Original Article

Ultrasonography in Stress Urinary Incontinence

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Abstract: Evaluation of the urethrovaginal junction in stress urinary incontinence is essential. For this reason the Q-tip test, a clinical test with debatable specificity; lateral cystourethrography, a conventional method; and videourethrocystography, a sophisticated method, have been in use. Because ultrasonography is inexpensive, reliable, easy to apply and free of any contrast material and X-ray exposure, it has practically replaced all the former methods in the evaluation of the urethrovaginal junction in stress urinary incontinence patients within the last decade.

Keywords: Stress Urinary Incontinence; Ultrasonography; Urethrovaginal Junction

Introduction

Poor anatomical support of the urethrovaginal junction (UVJ), bladder base and proximal urethra, resulting in descent and hypermobility outside the intra-abdominal pressure transmission zone, is considered to be the major anatomical basis of genuine stress urinary incontinence (SUI) [1].

The Q-tip test, a simple clinical test to evaluate the bladder neck, was devised by Crystle et al. [2] in 1972. Lateral bead chain cystourethrography [3-5] was the method of choice for the anatomical assessment of the bladder, urethra and UVJ until ultrasonographic methods were developed. Currently, lateral bead chain cystourethrography remains the single conventional diagnostic method. Although videourethrocystography [6-9] has been available for several decades, it has not been in common use since it is a highly sophisticated method.

The first real-time ultrasonography using an abdominal approach was performed in 1980 by White et al. [10] to evaluate the bladder base and UVJ mobility. Following this study, in the mid 1980s further ultrasonographic methods were undertaken and have replaced lateral cystourethrography in the last decade [11-20].

Ultrasonographic analyses are named according to the anatomical location where the probe is applied (Table 1).

Abdominal Ultrasonography

White et al. [10] performed the first real-time ultrasonography with 2.4 and 3.5 MHz probes. They encountered minimal difficulties in just a few patients, who were extremely obese or had pubic symphysis 'shadowing' which obscured visualization of the UVJ. The authors proposed that it required very little expertise, was a rapid test, was safe, involved minimal discomfort, avoided X-irradiation and could be easily repeated.

Bhatia et al. [21] performed abdominal ultrasonography and the Q-tip test on patients with urinary complaints. They found UVJ mobility to be significantly different in the cases with SUI both preoperatively and postoperatively. The Q-tip test also revealed similar results. The UVJ cannot be seen using the linear array probe, but most of these difficulties have been overcome by the use of the sector array probe.

Abdominal ultrasonography is difficult in obese patients and in patients with large cystoceles or excessive descent of the bladder, since the UVJ is hidden behind the pubis during stress. Currently other ultrasonographic applications are preferred, owing to the difficulties with this approach [22].
Table 1. Comparison of ultrasonographic methods

<table>
<thead>
<tr>
<th>Ultrasonographic method</th>
<th>Probe type</th>
<th>MHz</th>
<th>Displacement of probe during stress</th>
<th>Limitation of UVJ by the probe</th>
<th>Urodynamics affected by the probe</th>
<th>Measurement between UVJ and probe</th>
<th>Patient acceptability</th>
<th>Imaging quality</th>
<th>Intraoperative application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal</td>
<td>Linear</td>
<td>2.4, 3.5, 5</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>good</td>
<td>good</td>
<td>no</td>
</tr>
<tr>
<td>Perineal</td>
<td>Linear</td>
<td>3.5, 5</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>good</td>
<td>good</td>
<td>no</td>
</tr>
<tr>
<td>Introital</td>
<td>Sector</td>
<td>5</td>
<td>maybe</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>good</td>
<td>very good</td>
<td>no</td>
</tr>
<tr>
<td>Transvaginal</td>
<td>Linear</td>
<td>5, 7, 7.5</td>
<td>maybe</td>
<td>maybe</td>
<td>maybe</td>
<td>no</td>
<td>good</td>
<td>very good</td>
<td>no</td>
</tr>
<tr>
<td>Transrectal</td>
<td>Linear</td>
<td>5, 7</td>
<td>maybe</td>
<td>maybe</td>
<td>no</td>
<td>no</td>
<td>not good</td>
<td>very good</td>
<td>yes</td>
</tr>
</tbody>
</table>

**Perineal Ultrasonography**

Koelbl et al. [23] compared perineal ultrasonography with the lateral catheter cystourethography, measuring the posterior urethrovescical angle (PUVA) and urethral inclination angle, and found a good correlation between the two methods. They suggested that perineal ultrasonography was superior to cystourethography since it is non-invasive and simple, and that the linear array probe was superior to the sector probe because it penetrates deeper into the tissues owing to its low frequency. The image quality is the same for tissues at different distances, whereas with the sector probe a punctiform image can be seen close to the probe, reducing the clarity of the image.

Kohorn et al. [19] and Gordon et al. [24] compared perineal ultrasonography with lateral bead chain cystourethography. They found a good correlation and a statistically significant difference between the two methods. They proposed that their perineal ultrasonographic method was superior to lateral cystourethography and other ultrasonographic methods for the assessment of the patient with SUI in every aspect. Gordon et al. [24] suggested that the transrectal ultrasonography performed by Nishizawa et al. [11], Perkas and Friedland [12] and Brown et al. [13] as uncomfortable for the patient owing to the large diameter of the probe, and also limited the movement of the UVJ during stress. There were similar problems with transvaginal ultrasonography, and it was found the presence of a cystocele would disrupt the view.

Wijma et al. [25] found a similar elevation of the UVJ during active contraction of the pelvic floor in both continent and incontinent women. During coughing UVJ descent was found in cases of SUI, whereas no change occurred in the control group (P<0.01). During the Valsalva maneuver an equal amount of descent was found in both groups. These authors proposed that their non-invasive method with the curved array probe had the advantage of displaying the whole lower urogenital region, including the pelvic floor.

Caputo and Benson [26] measured UVJ mobility in the sitting position and with the Q-tip test in the supine position. They assumed the ultrasonographic findings to be standard, and compared these to the findings of the Q-tip test. They defined hypermobility as being greater than 1 cm at perineal ultrasonography and with the Q-tip test greater than 30°. Their results revealed that the Q-tip test, when compared to perineal ultrasonography, failed to identify 75% of patients with UVJ hypermobility, and falsely diagnosed this entity in 22% of patients with normal UVJ mobility. They believed that there is no evidence to suggest the different forces are generated during stress between the supine and the sitting positions, but offered no evidence to that effect.

Demirci et al. [27] took a different approach using perineal ultrasonography compared to previous authors. Those that use perineal ultrasonography measure the movement of the UVJ in only one direction [19,23,25,26]. Demirci et al. took the inferior edge of the symphysis pubis as the reference point and measured the cephalocaudal and ventrodorsal components of UVJ mobility for the first time, and standardized it with other studies [28,29]. They suggested that they were able to compare other components of UVJ mobility and that the topographic location of the UVJ could be determined more precisely.

Schaer et al. [30] also measured two components of UVJ mobility. They compared perineal ultrasonography to lateral bead chain cystourethography and found significant differences between the PUVA (at rest and during Valsalva) and ventrodorsal and cephalocaudal movement of the UVJ during Valsalva only. However Koelble et al. [23] measured the PUVA and urethral inclination angle, Kohorn et al. [19] and Gordon et al. [24] measured UVJ mobility and found no significant differences between perineal ultrasonography and lateral cystourethography, Schaer et al. [30] proposed that the PUVA was a weak index to evaluate SUI. They also found that the PUVA and the funneling of the bladder neck were measured more accurately using lateral bead chain cystourethography.

The advantage of perineal ultrasonography is that the probe does not move during stress, does not limit the movement of the UVJ, and gives a better topographic view of the UVJ, bladder and urethra. A catheter may not be required [22,30]. The disadvantage is that the imaging quality achieved by transvaginal ultrasono-