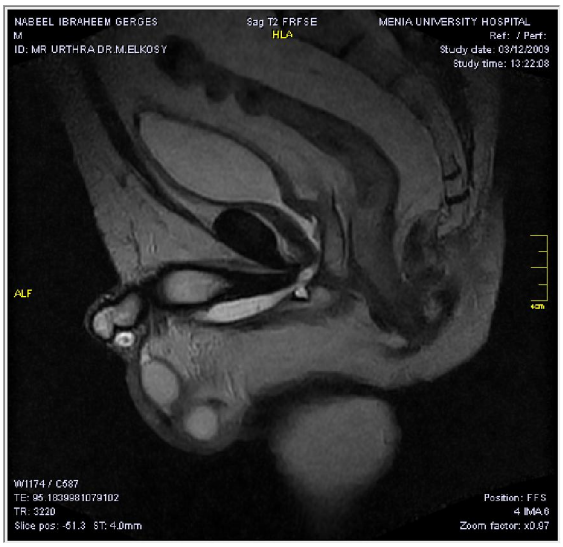

Fig.2b: Sagittal T2-weighted MR image showing well delineated urethral diverticulum

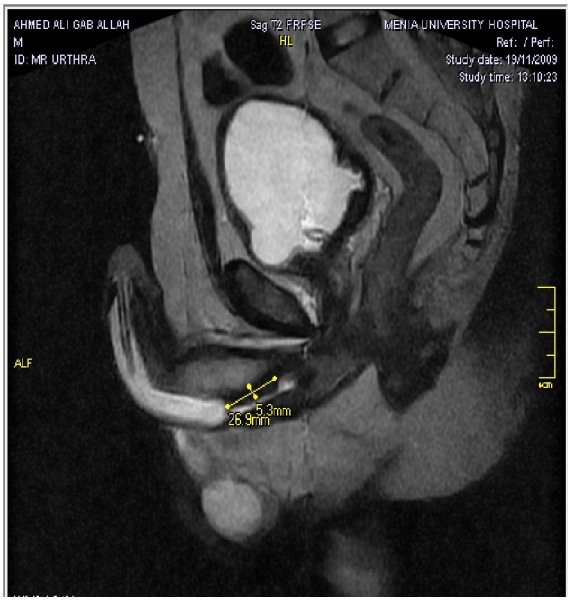

Fig 3: sagittal T2 weighted image of male 35 year showing an evident low signal intensity area of spongiofibrosis at bulbar urethra

4.Discussion:

Urethral stricture is generally defined as any obstructive fibrous scarring of the urethra. [1]. There are many treatment options for urethral stricture disease however, the choice of best one should be done according to many factors. As the stricture length is the most critical of these factors, great effort should be done to preoperatively clarify it [7&8]. Other factors that also contribute to the surgical decision are the etiology of current pathology, presence of

spongiofibrosis and its extent, recurrent cases, surgeon's experience and preference [9].

Cunningham, in 1910 popularized the RUG as the gold standard imaging study for diagnosis of urethral strictures, being simple, easily available and cost effective technique [11].

However accurate estimation of the stricture length may be affected by certain factors such as patient positioning, degree of penile traction and force of contrast injection which may lead to a false diagnosis of urethral stricture [12]. Even with following standard technique ,still there are fallacies in stricture length estimation [13]and no data is obtained about spongiofibrosis [14]

In this study, we used the Magic Veiw Picture Archiving and Communicating System (PACS; General Electric, Milwaukee,WI) to get the most accurate measurements possible.

To overcome the limitations of RUG, sonourethrography was first introduced by McAninch in 1988 [15]. However, it has not been widely used because of its narrow field of view as well as the need of a highly experienced radiologist for its interpretation. In a more recent study, combination of sonourethrography and RUG was recommended for better assessment of urethral strictures [13].

MR urethrography was suggested to be an extra radiological diagnostic tool for urethral stricture diseasese [5&6].

In our study sterile gel was used to distend the urethra as described by Osman *et al.* [16]. This can give an easier and more comfortable distension of the urethra in comparison to saline that was previously used.. [5].

Accurate measurement of stricture length is very important for proper selection of treatment modalities. VIU is mostly effective for short segment stricture(<1.5cm) with no associated spongiofibrosis while longer strictures or strictures associated with spongiofibrosis necessitate open reconstructive procedure[7]. Inaccurate estimation of stricture length by RUG was commonly reported [13]

In this study we compared the stricture length measured by RUG and MR urethrography with the intraoperative stricture length. MR urethrography allowed accurate estimation of urethral stricture length, with the data obtained were nearly identical to the endoscopic and operative findings in all cases in contrast to RUG that inaccuretly measured the stricture length in the form of overestimation in two cases. These findings were in agreement with reports of Osman et al,[16] and Abou ELghar et al.,[17] who found that MR urethrography provided accurate estimation of stricture length with the data obtained matched the operative and endoscopic findings in all cases. Sung *et al.* [18] in his series reported that, MR urethrography has a significantly lower incidence of fallacies in urethral stricture length than conventional RUG.

Another important determinant of proper treatment is spongiofibrosis and according to its degree, the treatment option is selected with open urethroplasty was conducted to these cases with full thickness fibrosis of corpus spongiosum [7]. Traditional methods for urethral stricture evaluation failed to detect any pathological changes beneath the urethral surface. Spongiography was suggested to assess this pathology but owing to its invasiveness, it was not widely accepted [14]

One of the greatest advantages of MR urethrography over RUG is the accurate assessment of the site and extent of spongiofibrosis(fig.3). After contrast medium injection, MRI can detect easily fibrotic changes in corpus spongiosum as hypointense areas that can be clearly differentiated from the hyperintense areas of normal spongy tissue [5].

Spongiofibrosis was accurately detected in 5 of our cases and affected the treatment plane in two of them(with short segment stricture), in whom, open urethroplasty was performed instead of VIU.

We considered MRI as an excellent imaging modality for evaluating urethral stricture. Being cost effective, its use could be restricted to selected patients who might benefit. Further studies are needed to determine the criteria of patients who can get maximum benefit.

Conclusion:

MR urethrography is considered a good, informative and promising tool for evaluation of anterior urethral stricture with better diagnostic accuracy than RUG. It provides accurate measurement of stricture length and precise judgment of spongiofibrosis. Thus, it is crucial for determining management plan and proper selection of treatment modality.

Correspondence:
Amr Mohamad Abdelhamid, MD,
Department of Urology, Minia University hospital, Minia, Egypt amrabdelhamid2002@yahoo.com

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