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Perspectiva

Usefulness of pelvic floor ultrasound in stress urinary incontinence: Evaluation before surgery and after placement of tension-free vaginal tape

Utilidad de la ecografía de suelo pélvico en la incontinencia urinaria de esfuerzo: valoración prequirúrgica y tras colocación de banda suburetral libre de tensión

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Key words:

Ultrasound. Pelvic floor. Stress urinary incontinence. Tension-free vaginal tape.

Abstract

Tension-free vaginal tape (TFVT) surgery is the approach of choice in women with moderate-severe stress urinary incontinence (SUI). Up to 15% of women are thought to experience complications after TFVT surgery. The sling fails in 5%, with persistence of SUI.

Pelvic floor ultrasound could prove useful in the presurgical evaluation of women with SUI. Similarly, it enables us to study the location and function of the TFVT after surgery and is especially indicated in patients with symptoms suggestive of TFVT-associated complications. In fact, there is a correlation between some ultrasound parameters and the symptoms reported by the patient, such as position, distance to the urethral complex, symmetry, and Valsalva maneuver with respect to the urethra. Pelvic floor ultrasound enables us to make more detailed diagnoses and tailor decisions on therapy.

Palabras clave:

Ecografía. Suelo pélvico. Incontinencia urinaria de esfuerzo. Banda suburetral libre de tensión.

Resumen

La cirugía mediante banda suburetral libre de tensión es la técnica de elección en las mujeres con incontinencia urinaria de esfuerzo moderada-severa. Se estima que hasta un 15% de mujeres tendrán una complicación tras una cirugía mediante BSLT, y en un 5%, la banda fallará persistiendo la IUE.

La ecografía de suelo pélvico (ESP) puede ser de utilidad para la evaluación prequirúrgica de las mujeres con IUE; a su vez, permite estudiar la localización y funcionalidad de las BSLT en el posoperatorio, especialmente indicada ante la presencia de sintomatología sugestiva de complicaciones asociadas a las BSLT. De hecho, existe una correlación entre algunos parámetros ecográficos y la clínica referida por la paciente, tales como la posición, distancia al complejo uretral, simetría, forma y movimiento en Valsalva respecto a la uretra. La ESP nos permite realizar diagnósticos más detallados y tomar decisiones terapéuticas cada vez más personalizadas.

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INTRODUCTION

Stress urinary incontinence (SUI) is the most prevalent type of urinary incontinence in women. The loss of urethral support leading to urethral hypermobility is considered the most frequent cause of SUI. The first therapeutic option in mild-to-moderate cases involves conservative treatment with re-education of the pelvic floor muscles. However, in cases of severe SUI or when there is no response to conservative treatment, surgery is considered the best option. For the last 20 years, the technique of choice has been placement of a macroporous, monofilament polypropylene sling—tension-free vaginal tape (TFVT)—in the mid-urethra. The objective of this approach is to restore suburethral support by creating a kink in the hypermobile urethra. Observational prospective cohort studies with follow-up periods of up to 10 years have shown that placement of TF generates cure rates of 80-90% in cases of pure SUI, although these are somewhat lower in patients who have undergone recurrent procedures, with mixed urinary incontinence and intrinsic urethral dysfunction. However, the technique is not free of complications, such as obstructive voiding dysfunction, overactive bladder with(out) urge urinary incontinence, pain, recurrent urinary tract infection, vaginal extrusion of the TFVT, or erosion of the TFVT towards the bladder or rectum. It is estimated that 15% of women experience a postsurgical complication with a TFVT and that in 5% the technique will fail, leading to recurrence or persistence of SUI (1).

Clinical practice guidelines recommend that patients with lower urinary tract symptoms after surgery for placement of a TFVT should be exhaustively assessed before undergoing any type of treatment, especially before considering undergoing a second procedure. The complete urodynamic study, with evaluation of urinary and urethral function, is considered essential for diagnosis of urinary dysfunction after TFVT surgery (2). In addition to the functional study, imaging tests to visualize the sling and identify its position with respect to the urethra could prove highly useful when taking decisions on the best treatment for the individual patient.

Polypropylene TFVTs are clearly visible on ultrasound (increased refringence). Compared with other imaging techniques for visualization of TFVTs, such as magnetic resonance and computed tomography, ultrasound is simpler, cheaper expensive, and more accessible. In addition, it does not require radiation and enables dynamic assessment. Its drawbacks include operator dependency and the learning curve. Furthermore, although data on its reproducibility have been reported (3), this is not universal (3), (4). Even so, ultrasound is considered the technique of choice for identification of TFVT in patients with symptoms suggestive of associated complications.

The present literature review describes the usefulness of pelvic floor ultrasound in women with SUI requiring surgery and in women who have already undergone surgery and experience symptoms associated with the complications of TFVT.

PELVIC FLOOR ULTRASOUND IN STRESS URINARY INCONTINENCE

Technique

Pelvic floor ultrasound should be performed with the patient in the gynecological position, semiseated if possible, since this facilitates contraction and the Valsalva maneuver (5).

The equipment necessary for pelvic floor ultrasound comprises a conventional linear or convex 3-6–MHz transducer, with a minimal angle of 70º. It is also possible to perform ultrasound with a conventional vaginal transducer. Frequencies of 5-9 MHz provide optimal resolution of the pelvic floor and the TFVT. Linear and convex transducers should be placed in the perineum and endocavitary transducers in the introitus. Therefore, ultrasound is known as transperineal or translabial ultrasound when linear or convex transducers are used and transintroital ultrasound when vaginal transducers are used.

Transperineal and transintroital ultrasound are performed by placing the transducer between the vulvar labia with the minimum pressure needed to obtain good image resolution and thus avoid compressing the neighboring organs and structures, movement of the TFVT, and pain. In the sagittal plane, from ventral to dorsal, we can identify the symphysis pubis, the urethra and bladder neck, the vagina, and the anorectal junction (Figure 1).

Presurgical evaluation of patients with stress urinary incontinence

Before surgery with a TFVT to correct SUI, it is necessary to evaluate the symptoms reported by the patient

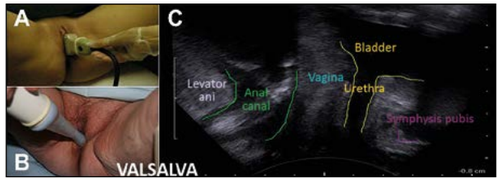

Figure 1. Transperineal/translabial 2D ultrasound with an abdominal transducer (A). Transintroital ultrasound with a vaginal transducer placed in the introitus (B). Image obtained in the medial sagittal plane (C).

(if possible, using validated questionnaires) (6), confirm SUI with a standard test (7), rule out voiding dysfunction, and ensure correct urethral mobility so that the TFVT can make the urethral kink necessary for it to be effective. In this context, pelvic floor ultrasound can help to rule out voiding dysfunction by measuring the postvoid residual urine and to evaluate the mobility of the urethra.

Measurement of residual urine volume

Voiding dysfunction can be ruled out using ultrasound measurement of the residual urine volume after spontaneous voiding, both abdominally and transvaginally. Various mathematical formulae can be used to calculate the residual urine volume with ultrasound. The first is that of Haylen (8), in which the longitudinal diameter of the medial sagittal slice of the bladder (in cm) is multiplied by the transverse diameter and correction factors are applied.

Haylen formula: (longitudinal diameter x anteroposterior diameter x 5.9) – 14.6 mL.

However, the most widely applied formula, owing to its ease of use, is that reported by Dietz in 2012. An axial slice of the bladder is taken by measuring the longitudinal diameter (A) and the anteroposterior diameter (B) (both in cm). If both diameters are multiplied by the correction factor 5.6, we obtain the residual urine volume in milliliters (9).

Dietz formula: longitudinal diameter x anteroposterior diameter x 5.6.

Measurement of urethral mobility

Several methods for measuring urethral mobility have been reported. However, the most widely used is that described by Dietz and Wilson in 1998 (10). A horizontal axis is traced transperineally to the symphysis pubis, and a line perpendicular to the axis is traced to the bladder neck. Mobility of the bladder neck is the difference between this distance at rest and during the Valsalva maneuver (Figure 2). A urethral mobility value of 5-15 mm is considered normal (11,12). The ultrasound diagnosis of hypermobile urethra is relevant, since some studies have reported that the placement of a TFVT in patients with this condition is less successful than in those with appropriate urethral mobility (12). Urethral mobility can be evaluated using physical examination, although pelvic floor ultrasound could prove useful in uncertain cases, especially in patients with risk factors for hypomobile or rigid urethra, such as those who have previously undergone surgery to treat incontinence with colposuspension (Burch or Marshal-Marchetti-Krantz techniques) or with TFVT, those who have pelvic received radiotherapy, those with connective tissue disease, and those with severe genitourinary syndrome of menopause.

Other ultrasound parameters

Pelvic floor ultrasound also provides information on the length of the urethra, funneling of the bladder neck, and thickness of the bladder walls.

The length of the urethra ranges from 19 mm to 45 mm in women, and measurement by transperineal pelvic floor ultrasound is validated, since it has been compared with measurement using a Foley catheter (13). It is useful to know the length of the urethra before placing a TFVT, since it has been proven that TFVTs are more effective when placed in the middle third of the urethra. Given that Ulmsten et al (14,15) described the retropubic TFVT technique, which is performed by means of an incision 1 cm from the meatus, this reference does not seem to be appropriate in women whose urethra measures 2-4 cm.

Funneling is opening of the bladder neck, which is usually accompanied by loss of urine (Figure 2). This can be observed after a Valsava maneuver in women with SUI or after an involuntary contraction of an overactive detrusor muscle in women with an overactive detrusor muscle and symptoms of urge urinary incontinence. Therefore, it does not define the type of incontinence, but rather points to greater severity of incontinence. When measured with the bladder full, funneling seems to be clearly associated with symptoms of SUI when the opening includes more than 50% of urethral length. It is asymptomatic in up to 16% of women when it affects < 50% of the urethra (16).

Finally, there seems to be a correlation between bladder wall thickness and the presence of involuntary contractions of the detrusor muscle in the urodynamic study

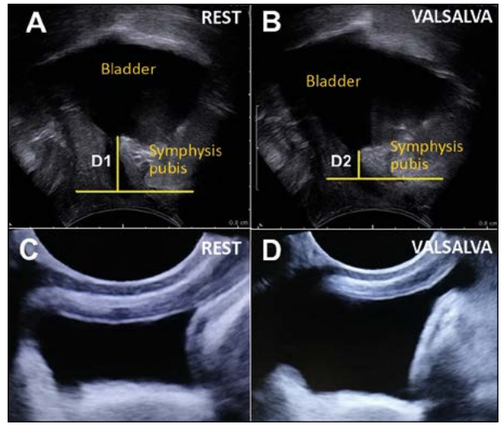

Figure 2. Measurement of urethral mobility (A and B). Horizontal axis to the symphysis pubis and a line perpendicular to the axis running to the bladder neck. (A) At rest. (D1) Distance at rest. (B) Valsalva. (D2) Distance in Valsalva. The mobility of the bladder neck is the difference between D1 and D2. Funneling of the bladder neck at rest (C) and during the Valsalva maneuver (D).

(17). Bladder wall thickness is measured transvaginally with convex or endocavitary transducers, with bladder volumes < 50 cc (empty bladder) (18). Mean thickness of the anterior bladder wall, dome, and trigone > 5-6.5 mm seems to be associated with an overactive detrusor muscle. However, the specificity and sensitivity of this parameter are lower than the gold standard (filling cystometry in the urodynamic study) (19).

Pelvic floor ultrasound in women who have undergone tension-free vaginal tape surgery

Evaluation of placement, characteristics, and functionality of tension-free vaginal tape

In order to study the location and functionality of a TFVT, pelvic floor ultrasound must include a medial sagittal slice (static and dynamic) and a transverse slice. The sagittal slice is obtained by placing the transducer parallel to the vulvar labia, where, ventrally to dorsally, we can identify the symphysis pubis, urethra and bladder neck, vagina, and anorectal angle. The TFVT is placed between the urethra and the vagina. The transverse slice is obtained by rotating the transducer 90º in order to identify the whole suburethral and paraurethral pathway of the TFVT.

The position of the sling at rest at the suburethral level and the interaction of the sling with the middle part of the urethra in the Valsalva maneuver are key to success after surgery (20). The parameters measured by ultrasound in patients with a history of surgery for TFVT are as follows:

- Position of the TFVT with respect to the urethra (proximal, medial, or distal third) both at rest and during the Valsalva maneuver.
- Distance between the sling and the posterior wall of the urethra (in 2D transperineally); with a high-frequency transducer, we can calculate the exact distance between the sling and the urethral lumen.
- Shape of the sling (at rest and during the Valsalva maneuver) and symmetry in the transverse plane.
- Agreement between movement of the urethra and that of the TFVT during the Valsalva maneuver (urethral kinking).

The highest success rates are generally observed with TFVTs placed in the medial third of the urethra that are symmetrical and flat at rest, become C-shaped in the Valsalva maneuver, pinch the mid-urethra during the Valsalva maneuver (kinking), do not slide toward the bladder neck or the meatus (discordant movement), and are at 3-5 mm from the posterior wall of the urethra (5,21-23).

Slings pressing on the bladder neck usually cause irritant symptoms (de novo overactivity of the detrusor muscle) and are obstructive, as are those that are too close to the urethral lumen. Slings that are too loose or creased can slip during the Valsalva maneuver without pinching the middle part of the urethra and can lead to persistent or recurrent SUI. Finally, slings that are placed too distally (close to the meatus) are usually less effective (21,22) (Figure 3).

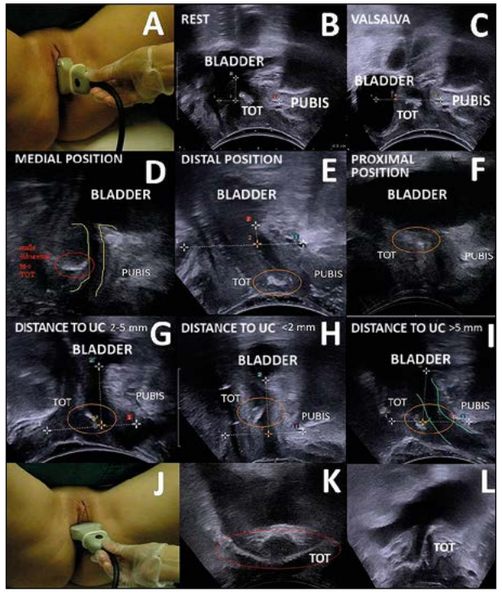

Figure 3. Ultrasound parameters for evaluating the placement and function of tension-free suburethral slings: transperineal ultrasound in the sagittal plane (A), which enables evaluation of the position of a transobturator tape (TOT) at rest (B), and urethral kinking during the Valsalva maneuver (C); position (D, middle third; E, distal third; F, proximal third); distance to the periurethral complex (UC) (G, 3-5 mm; H, < 3 mm; I, > 5 mm); transperineal ultrasound in the transverse plane (J), which makes it possible to evaluate the symmetry of the tape (K, symmetrical; J, asymmetrical).

Role of ultrasound in clinical decision making in women with symptoms of lower urinary tract infection after placement of a tension-free vaginal tape

Given the association between the position of the TFVT and symptoms reported by the patient, ultrasound could prove particularly useful for decision making in women who have undergone TFVT surgery and report symptoms suggestive of associated complications.

The algorithm to be followed in a patient with a history of TFVT surgery and symptoms indicating an associated complication comprises taking a detailed history, followed by a physical examination, urodynamic study, and pelvic floor ultrasound.

If ultrasound reveals that the TFVT is correctly placed according to the abovementioned parameters, treatment should be conservative, with additional diagnostic tests if appropriate. On the other hand, if ultrasound reveals that placement of the TFVT is not optimal, then it must be determined whether the abnormality is associated with symptoms. If this is the case, the patient must undergo specific treatment, which, in some cases, will involve surgery.

If pelvic floor ultrasound shows the TFVT to be correctly placed in a patient with early complications (< 7 days after surgery), then a wait-and-see approach should be adopted. In contrast, if ultrasound shows that the TFVT is too tight, such as when it is inserted in the posterior wall of the urethra at < 3 mm from the urethral complex and the patient has symptoms of obstructive voiding dysfunction, then an attempt can be made to reduce the tension in the sling early. This type of readjustment intervention has been reported to re-establish normal bladder function in approximately 97% of cases (24).

Urethral plication can be performed in the case of an excessively loose TFVT. This approach could prove effective in very specific cases, despite the paucity of data on the procedure in the literature (25).

In the case of later complications (> 7 days after surgery), for example, if the TFVT is too close to the bladder neck and shows signs of excessive tension, then it can be released or removed surgically (26). Placement of a new TFVT after removal of a tight TFVT has an 88.6% success rate. Nevertheless, management of recurrent SUI after anti-incontinence surgery with TFVT is a major therapeutic challenge, and the best option must be chosen on an individual basis. Once again, pelvic floor ultrasound can prove to be very useful in this context for determining whether the initial TFVT interferes with the placement of a second TFVT (collision phenomenon) (22) and thus deciding whether it is appropriate to remove the first TFVT before fitting the second.

CONCLUSIONS

2D transperineal/transintroital pelvic floor ultrasound can be applied in clinical practice to evaluate women with lower urinary tract symptoms, as a complement to functional testing. This approach can prove very useful for measurement of postvoid residual urine, bladder neck mobility, urethral length, and the presence of bladder neck funneling in women with SUI who are candidates for surgery. Similarly, it seems to be useful for evaluating the position and function of a TFVT in women with postsurgical complications and enables more detailed diagnosis and increasingly tailored decisions on therapy.

Current clinical practice guidelines do not consider this approach to be part of the basic work-up in women with pelvic floor disorder and recommend it as optional in complex or recurrent cases, such as women with recurrent SUI (2).

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