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Particularities of the anterior compartment of the pelvic floor in women with urinary incontinence, revealed by transperineal ultrasound

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Abstract

Urinary incontinence (UI) represents a condition that, although not vital, has a significant impact that can interfere with the quality of life in a meaningful way for many women, its overall prevalence being of approximately 40%. Since 1920, urogynecologists showed an increasing interest in imaging techniques of the pelvic floor, ultrasound being the method of examination most frequently used with benefits that result from easy accessibility and reduced costs. At the beginning, B-mode ultrasound via transvaginal or transperineal route, was used to describe the urinary bladder and the anterior compartment and only later, the other pelvic compartments. Pelvic floor dysfunctions include several conditions among which UI. The main indications for transperineal ultrasound are: recurrent urinary tract infections, urgency-, frequency-, stress-UI, dysuria, prolapse of pelvic organs, dyspareunia, fecal incontinence, pelvic masses. This method proves its utility in assessing parameters like: residual urine, detrusor wall thickness, mobility of the bladder neck, anterior and posterior urethrovesical angle, urethral integrity. Stress UI may be highlighted by Color Doppler. Studying the pelvic floor during contractions or Valsalva maneuvre allows the assessment of the functional anatomy, keypoint for understanding the UI pathophysiology. The assessment of these specific objective and reproducible parameters is complementary to the diagnosis of UI and puts several therapeutic options in a different light. The progress in imaging permanently contributes to the improvement of therapeutic management either refining existing techniques or supporting the development of new procedures in urogynecology.
Keywords: *urinary incontinence, pelvic floor imaging, transperineal ultrasound*

Introduction

Since 1920, urogynecologists showed an increasing interest in imaging techniques of the pelvic floor, magnetic resonance imaging (MRI) and ultrasound being the most frequently used methods[(1)]. Ultrasound is used more often, with benefits that result from easy accessibility and reduced costs. At the beginning, B-mode ultrasound via transvaginal or transperineal route[(2)], was used to describe the urinary bladder and the anterior pelvic compartment and only later, the other compartments. Recently, MRI may be considered an alternative[(3)], but the implications of acquiring information limits the usefulness of this technique.

Pelvic floor dysfunctions include several conditions among which urinary incontinece (UI). The main indications for transperineal ultrasound are: recurrent urinary tract infections, urgency-, frequency-, stress-UI, dysuria, prolapse of pelvic organs, dyspareunia, fecal incontinence, pelvic masses[(4-6)]. Most often, UI is not encountered isolated, but associated with: pelvic organ prolapse, impaired defecation or sexual dysfunction. In these cases, imaging may play a significant role in the clinical management algorithm, also opening research opportunities. Representing a low cost and easy access method, transperineal ultrasound proves its utility in assessing certain parameters like: residual urine, detrusor wall thickness (DWT), mobility of the bladder neck, anterior and posterior urethrovesical angle, urethral integrity, pelvic floor compartments prolapse, levator ani anatomy and function[(7)]. Stress UI may be highlighted by Color Doppler[(8)]. Study of the pelvic floor during contractions or Valsalva manoeuvre allows the assessment of the functional anatomy, keypoint for understanding the pathophysiological mechanisms that lead to UI.

The subject of this review will highlight the contribution of transperineal ultrasound in the UI diagnostic algorithm.

Transperineal ultrasound. Description of the method of examination.

Basic instrumentation and patient positioning; In order to assess specific parameters via transperineal route, an ultrasound system with a 3.5-6 Mhz convex transducer[(9)], is the minimal requirement. Ultrasonography is performed with the patient in dorsal

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decubitus with the hips flexed on the abdomen and shoulder-width abducted and the calves flexed on the hips at a 45 degrees angle. Then, after covering the transducer with a powder-free glove, it is placed on the perineum, between the labia and midsagittal views are obtained according to a standard protocol that requires visualization of the symphysis pubis, urethra, bladder neck, urinary bladder, vagina and rectum[10] as shown in Figure 1 for an optimal interpretation of the parameters further described.

DWT decreases with bladder filling up to 50% of its capacity, then remains constant[11]. Therefore, in order to obtain the maximum DWT, this parameter should be measured immediately after voiding, at specific sites: anterior vesical wall[11], bladder dome or at the trigone[12], a mean of these values being calculated.

Bladder neck mobility is assessed at rest and on maximal Valsalva, voiding being specified. The reference point for this measurement is considered the central axis of the symphysis pubis to which the position of the bladder neck is related under dynamic circumstances[13]. The difference between these measurements yields a value translated into bladder neck descent.

The posterior urethro-vesical angle, formed between the longitudinal axis of the urethra and the posterior vesical wall and the anterior urethral (rotational) angle, between the longitudinal axis of the urethra and the central axis of the symphysis pubis were assessed both at rest and on maximal Valsalva[14]. The differences between these angles in the above mentioned states were considered as the rotation angles[14].

UI represents a condition that, although not vital, has a significant impact that can interfere with the quality of life in a meaningful way for many women, its overall prevalence being of approximately 40%[15]. Various imaging methods can be used complementary to clinical examination. Ultrasound is a valuable clinical tool that allows a dynamic morpho-functional evaluation of the pelvic floor of female patients suffering from UI, via transperineal route. It also has the benefit of great accessibility in urogynecology departments. However, some authors consider that ultrasound does not have a significant diagnostic input and thus do not recommend routine use of this method[16-17].

Different examination techniques have been approached over time, none of which have been able to impose as a gold standard. Thus, the position of the patient and the urinary bladder filling at the time of examination are significantly variable; consequently, a unanimous point of view regarding UI diagnostic contribution by transperineal ultrasound appears difficult. For this reason, this paper presents specific parameters studied in female patients with UI and outlines clinical related associations.

Supine positioning of the patient for transperineal examination, with the hips flexed on the abdomen, shoulder-width abducted and the calves flexed on the hips at a 45 degrees angle has been utilized by most examiners, although standing or dorsal litothomy position

Figure 1. *Standard midsagittal comparative image depicting the following landmarks: symphysis pubis (SP), urinary bladder (UB), bladder neck (BN), urethra (U), vagina (V), rectum (R) at rest and on Valsalva in a continent patient*

were encountered. It has been shown a preference for the first one by most ultrasonographers.

Dynamic evaluation of the pelvic floor has to be done comparatively. Therefore, Valsalva maneuver is routinely used. There were attempts to quantify the intensity of Valsalva maneuver or the cough effort by setting a time threshold, at which point the measurements should be made. The authors preference is recording the data for 3-5 seconds[17] of voluntary effort for every patient. This timeframe is referred as maximal Valsalva/cough effort.

In terms of technical aspects, the 3.5 to 6 Mhz convex ultrasound probe should be covered with gloves or a condom for the examination. Powder containing gloves can generate artifacts that are likely to impair the quality of the image, which is the reason why their use is avoided[18]. Scar tissue may also interfere with optimal visibility. Confusing images may also be caused by: inadequate probe cover, improper image orientation, excessive distance between symphysis pubis and the transducer, air between the transducer and the probe cover or stool impactation[19].

DWT was proposed as a marker of overactive bladder, but it cannot replace urodynamic studies[20]. This hypothesis has its objectors. As considered that DWT decreases with bladder filling up to 50% of its capacity, then remains constant[11], the authors suggest that the measurement of this item should be made on an empty bladder, immediately after voiding. No optimal DWT values were reported in healthy patients, therefore it is difficult to establish a pathological threshold. „It was reported that higher BWT values were associated with urodynamically detected detrosor overactivity, and 6.5 mm was the most appropriate cut-off value"[21].

Bladder neck mobility, suggested to have a heritable trait[22], can be evaluated with a high level of reliability and reproductibility. Specific cut-offs (15, 20 and 25 mm) for bladder neck descent[23], defined as the difference between the bladder neck position relative to the central axis of the symphysis pubis have been proposed to characterize hypermobility. Some aspects like patient position and bladder filling have been shown to influence the measurements. Another confounder is represented by levator co-activation[24], that makes Valsalva maneuver difficult to obtain predominantly

at nulliparous. This marker has been suggested as an otucome predictor for suburethral tapes[25].

Over time, several methods have been sought to try to objectify certain morpho-functional parameters to document UI. Starting from the 1980s, transperineal ultrasound has begun to gain ground from urethrohistography with the benefit of no x-ray exposure and dynamic evaluation[14]. Several researchers came up with positive correlations between the anterior/posterior urethrovesical angle and UI[14, 26-27]. Variations of normal regarding the measurements may be biased by the same confounders recalled earlier.

Conclusions

The progress in imaging permanently contributes to the improvement of therapeutic management either refining existing techniques or supporting the development of new procedures in urogynecology. Also, the recognition of specific morphofunctional aspects, assessed in dynamics, may put several therapeutic options in a different light. DWT, bladder neck mobility, anterior and posterior urethrovesical angle represent objective and reproducible parameters that are complementary to the diagnosis of UI. Abnormalities found incidentally may also guide clinical conduct. Even if the lack of standardization of diagnostic procedures for UI is admitted, it raises questions that lie beneath the evolution of knowledge and makes research in this field intriguing. ■

Conflict of interests: The authors declare no conflict of interests.

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