Modern methods of imaging in urogynecology – when do we really need them?

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Abstract
Imaging is more often used in modern urogynecology, especially before the operation and in complicated cases. There are different modes of imaging of the pelvic floor in women. They can be static, dynamic and quasi-dynamic (i.e. 4D ultrasound). In our opinion it is important to use widely available, cheaper, less invasive and dynamic modes. Ultrasound is usually standard equipment in urogynecologic clinic, may be used by clinician himself as an adjunct to clinical diagnosis without transferring the patient to the radiology rooms. In many centers 2D and 4D ultrasound performed transabdominally with transabdominal probe is used. In the latest guideline for German speaking countries specialists advocate that 2D ultrasound should be included in standard examination and is especially useful in urinary incontinent patients. In our opinion 2D ultrasound performed with transvaginal probe can be also used in many urogynecological centers, because such equipment is widely available, and many specialists are familiar with transvaginal probe.

Key words: urogynecology, imaging, pelvic floor ultrasound, transvaginal probe, abdominal probe

Pelvic floor sonography with a transvaginal probe performed introitally

Instrumentation and methodology
Initial pelvic floor sonography should be performed with the transvaginal probe (PFS-TV) at approximately 300 ml bladder filling, followed by a second sonography to determine the post-void residual volume. Pelvic organ prolapse should be evaluated for residual volumes < 50 ml. During the Valsalva maneuver, not analyzed compartments should be pushed away by a speculum. The woman should be in a semi-sitting position, while an additional sonography in standing position is optional. Ultrasound settings should include: transducer at 4-8 MHz for the transvaginal probe, beam angle at 160°, one focal zone, the object of interest should occupy about 75% of the image area [1, 2]. It is possible to visualize pelvic floor in 3 planes: sagittal, frontal and axial (Fig. 1).

Imaging of the patients with stress urinary incontinence before the suburethral tape implantation.

Focal lesions
It is possible to detect pathological abnormalities, which can have the influence on the suburethral tape implantation, in and close to the urethra, and in the bladder [3-6]. Typical example of urethral disease is urethral diverticulum, which is a contraindication for tape implantation. It is easy to detect stone in the bladder. It should be first treated, especially that in some cases bladder stone can be the reason of most urogynecological symptoms that bother the patient.

Urethral length and urethral mobility
The probe is positioned in the area of the vaginal opening at the level of the external urethral orifice exerting the slightest pressure possible and aligning the axis to the patient’s long body axis. Median sagittal ultrasonic view includes the urinary bladder, the urethra, the suburethral vagina, the symphysis pubis, and the interpubic disc (Fig. 1a).

The sonographic urethral length is defined as the distance from the bladder neck to the distal end of the hypoechoic urethra at the urethral papilla (Fig. 2). It is important to position the probe “without tension”, since pressure on the probe reduces the urethral length [1, 2, 7].

In order to evaluate the urethral mobility during Kegel’s exercises and Valsalva maneuver (Fig. 3), the bladder neck positions at rest, during contraction or during straining are first determined [8-10]. For this, a horizontal line is drawn through the lowest point of the symphysis pubis. The distance H is determined as the distance from the bladder neck (BN) to the horizontal line. Positive or negative numbers of H (in mm) are possible, depending on the BN location above or below the horizontal reference line.

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The distance D is measured as the distance from the symphysis pubis to the vertical projection of the BN to the horizontal line (in mm). Positions to the right from interpubic disc are positive, positions to the left of it are negative. Urethral mobility during Valsalva maneuver can be calculated according to formula 1: Fig. 1.

This parameter is called the linear dorsocaudal movement (LDM). Last articles suggest that hypomobile urethra can be defined when the value of LDM is ≤ 5 mm, normobile: between 5 and 15 mm, hypermobile: ≥15 mm [1, 11].

Urethral funneling

Urethral funneling with urine flow visualized in PFS-TV during Valsalva maneuver or coughing seems to be the confirmation stress urinary incontinence [12].

Individually planned tape implantation

Studies suggest that cure of SUI depends on urethral mobility, type of used tape and tape location [1, 2, 8, 11, 13].

Retropubic tape TVT should be placed using formula 1/3. Transobturator tape TVT-O should be placed according to formula 1/2 [1, 2].
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In women with normobile optimal tape-urethra distance is between 3 and 5 mm, while in patients with hypomobile urethra we should try to obtain distance 2.5-3.5 mm. In our opinion intraoperative cough test is useful to obtain optimal tape-urethra distance [1, 2, 11].

Imaging of the patients with stress urinary incontinence a few days after the suburethral tape implantation

**Tape location**

Position, symmetry, form and functionality of the suburethral tape are evaluated by sagittal and axial PFS-TV imaging (Fig. 4) [2, 8, 13, 14]. The distance from the tape to the urethra (in mm) is defined as the shortest distance between the tape and the longitudinal smooth muscle complex of the urethra called tape-LSM distance or tape-urethra distance. The tape position (in %) indicates the distance from the mid-tape (projected to the urethra) to the bladder neck divided by the length of the entire urethra [2, 8, 14].

Tape shape and functionality give information whether the tape is positioned “tension free”, or too loose or too tight. A tape that is too loose can be recognized as having a flat appearance at rest and at Valsalva maneuver, while a tape classified as too tight is C-shaped at both [2, 8, 13, 14].

**Loosening the tape**

If tape has optimal position (50-70%), but is too tight (tape-urethra distance < 3 mm) it can be loosened successfully during first few days after TVT implantation [14].

**Imaging of the patients with stress urinary incontinence weeks after the suburethral tape implantation**

**Excising the tape**

In patients with persisting SUI, OAB de novo or post-void residual of urine when tape is not optimally lo-
cated, tape should be excised. New tape should be implanted minimum 6 weeks later [15].

**Loosen of adhesions**

The adhesion of a tape edge to the anterior vaginal wall is called a “tethered tape”. Adhesion may happen during primary wound closure or due to secondary ingrowths [16]. Typically, tethered tapes are associated with recurrent stress urinary incontinence (SUI) during activities or changes in posture. Sagittal PFS-TV imaging identifies a tethered tape by its oblique orientation at rest, its abnormal closeness to the transducer, or its changes in shape while manipulating the vaginal probe [16]. During PFS-TV, two characteristic signs clearly identify a tethered tape: 1) the tape changes its shape during moving and pressing of the transvaginal probe; 2) the shape of the tape at rest resembles an “open horseshoe”, while non-tethered tapes are flat or look more like a “closed horseshoe” [16].

**POP repair**

In patients with optimal tape position and post-voidurine residual de novo cystocele can be the reason of the problem. PFS-TV helps to confirm the reason of residual and to plan optimal solution – anterior repair (not published data).

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**4D pelvic floor ultrasound with a transabdominal probe in patients with pelvic organ prolapse before the operation**

Using meshes to treat pelvic organ prolapse is still source of controversy. In our opinion meshes are big step forward and they should be used in selected cases. It is important to have as much as possible information to confirm the use of mesh in every individual patient. 4D pelvic floor ultrasound is useful to find patients at higher risk of recurrence if mesh is not used. TUI is useful to detect total puborectalis avulsion (one or both sides). It was showed that using mesh reduces significantly the recurrence rate after pelvic organ prolapse operation in these patients in comparison with repair performed only with native tissue [17].

**Summary**

PFS-TV is useful to:

1) detect focal lesion in and near the urethra and bladder,
2) detect patients with low mobile urethra, who are at higher risk for failure,
3) individually plan suburethral tape implantation,
4) control the suburethral tape location,
5) plan management in patients with post-void residual during first few days after tape implantation,
6) plan optimal management of the patients after unsuccessful operative treatment and with complications.

We suggest to perform PFS-TV day after the suburethral tape and mesh implantation, when we usually remember many details of the operation. In our opinion it can be useful to improve the operative technique. PFS-TV is helpful to check if the tape implantation was performed correctly and to detect individual surgeons differences, which may have the influence of the final result. In our opinion PFS-TV performed day after the procedure is helpful to standardize the operative technique (unpublished data). It is important because specialists generally agree that truly skilled surgeons can give really optimal results of operative treatment [18].

4D pelvic floor ultrasound is useful to find the optimal patient for mesh implantation in women with POP.

References


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