Ultrasound in Urogynecology: 2D and 3D Imaging in Diagnosis of Pelvic Floor Disorders

W27, 30 August 2011 09:00 - 12:00

Start	End	Topic	Speakers
09:00	09:05	Introduction	• Heinz Koelbl
09:05	09:30	Basics in pelvic floor ultrasound: terminology, normal anatomy in 2D, basics of 3D ultrasound	• Stefan Albrich • Gert Naumann
09:30	09:50	Anterior compartment: urethra, bladder, cystoceles	• Rainer Lange
09:50	10:10	Middle-Posterior compartment: rectum, rectoceles, intussusceptions. Anal sphincter	• Stefan Albrich
10:10	10:30	Levator ani muscle and postpartum changes. Implants: Slings, Meshes and Bulking Agents	• Rosa Maria Laterza
10:30	11:00	Break	None
11:00	11:25	Interesting cases, pictures, troubleshooting	All
11:25	11:35	Discussion	All
11:35	12:00	Hand-on training and imaging processing with software	All

Aims of course/workshop

This workshop aims to provide the principles of the ultrasound application in urogynecology in order to complete the clinical assessment and to improve diagnostic skills into routine urogynecological practice. The course is intended to give clinicians ideas about the standard requirements for basic 2D-3D pelvic floor ultrasound: after attending this workshop the participants should be able to perform a transvaginal and perineal pelvic floor ultrasound, obtaining basic measurements. The course will be delivered in a lecture format with a concluding panel discussion, giving delegates the opportunity to share practice with hands-on training and image processing software.

Educational Objectives

- To understand the indications for pelvic floor ultrasound in urogynecology
- To learn about the equipment and the examination technique
- To obtain a standard acquisition screen of 2D and 3D pelvic floor ultrasound
- To obtain basic measurements of 2D and 3D images
- To recognize normal and abnormal anatomy in the context of urogynecological diseases (pelvic organ prolapse, urinary and fecal incontinence, defecation disorders)
- To understand the functional anatomy of levator ani muscle, the morphological postpartum changes and the levator avulsions
- To visualize slings, meshes and implants and to recognize them in success and failure

Basics of pelvic floor ultrasound: terminology, normal anatomy in 2D, basics of 3D ultrasound

S. Albrich, G. Naumann

In an aging society urogynecologic problems gain an increasing attention. In recent years ultrasound has become an indispensable diagnostic tool in urogynecology. Its broad availability, cost-effectiveness, painless, fast and radiation-free performance are only a few advantages compared to x-ray and MRI-technology.

Participants will be introduced to basics of urogynecological ultrasound according to the published guidelines of the German, Austrian and Swiss urogynecological recommendations. We will acquaint the participants with the necessary information about equipment, setting and examination techniques (position of the patient, bladder and rectum filling, handling of different probes (Fig.1), image settings, major planes and standard ultrasound orientation); indication for pelvic floor ultrasound in urogynecology clinical practice were also be discussed.

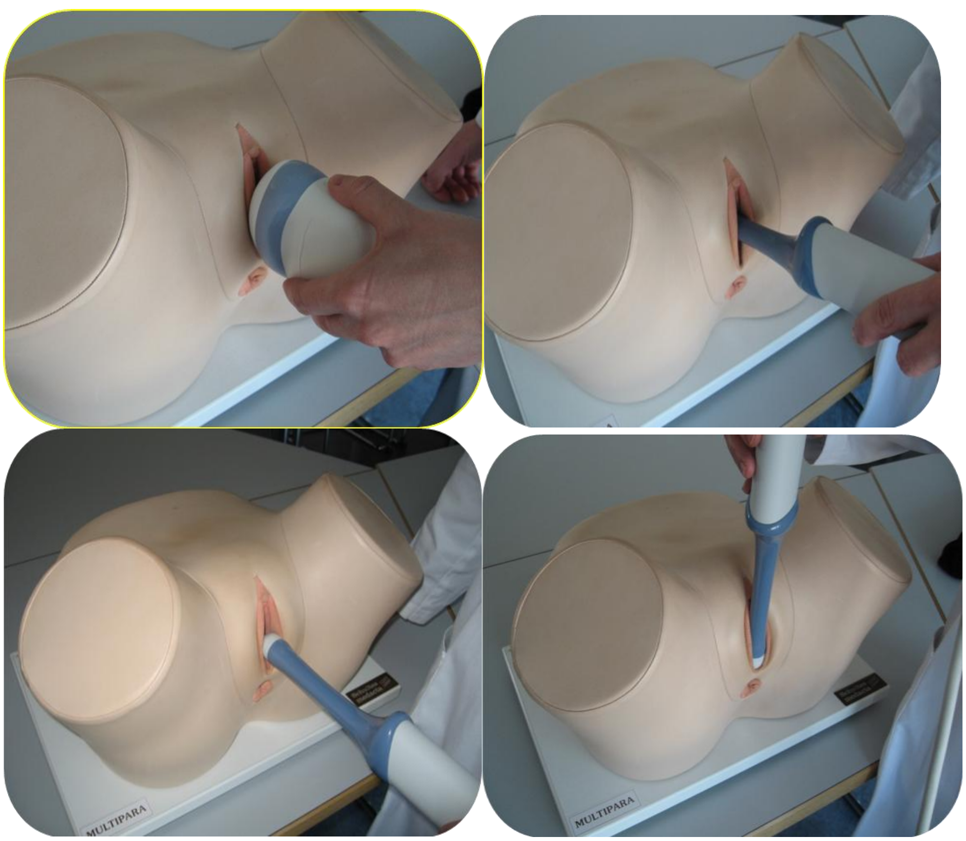

Fig.1. Perineal (top left), vaginal (top right), introital (below left and right)

Main structures like the urethra, bladder neck, bladder, uterus, anterior and posterior vaginal wall and the anal canal complex can be identified by 2D ultrasonography (Fig.2). In addition dynamic movements of organs can be observed and documented real-time during straining and pelvic floor muscle contraction.

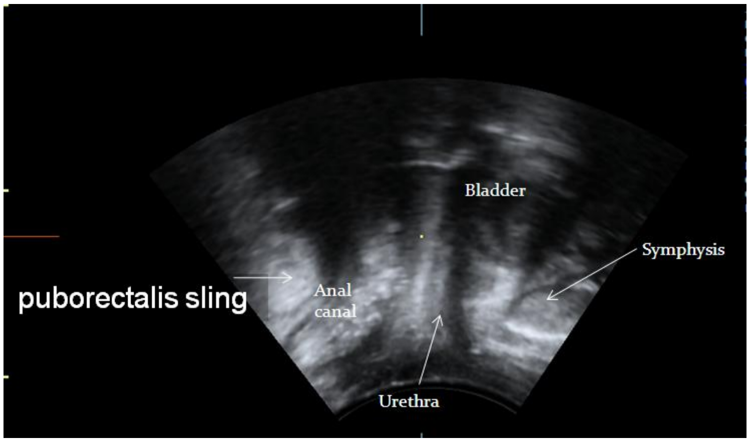

Fig.2. Mid sagittal plane

Due to recent advances in 3D ultrasound technology, new planes have become accessible for assessment of the pelvic floor. The acquisition of the axial plane enable us to identify the shape of the puborectal sling as part of the levator ani muscle, the biometry of the genital hiatus and structural defects of the levator insertion at rest and during Valsalva.

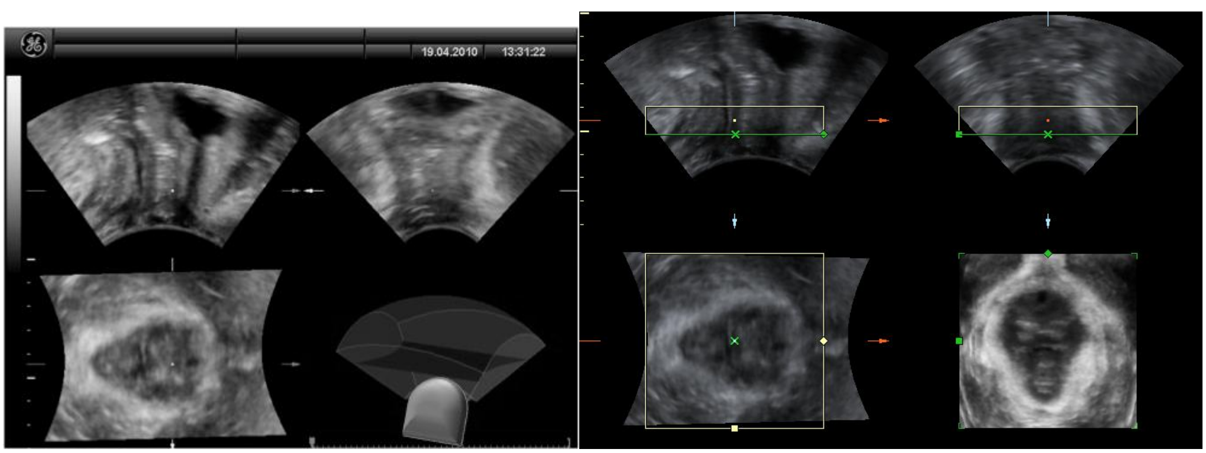

Fig. 3. Levator ani muscle assessed with 3D ultrasound

Anterior compartment: urethra, bladder, cystoceles

Dr. R. Lange

The mobility of the bladder neck is one of the most important factors concerning the choice of the surgical procedure in the treatment of urinary stress incontinence. Pelvic floor sonography is actually considered the best tool to evaluate the mobility of the urethra and the bladder neck. The landmark is represented by the horizontal line through the lower edge of the symphysis. Hypermobility of the bladder neck is easy demonstrated in pelvic floor sonography, with good correlation with radiological methods and high reproducibility. In consideration that the most prominent risk factor for failure of mid-urethral sling seems to be hypomobility, ultrasound represents an essential tool during preoperative evaluation, in conjunction with clinical findings and urodynamic assesesement.

Cases of tethered vaginal syndrome (urethra does not show any movement during straining) can also easily be detected with ultrasound. After an unsuccessful colposuspension, perineal sonography can help to understand weather a transobturator procedure might be successful or if the urethra is too much elevated that only a classic retropubic tape will give enough support to obtain continence.

Funneling of the urethra is a sign of significant failure of the closure mechanism: marked funneling has been shown to be associated with poor urethral closure pressures. Perineal ultrasound allowed the quantification of depth and diameter of bladder neck dilatation in incontinent women. The persistence of urethral funneling after an incontinence operation is associated with a failure rate.

The use of vaginal ultrasound probe seems to be the best method to evaluate residual urine and bladder wall thickness, the latter sign of detrusor overactivity. Another sign of overactive bladder is the shape of the bladder: while it is normally amorphous concerning the pressure of the surrounding organs, in cases of elevated intravesical pressure, already with small volumes, it is round shaped.

The measurement of urethra-vesical angles was dropped long ago in radiological diagnostics of incontinence. With the pelvic floor sonography there was a revival of these parameters, especially for reasearch purposes.

Diverticulas and paraurethral cysts can be easily detected with pelvic floor sonography. In particular the ultrasound assessment is necessary to differentiate a clinical cystocele from an urethral diverticulum (simple or complex), a Gartner duct cyst or a suburethral tumor.

In diagnosis of prolapse the distinction between a central and lateral defect (distension cystocele /traction cystocele) can be shown in routine pelvic floor sonography. While in central defects the bladder base is the lowest part during straining and the bladder neck stays in the normal position, in lateral defect the bladder neck remains the deepest part of the bladder during Valsalva maneuver.

Middle-Posterior compartment: rectum, rectoceles, intussusceptions. Anal sphincter

S. Albrich

In addition to the anterior compartment, changes of the middle and posterior compartment can be identified by pelvic floor ultrasound. In contrast to the anterior compartment the vaginal apex and the dorsal vaginal wall are less easy to describe on ultrasound, due to some interfering factors like distance to ultrasound probe or stool in the rectal ampulla.

Descending organs can be visualized by ultrasound, although a prolapse beyond the introitus needs some experience with probe placement on the perineum/ prolapse. A descending vaginal vault or uterus can be demonstrated at rest and on Valsalva manoeuver.

The identification of the posterior vaginal wall allows the distinction between a descending rectocele and enterocele (Fig.1).

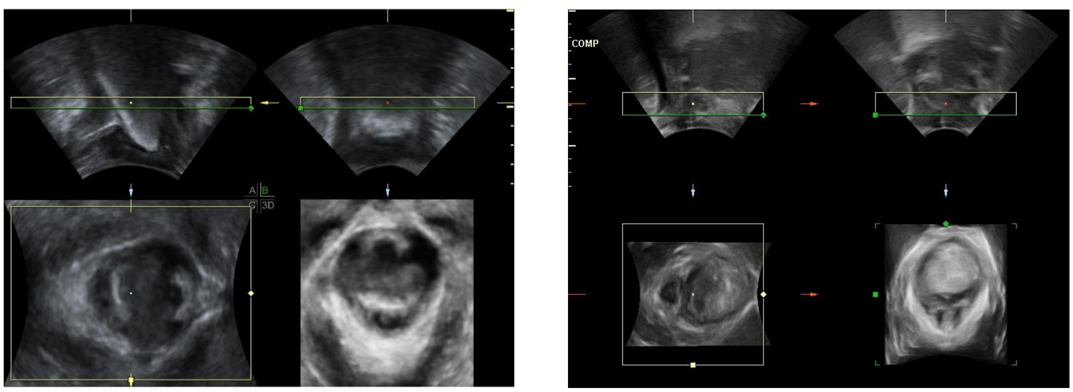

Fig.1. Rectocele (left) and Enterocele (right)

Even an intussusception as an invagination of intestinal structures into the rectum and anal canal can be detected.

The complex structure of the anal canal with the hyperechoic external anal sphincter, the hypoechoic internal anal sphincter and the hyperechoic mucosa and submucosa can be evaluated on the midsagittal and axial plane by 2D and 3D ultrasound (Fig.2).

Fig.2. Anal canal

Levator ani trauma and postpartum changes

R.M. Laterza

The method of obtaining hiatal dimensions was described by Dietz et al (1): with translabial acquisition, the plane of minimal hiatal dimensions is identified in the midsagittal plane, evident as the minimal distance between the hyperechogenic posterior aspect of the pubic symphysis and the hyperechogenic anterior border of the levator ani muscle, just posterior to the anorectum. When a satisfactory 2D ultrasound image was achieved, the 3D volume is obtained automatically by the 3D system: the pubococcigeus-puborectalis mucle (as part of levator ani muscle (LAM)) can be visulized as a highly echogenic structure, that delimits the hiatus genitalis. The biometry of levator hiatus can be evaluated measuring the midsagittal (hAP) and coronal (hLL) diameter of levator hiatus, the hiatal area (hA) and hiatal circumference (hC) (Fig.1).

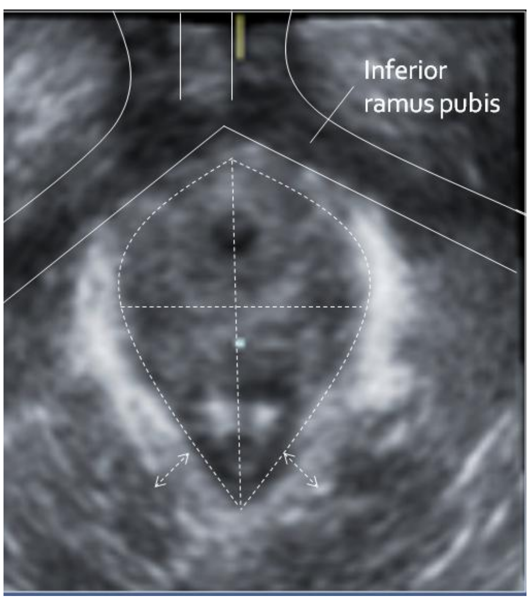

Fig.1.Biometry of levator hiatus

An injury of LAM is diagnosed when a break in the normal texture of the pubocoggygeal-puborectalis muscle (a u.s. hypo/anechogenic lesion interrupting the hyperechogenic course of muscle fibres) is recognizable. Tomographic multislice ultrasound imaging (TUI) is an essential tool to assess LAM integrity: this allows to obtain consecutive slices above and below the plane of minimal hiatal dimension (Fig.2). Complete avulsion is diagnosed if all three central slices (slice at plane of minimal hiatal dimension plus the two above) are abnormal, and partial avulsion when any three to eight slices were abnormal (2). The use of rendered volume and the measurement of the levator urethra-gap are additional instruments to assess doubtful cases of LAM trauma.

The risk of LAM trauma after vaginal delivery evaluated in nulliparous women is reported in the literature at between 18% and 36% by ultrasound (3-5) and between 18% and 48% by MRI (6-8).

Delivery is the most stressful and dangerous event that the pelvic diaphragm is submitted to during a woman´s life. The area of the levator hiatus, which varies widely in size from 6 cm^2 to 35 cm^2 during the Valsalva maneuver (1), needs a distension of between 25% and 245% to allow the passage of the fetal head. DeLancey's group demonstrated that the medial part of the pubococcygeal muscle is submitted to a stretch equal to a factor of 3.2 during crowning of the fetal head (9).

Dietz *et al.*(10) have shown, through the use of ultrasound, that women with levator defects may be around two times as likely to develop pelvic organ prolapse later in life. The association of LAM avulsion with prolapse of the anterior and central compartment has been confirmed by magnetic resonance imaging (MRI) too(10,11). On the other hand, the etiological role of LAM integrity in bladder dysfunction is still not completely clear. A weakly significant association between levator avulsion and worsening or de novo urinary incontinence has been reported 3 months postpartum, through the use of ultrasound (3) but recent evidence questions this link (13,14). As regards anorectal function, Heilbrun *et al*.(6) have shown a weak trend towards more fecal incontinence in women with LAM avulsion and anal sphincter tears, but the interpretation of these results must take into account that this is rather select group, with a special set of risk factors.

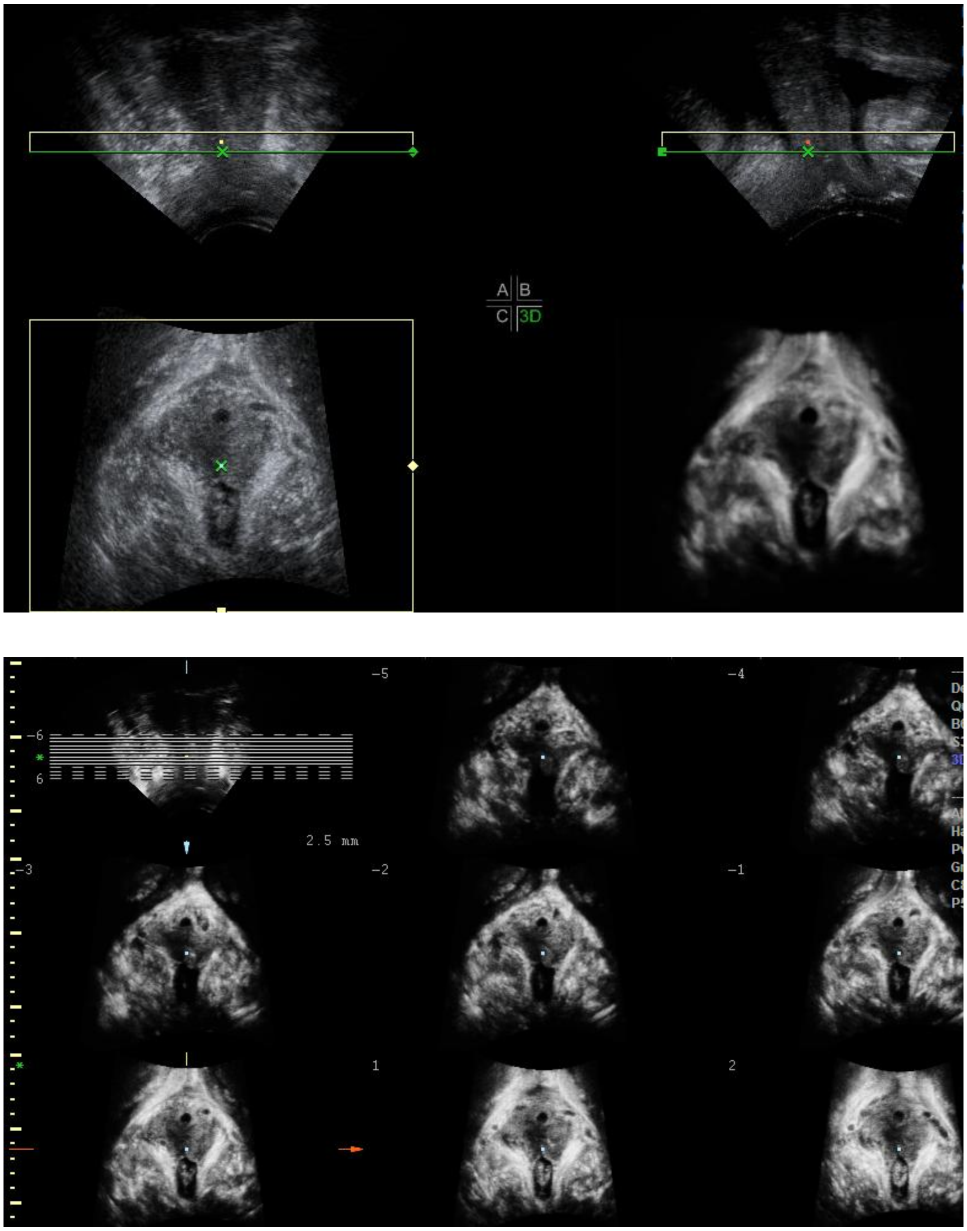

Figure 3. Levator ani defect early postpartum in a patient after spontaneous vaginal delivery. Multiplanar mode (above) and TUI (below).

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Implants: Sling, Meshes and Bulking Agents

R.M. Laterza

Pre- and postoperative ultrasound assessments are useful to support eligible surgical urogynecological procedures. Preoperatively, the measurement of urethra length helps to find the correct position where the mid-urethral sling has to be located, leading intraoperatively to an adaptation of the vaginal incision. This allows to avoid improper tape insertion, (i.g. in proximal position of bladder neck area).

Transobturator and trans-Retzius implants show different ultrasound signs (Fig.1) (1) and this makes possible to exactly identify the sling position and mobility. In case of postoperative complications of suburethral slings such as voiding dysfunction or de novo symptoms of urgency, the ultrasound imaging is useful to find strategies to overcome these problems. Sonography helps the surgeon to make a decision to remove or cut the tape in case of improper position or dislodgement.

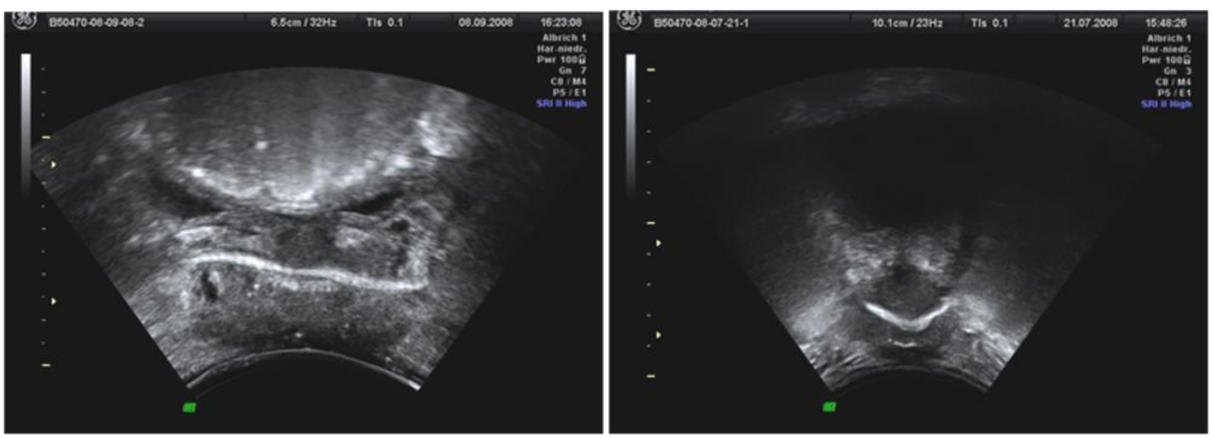

Fig1. Transobturator (left) and retropubic sling (right)

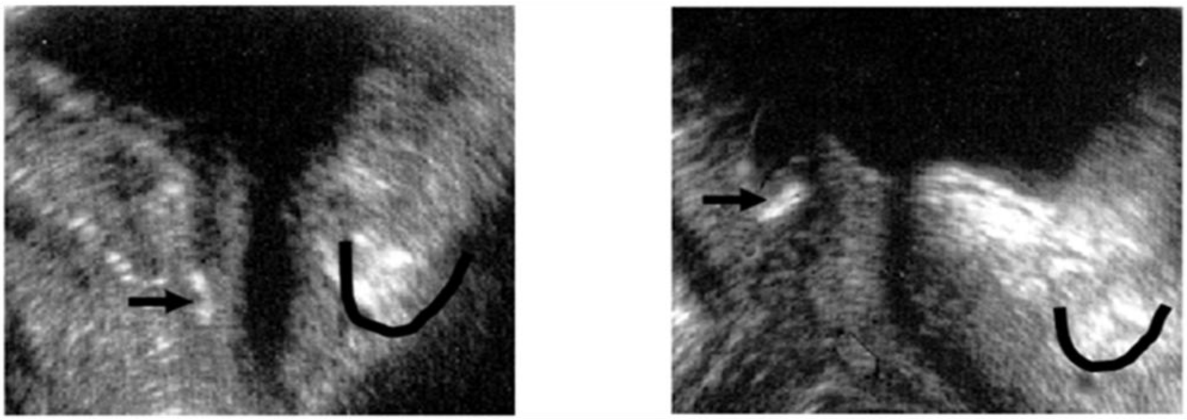

Fig.2. Correct (left) and wrong (right) position of midurethral sling.

2D ultrasound permits the visualization of the injectables used in anti-incontinence surgery (Fig.3): they appear as a hyperechoic donut shape surrounding the urethra (2). The correct application of these bulking substances is in the midurethral region; sometimes the material turns out in unexpected locations, such as underneath the bladder neck, protruding into the bladder itself or in the space of Retzius. An excess of this material in bladder neck region could lead the risk of de novo Urgency.

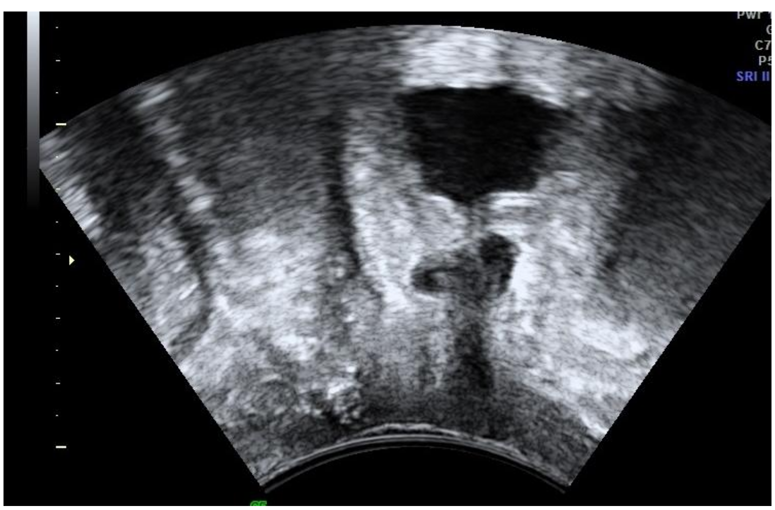

Fig.3 Periurethral injection

Polypropilene meshes are highly echogenic and their visibility is limited only by persistent prolapse and distance from the transducer. Complex pelvic floor reconstruction with use of synthetic mesh could lead to postoperative complications (voiding problems, obstruction, de novo urgency or de novo stress urinary incontinence, dyspareunia and groin pain). Pelvic floor ultrasound permits to identify the implants (Fig.4) and could help to better understand the causes of these problems. Extent and mobility of the mesh could be measured; shrinkage, contraction or retraction of a mesh are easily identifiable with ultrasound. In case of support failure possible dislodgment of anchoring arms could also be seen (3,4).

Fig.4. Anterior mesh

Ultrasound imaging is indispensable part of complete preoperative workup; pre- and post-operative data can be compared using storing volume data-set. This makes the ultrasound a fundamental instrument of the surgical development.

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