Pelvic Floor Ultrasound Imaging

Workshop IUGA 2015 Nice

Faculty:

Prof HP Dietz (Sydney)
A/Prof KL Shek (Sydney)
Dr R Guzman Rojas (Santiago de Chile)
Dr Kamil Svabik (Prague)
The use of translabial ultrasound in women with pelvic floor disorders

Imaging plays a growing role in the investigation of pelvic floor disorders, especially translabial or perineal ultrasound. With this method most structures of interest in pelvic floor disorders can be observed in the near field, at high frequencies, and with sufficient clarity due to excellent tissue discrimination between urethra, bladder, vagina, anorectum and levator muscle. It is performed by placing a curved array 2D or 3D transducer on the perineum (Figure 1).

Anterior Compartment

The original indication for translabial or transperineal ultrasound was (and still is) the determination of bladder neck mobility (Figure 2). This is done against the reference of either the inferior margin of the symphysis, or against the central axis of the same. The former is more convenient, the latter may be marginally more repeatable. However, modern systems allow much more than determination of bladder neck mobility. Mobility of the entire urethra can be determined, which has shown that it is the mid-urethra, rather than the bladder neck, that matters most for stress continence, and that pregnancy, rather than childbirth, influences this parameter.

Translabial ultrasound is also helpful in determining residual urine, detrusor wall thickness, urethral integrity, the retrovesical angle, urethral rotation and cystocele descent. It distinguishes between two distinct forms of cystocele (Green Type 2 and 3), which have very different implications for function. Cystoceles with an open retrovesical angle and funnelling are the commonest anatomical correlate of stress urinary incontinence (Green 2), and cystoceles with intact retrovesical angle (Green 3) are usually found in women with symptoms of prolapse and voiding dysfunction. Even more interesting, one is associated with an intact pelvic floor muscle, the other with levator avulsion. Translabial ultrasound graphically shows urethral kinking in women.
with prolapse, potentially explaining voiding dysfunction. It is at least equivalent to other imaging methods in visualising urethral diverticula (Figure 3), Gartner duct cysts and suburethral slings (see below). Ultrasound is the only method able to image modern mesh slings and implants, and may predict who actually needs such implants.

Figure 2: Bladder neck descent (BND) measured on translabial ultrasound (rest at left, on Valsalva on right). S = symphysis pubis, B = bladder, U = urethra. BND = 3.9cm.

Figure 3: Typical large posterior urethral diverticulum as imaged in the midsagittal plane (top left), coronal plane (top right), axial plane (bottom left) and in a rendered axial plane volume (bottom right), delineated by arrows.
The Posterior Compartment

Pelvic floor ultrasound is particularly useful in the posterior compartment, and we have in no way realised its potential benefits for clinical practice. We see descent of the posterior vaginal wall and diagnose a ‘rectocele’, usually quite unaware that at least five different anatomically distinct conditions can cause this appearance.

A Stage II rectocele observed on clinical examination could be due to a true rectocele (Figure 4), i.e., a defect of the rectovaginal septum (most common, and associated with symptoms of prolapse, incomplete bowel emptying and straining at stool), due to an abnormally distensible, intact rectovaginal septum (common and associated only with prolapse symptoms), a combined recto-enterocele (less common), an isolated enterocele (uncommon), or just a deficient perineum giving the impression of a ‘bulge’. Occasionally a ‘rectocele’ turns out to be a rectal intussusception, an early stage of rectal prolapse, where the wall of the rectal ampulla is inverted and enters the anal canal on Valsalva. In addition, this form of imaging can provide information on the anal canal and sphincter at no additional cost or inconvenience (Figures 5 and 6).

Figure 4: Rectocele imaged by defecation proctography (left) and translabial 2D ultrasound (right).

A core aspect of this new technology for sphincter imaging is standardisation of postnatal assessment, and the key is establishing the extent of the external anal sphincter (EAS) dorsal to the anal canal, where it is very rarely damaged. Figure 4 shows identification of the cranial termination of the EAS and of the caudal termination of the internal anal sphincter (IAS). Once this is achieved, the part of the anal canal between these planes is represented by 6 tomographic slices, with the interslice interval determined individually. The result is complete coverage of the EAS from its most cranial aspects to the subcutaneous EAS, simplifying assessment. Following Abdul Sultan’s 2/3 rule we diagnose a ‘major residual defect’ if at least 4 out of 6 slices show an EAS defect of at least 30 degrees, a method that has been validated in large data sets.
Translabial imaging of the anal sphincters has major advantages over the established ‘gold standard’ technology of endo-anal ultrasound: it is much better tolerated, the necessary equipment is near-ubiquitous, and it can be done in the context of a full pelvic floor assessment, adding at most 5 minutes to such an examination. In the postpartum setting this allows a comprehensive assessment for maternal birth trauma and opens up opportunities for practice improvement. It now seems feasible to make maternal birth trauma a key performance indicator for maternity services, allowing for clinical audit and preventative intervention studies. As it is now obvious that traumatic childbirth is the main etiological factor for future pelvic organ prolapse and anal incontinence, sonographic diagnosis of anal sphincter and levator trauma (see below) has the potential for major beneficial impacts on future pelvic floor health.
Imaging of slings and meshes

Since the late 1990s synthetic suburethral slings have become very popular. Ultrasound can confirm the presence of such a sling, distinguish between transobturator and transretzius implants, especially when examining the axial plane (see Figure 7), and allow an educated guess regarding the type of implant. As these meshes are highly echogenic, ultrasound is superior to MR in identifying implants and has helped elucidate their mode of action. It is also very helpful when assessing women with complications of suburethral slings such as voiding dysfunction and de novo symptoms of urgency, helping the surgeon to decide whether to cut a sling.

Figure 7: A transobturator tape (arrows) as seen in the midsagittal plane (left) and in the axial plane (right).

There is a worldwide trend towards the use of permanent vaginal wall meshes, especially for recurrent prolapse, and complications such as support failure, mesh erosion and chronic pain are not that uncommon. Polypropylene meshes are highly echogenic (see Figure 8), and their visibility is limited only by persistent prolapse and distance from the transducer.

3D translabial ultrasound has demonstrated that the implanted mesh often is nowhere near as wide as it is supposed to be. Surgical technique seems to play a role here as fixation of mesh to underlying tissues results in a flatter, more even appearance. The position, extent and mobility of vaginal wall mesh can be determined, helping with the assessment of individual technique, and ultrasound may uncover complications such as dislodgment of anchoring arms. Meshes are only as supportive as their anchoring allows them to be. Translabial 4D ultrasound is useful in determining functional outcome and location of implants, and helps in optimizing both implant design and surgical technique. And finally, the identification of levator avulsion and hiatal ballooning provides objective criteria for the selection of patients at high risk of prolapse recurrence, allowing more rational use of prolapse mesh implants.
Pelvic Floor Trauma

Major delivery-related trauma of the puborectalis muscle (‘avulsion’, see Figure 9) is a major factor in the aetiology of female pelvic organ prolapse. It occurs in 10-30% of first vaginal deliveries, more commonly after Forceps and in older primiparae, and is strongly associated with cystocele and uterine prolapse, and with recurrence after prolapse surgery. Avulsion reduces pelvic floor muscle function by about one third and has a marked effect on hiatal biometry and distensibility. In the past it was generally assumed that abnormal muscle function was due to neuropathy, but damage to the innervation of the levator ani muscle is likely to play a much smaller role compared to direct trauma.

These defects are palpable, but palpation requires significant teaching and is clearly less repeatable than identification by ultrasound. Identification of an avulsion injury is aided by measurement of the ‘levator-urethra gap’, the distance from the center of the urethral lumen to the most medial aspect of the puborectalis muscle, and tomographic US is particularly useful (see Figure 10). For the latter we use the plane
of minimal hiatal dimensions as the reference plane. The minimal criterion for the diagnosis of a full avulsion is a clearly abnormal muscle insertion in the reference slice plus the two slices immediately cranial to that slice, at an interslice interval of 2.5 mm.

Avulsion injury does not seem to be associated with stress urinary incontinence and urodynamic stress incontinence, nor does it seem to matter much for faecal incontinence. Despite this there seems to be a high prevalence of levator defects in women with anal sphincter defects, which is not really surprising given the overlap in risk factors. Bilateral defects are more difficult to detect since there is no normal side to compare with, but they have a particularly severe impact on pelvic floor function and organ support.

Avulsion is a major risk factor for prolapse recurrence after surgical reconstruction, and this is also likely to be true for irreversible overdistension of the levator hiatus which affects even more women than outright levator muscle tears. Both factors can help select patients for mesh use.

Figure 10: Translabial tomographic imaging of a unilateral avulsion, with all panels abnormal on the right (*), i.e., the patient’s left hand side.