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Usefulness of urethral ultrasound imaging in urethral stricture

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**KEYWORDS**

Stricture; Urethra; Ultrasound; Mexico.

**Abstract**

**Background:** Urethral stricture is defined as a narrowing secondary to tissue scarring. Diagnosis is made with contrast-enhanced imaging studies such as cystourethrography. Urethral ultrasound is a noninvasive imaging method that enables the diagnosis and classification of urethral stricture.

**Material and methods:** Thirty patients with a past history of urethral stricture underwent urethral ultrasound. The strictures were measured, a questionnaire on urethral ultrasound was applied, and a descriptive data analysis was done.

**Results:** The mean age of the patients was 66 years. A total of 33.3% patients underwent cystoscopy and 73% had cystourethrography. In 50% of the patients, initial treatment was urethral dilation. Significant urethral stricture was found through ultrasound in 80% of the patients. The mean stricture length was 0.84 cm and the mean depth was 0.37 cm. The patients experienced less “discomfort” during the ultrasound procedure and would recommend it over voiding cystourethrography (VCUG) and/or cystoscopy.

**Discussion:** Urethral ultrasound is a noninvasive imaging method that identifies stricture location and length and evaluates the depth of the spongiformis. Cystourethrography can underestimate stricture length and it does not provide information on depth and density. Ultrasound imaging should be complementary in patients with urethral stricture and should be used for surgical planning and adequate follow-up.

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Utilidad ultrasonido uretral en estenosis de uretra

Resumen

Introducción: La estenosis de uretra se define como una estrechez secundaria a tejido cicatrizal. El diagnóstico se realiza con estudios de imagen con medio de contraste, tal como la uretrocistografía. El ultrasonido uretral es un método de imagen no invasivo, que permite diagnosticar y clasificar la estenosis de uretra.

Material y métodos: Se realizó ultrasonido uretral en 30 pacientes con antecedente de estenosis de uretra. Se midieron las estenosis. Se realizó un cuestionario sobre el ultrasonido uretral. Se hizo un análisis descriptivo de los datos.

Resultados: La edad promedio fue de 66 años. El 33.3% tenía cistoscopia y el 73% uretrocistografía. En el 50% el tratamiento inicial fue con dilatación. En el 80% de los pacientes se encontró estenosis de uretra significativa por ultrasonido. La longitud promedio fue de 0.84 cm y la profundidad promedio fue de 0.37 cm. Los pacientes sintieron menos “molestia” durante el ultrasonido, y lo recomendarían más que la uretrocistografía miccional (UCGM) y/o la cistoscopia.

Discusión: El ultrasonido uretral es no invasivo. Permite obtener la localización y la longitud, así como la valoración de la profundidad de la espioniofibrosis. La uretrocistografía puede subestimar la longitud, y no informa la profundidad y densidad. El ultrasonido debe ser complementario en los pacientes con estenosis de uretra. El ultrasonido debe hacerse para una planeación quirúrgica y un adecuado seguimiento.

Introduction

According to information from the U.S. Veterans Affairs hospital database the rate of urethral stricture was 193/100,000 for the year 2003. According to this database, the stricture rate increased significantly in patients above the age of 55 years. However, the incidence of urethral stricture is unknown. Medical consultations for urethral stricture determined by the U.S. National Ambulatory Medical Care Survey within the time frame of 1992 to 2000 were reported at a rate of 229/100,000.¹ Urethral stricture is defined as a narrowing of the urethral lumen secondary to scar tissue. Etiology can be infectious, iatrogenic, traumatic, or idiopathic. These patients present with urinary symptomatology that affects quality of life and they are often offered procedures such as dilation or optical internal urethrotomy (OIU). In some cases the patients may develop severe symptoms such as kidney failure, acute urine retention, urethral carcinoma, Fournier’s gangrene, and bladder dysfunction as a consequence of the stricture.² According to the same survey, the number of retrograde urethrogram carried out on the population over 65 years of age was 6,557/100,000 in 2001. In other words, 6.5% of the patients above the age of 65 years with urethral stricture underwent that study.³

Numerous studies have shown that urethral ultrasound imaging offers greater precision in determining stricture length.¹⁴

Ultrasound as a diagnostic tool for urethral stricture offers the advantages of being a non-invasive study that enables the anterior urethral strictures to be seen rapidly, simply, and precisely. Likewise, it measures stricture length and depth more exactly than retrograde urethrography.

Methods

A descriptive study was conducted on 30 men using urethral ultrasound as a support tool in the management of patients presenting with urethral stricture. The study was carried out at the Urology Service of the Hospital Regional Lic. Adolfo López Mateos of the ISSSTE. Prior to their participation, all patients signed informed consent statements. The ultrasound equipment used was the Esaote Mylab⁴ Desk with a 7.5 mHz linear transducer. With the patient in the dorsal decubitus position, a 12Fr Foley catheter was placed in the navicular fossa and with a continuous drip through the catheter, an ultrasound sweep of the anterior urethra was carried out. All the studies were performed by the same physician. The location, length, and depth of the strictures found were recorded. After the ultrasound, a still non-validated questionnaire that was created in stages was applied to identify the grade of discomfort of the ultrasound study, to be compared with cystoscopy and retrograde urethrocytography.

A descriptive analysis of the data was done, obtaining means, standard deviation, and frequencies.

Results

An ultrasound study of the urethra was carried out on 30 male patients. Their mean age was 66 ± 9.1 years. A total of 30% of the patients had a past history of diabetes mellitus type 2, 46.7% high blood pressure, 13.3% heart disease, and 10% had a history of kidney failure. Ten percent of the patients had prostate cancer and 13.3% presented with some other comorbidity. A total of 24 patients (80%) had a past history of TURP and 21 (70%) had been treated with OIU.

A total of 13.3% of the patients had undergone open or radical prostatectomy and 23.3% had some other surgery.
Of the patients with previous urologic surgery, the mean time of stricture diagnosis after the surgery was 26.3 ± 24.5 months.

Thirty-three percent of the patients had a cystoscopic study, whereas 73.3% had cystourethrography. Of the patients that had cystoscopy, 80% presented with urethral stricture. Ninety-five percent of the patients that had cystourethrography presented with urethral stricture data (fig. 1).

Of the patients that had some kind of diagnostic study (cystoscopy and/or cystourethrography), 70% presented with stricture in the bulbous urethra, 20% in the penile urethra, and 13% in the prostatic urethra.

Initial treatment was dilation or calibration in 46.7% of the patients. OIU was done on 23.3%. Treatment was transurethral catheter placement or cystostomy in 16.7% of the patients, and there was no initial treatment in 13% (table 1).

Prior to the ultrasound, the International Prostate Symptom Score (IPSS) questionnaire was applied to all the patients. Forty percent of them had a moderate score (8 to 19 points), 30% had a severe score (20 to 35 points), and 30% had a mild score (1 to 7 points).

Urethral stricture was found in 80% (n=24) of the patients that had ultrasound; it was situated in the penile urethra in 36.7%, in the bulbous urethra in 40%, and in the membranous urethra in 3.3%.

A second stricture was found in the bulbous urethra in 6 cases and a third stricture was found in the bulbous urethra in 2 cases.

In 89.3% of the patients, the location of the stricture found through ultrasound imaging coincided with the location found through cystoscopy and/or cystourethrography.

The mean number of strictures found was 1 ± 0.78, the mean stricture length was 0.84 ± 0.50 cm, and the mean depth was 0.37 ± 0.17 cm (table 2).

In relation to the responses to the questionnaire applied after urethral ultrasonography, 79.3% of the patients said there was less discomfort with the ultrasound study than with the previous study (cystoscopy and/or cystourethrography), 17.2% stated there was more discomfort, and 3.4% said the discomfort was the same. The ultrasound study was regarded as less invasive by 75.9% of the patients and 86.2% considered that it took less time than the previous study.

A total of 72.4% stated that they had felt pain with the cystoscopy and/or cystourethrography. Of those patients, the mean pain score was 5 ± 3.36 points, according to the visual pain analog scale. On the other hand, 48.3% of the patients stated they had felt pain with the ultrasound study and had a mean pain score of 2.2 ± 2.7 points.
Thirty-one percent of the patients that had cystoscopy and/or cystourethrography reported having had some kind of complication such as hematuria, pain, micturition difficulty, infection, etc. A total of 55.2% of this group of patients presented with dysuria at some point after the procedure.

Ninety-six percent of the patients said they had none of the abovementioned complications after urethral ultrasonography and 6.7% of the patients in this group presented with dysuria after the ultrasound study.

The greatest discomfort for the patients during the urethral ultrasound study was when the Foley catheter was placed in the navicular fossa.

A total of 96.6% of the patients would recommend urethral ultrasonography rather than cystoscopy or cystourethrography.

Discussion

The age at which patients present with urethral stricture can vary. It has been observed that as the individual ages, the incidence of stricture is more frequent, with the greatest incidence in patients above the age of 55 years. The mean age of the patients in the present study was 66.4 years. According to statistics in the United States, stricture incidence for this age is calculated at 600/100,000. In relation to their etiology, strictures can be divided as follows: idiopathic, traumatic, infectious, and iatrogenic. Eighty percent of the patients studied had a previous TURP. In the study by Greenwell et al., the TURP was the cause of the stricture in 33% of the patients.

According to a survey applied to urologists in the U.S., in relation to all procedures included in the questionnaire, dilatation and urethrotomy are used to treat stricture in 92.8% and 85.6% of the cases, respectively. Of the 30 patients included in our study, 46.7% were managed with dilation and 23.3% had undergone a previous OIU.

Cystourethrography is currently regarded as the study of choice for urethral stricture diagnosis. It offers the diagnostic advantages of complete visualization of the urethral course from the navicular fossa to the bladder neck in a retrograde phase and a micturition phase. Nevertheless, some disadvantages of cystourethrography are patient radiation exposure, the use of iodized contrast mediums, the changing of positions for the taking of images, the length of time of the study, the occasionally traumatic introduction of the catheter for instilling the contrast medium, the low sensitivity for observing strictures that are not significant, and the image interpretation variability. Moreover, stricture depth cannot be measured with this method and it often underestimates stricture length.

Spongiofibrosis refers to the presence of fibrous tissue beyond the urethral epithelium that affects the spongy body, and in severe cases, the corpora cavernosa. The best treatment can be chosen if the amount of spongiofibrosis surrounding the stricture is known. Cystourethrography does not have the ability to show this periurethral tissue.

Despite these disadvantages of cystourethrography, the reason why ultrasound is not a routine study in patients with urethral stricture or with urethral pathology in general is most likely related to the cost, the time it takes, and the lack of trained radiologists.

Ultrasound that is carried out with a linear transducer, as was done in our study, has advantages over radiographic studies. It is possible to obtain real time longitudinal and transverse images, as well as objective measurements of the length and diameter of the urethral lumen. It is a study that is comfortable and well tolerated by patients and it does not require the use of ionizing radiation or contrast medium. To the contrary, the urethra can be irrigated with

### Table 1 General patient characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Age (years)</td>
<td>66 ± 9.1</td>
</tr>
<tr>
<td>DM2</td>
<td>30%</td>
</tr>
<tr>
<td>HBP</td>
<td>46.7%</td>
</tr>
<tr>
<td>Heart disease</td>
<td>13.3%</td>
</tr>
<tr>
<td>CKF</td>
<td>10%</td>
</tr>
<tr>
<td>Prostate cancer</td>
<td>10%</td>
</tr>
<tr>
<td>Previous TURP</td>
<td>80%</td>
</tr>
<tr>
<td>Previous OIU</td>
<td>70%</td>
</tr>
<tr>
<td>Cystoscopy</td>
<td>33.3%</td>
</tr>
<tr>
<td>Cystourethrography</td>
<td>73.3%</td>
</tr>
<tr>
<td>Initial treatment</td>
<td></td>
</tr>
<tr>
<td>Dilation</td>
<td>46.7%</td>
</tr>
<tr>
<td>OIU</td>
<td>23.3%</td>
</tr>
<tr>
<td>Others</td>
<td>16.7%</td>
</tr>
<tr>
<td>Without treatment</td>
<td>13.3%</td>
</tr>
</tbody>
</table>

DM2: diabetes mellitus type 2; HBP: high blood pressure; CKF: chronic kidney failure; TURP: transurethral resection of the prostate; OIU: optical internal urethrotomy.

### Table 2 Urethral stricture location percentage and length and depth through ultrasonography

<table>
<thead>
<tr>
<th>Stricture Location</th>
<th>Percentage</th>
<th>Length (cm)</th>
<th>Depth (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penile urethra</td>
<td>36.7%</td>
<td>0.84 ± 0.50</td>
<td>0.37 ± 0.1</td>
</tr>
<tr>
<td>Bulbous urethra</td>
<td>40%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Membranous urethra</td>
<td>3.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coinciding with cystoscopy</td>
<td>89.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and/or cystourethroscopy</td>
<td></td>
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</tbody>
</table>
physiologic solution or gel can be used to obtain adequate visibility.

Perhaps one of the limitations of ultrasonography is the impossibility to observe the posterior urethra. In 1988, McA-ninch et al. first demonstrated the poor correlation between cystourethrography and ultrasound imaging for measuring stricture length. They showed how cystourethrography underestimated the length of the narrowings when compared with the length measured during the surgical procedure, whereas the ultrasound measurements coincided with the latter.9

Other studies followed, reporting their preliminary experience when evaluating urethral stricture with ultrasonography.10,11

In 1990 Merkle and Wagner predicted the success of the OIU in relation to the evaluation of scar tissue observed with ultrasound and found that 80% of the patients with ultrasonographic evidence of periurethral fibrosis had recurrences at 6 months from the surgery.12

Urethral ultrasound has various applications and one of them is in presurgical planning, especially for strictures located in the bulbous urethra. The evaluation of the length of the narrowing is perhaps the most important criterion for determining the best treatment.13 According to a study by Nash et al. in 1995, the length of the narrowing in the bulbous urethra observed through ultrasound was very highly correlated with the length found during the surgical procedure (p<0.007), which was not the case with retrograde urethrography.7 Another application of ultrasound is in severe strictures that are generally produced by perineal or pelvic trauma in which the size of the fibrosis or stricture of the bulbous urethra cannot be exactly defined through radiologic techniques.14

In our study, bulbar strictures presented in 40% of the patients, whereas penile strictures presented in 36.7%. This coincides with another study in which bulbar strictures were more frequent, presenting in 48.47% and penile strictures in 25.4%.15-17

The healthy urethral wall has special characteristics such as elasticity, softness, and the capacity to dilate when a liquid is instilled inside it (compliance). In ultrasound imaging, spongiofibrosis is seen as a thickened and irregular tissue with little compliance, projecting into the urethral lumen. This fibrosis can be observed with increased echogenicity, even though the areas that do not distend can alter the echogenicity. Unlike cystoscopy or cystourethrography, ultrasonography has the capacity to adequately measure the quantity of spongiofibrosis, which can be done by measuring the length and depth or by objectively measuring the diameter of the urethral lumen. During maximum retrograde

Figure 2 A) Cystourethrography with no data of urethral stricture. B) C) and D) Portions of the urethra (penile and bulbous) with adequate compliance and no evidence of stricture.
distension, if the diameter of the urethral lumen measures less than 3 mm, the spongiofibrosis is regarded as severe. The presence of an acoustic shadow means that the fibrosis is so dense that the ultrasound wavelengths cannot pass through it. In our study we measured the length of the strictures and the depth of the spongiofibrosis at their maximum points, obtaining a mean length of $0.84 \pm 0.50$ cm (0.20 to 2.27 cm) and a mean depth of $0.37 \pm 0.1$ cm (0.11 to 0.89 cm). We did not carry out a routine measurement of the urethral lumen, but we believe that it can be another objective parameter for stricture diagnosis. The mean length of the strictures found in our study was shorter than those reported in other series (fig. 3).

When patients present with strictures that were already operated on, cystoscopic evaluation may be impossible. In those patients in whom a reconstruction with a scrotal skin flap was done, ultrasound imaging can even identify the presence of hair inside the urethra.

Other applications of urethral ultrasound are the visualization of urethral stones, diverticula, abscesses, false pathways, and fistulas. In our series, we found a urethral diverticulum that was also diagnosed through cystourethrography (fig. 4).

One of the limitations of our study was that not all patients had undergone cystourethrography and therefore we were not able to compare means.

We believe that due to the complexity of the urethral pathology and its management, it is essential to have as much information on the stricture site as possible. Cystourethrography is a good diagnostic and detection method, but it does not provide all the information necessary for adequate treatment planning and choice. We join the other authors that have proposed that ultrasound study of the urethra be a complementary study in the evaluation and follow-up of patients with urethral stricture.13,15,18-20

Figure 3 Stricture in the bulbous urethra with measurements of length and depth.

Figure 4 A) Cystourethrography with the image of a urethral diverticulum in the penile urethra. B) Ultrasonographic longitudinal view showing the diverticulum in the penile urethra. C) Transverse view in which the lumen of the diverticulum and the urethra can be seen.
Conclusions

Urethral strictures present in men of all ages, with a greater incidence after 55 years of age. Urethral pathology is a frequent cause of visits to the urologist and represents an important expense for the patient and the institution.

Urethral stricture treatment is complex and the majority of urologists opt for dilation or OIU, treatments that have an important recurrence rate. Urethroplasty in its different modalities is the best treatment in well-selected patients. Cystourethrography is regarded as the diagnostic study of choice, however it is not a perfect method. Urethral ultrasound is a noninvasive, inexpensive, and available method that provides objective information on the characteristics of the urethral stricture.

We propose urethral ultrasound imaging as a complementary study to cystourethrography in all patients with urethral stricture.

Conflict of interest

The authors declare that there is no conflict of interest.

Financial disclosure

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