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PICTORIAL REVIEW

Total pelvic floor ultrasound for pelvic floor defaecatory dysfunction: a pictorial review

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ABSTRACT

Total pelvic floor ultrasound is used for the dynamic assessment of pelvic floor dysfunction and allows multicompartamental anatomical and functional assessment. Pelvic floor dysfunction includes defaecatory, urinary and sexual dysfunction, pelvic organ prolapse and pain. It is common, increasingly recognized and associated with increasing age and multiparity. Other options for assessment include defaecation proctography and defaecation MRI. Total pelvic floor ultrasound is a cheap, safe, imaging tool, which may be performed as a first-line investigation in outpatients. It allows dynamic assessment of the entire pelvic floor, essential for treatment planning for females who often have multiple diagnoses where treatment should address all aspects of dysfunction to yield optimal results. Transvaginal scanning using a rotating single crystal probe provides sagittal views of bladder neck support anteriorly. Posterior transvaginal ultrasound may reveal rectocele, enterocele or intussusception whilst bearing down. The vaginal probe is also used to acquire a 360° cross-sectional image to allow anatomical visualization of the pelvic floor and provides information regarding levator plate integrity and pelvic organ alignment. Dynamic transperineal ultrasound using a conventional curved array probe provides a global view of the anterior, middle and posterior compartments and may show cystocele, enterocele, sigmoidocele or rectocele. This pictorial review provides an atlas of normal and pathological images required for global pelvic floor assessment in females presenting with defaecatory dysfunction. Total pelvic floor ultrasound may be used with complementary endoanal ultrasound to assess the sphincter complex, but this is beyond the scope of this review.

INDICATIONS

Total pelvic floor ultrasound is used for the assessment of pelvic floor dysfunction in females. Other options include defaecation proctography and MRI. Although these allow the assessment of defaecatory dynamics, ultrasound has the advantages of providing a simple, cheap, portable assessment tool which avoids radiation and is well tolerated.^{1,2} Total pelvic floor ultrasound is currently underutilized but may be a useful first-line assessment tool for pelvic floor defaecatory dysfunction.^{2,3}

It allows functional and anatomical evaluation of the anterior, middle and posterior pelvic floor compartments. Multicompartamental assessment is paramount for effective treatment planning as multiple pathologies often co-exist and therapies which do not address all components may result in suboptimal outcomes. Total pelvic floor ultrasound may be used in conjunction with endoanal ultrasound for sphincter complex visualization, though this is not described here.

TECHNIQUE

Transvaginal and transperineal scans are both routinely performed for all patients. The patient lies supine with the

legs drawn up and flexed, the feet together and legs apart. The dorsal lithotomy position with the legs in stirrups may also be adopted. Each probe is covered with ultrasound coupling gel, a latex sheath and further coupling gel, ensuring that there are no air bubbles. The probes are decontaminated between each patient, including the use of an antiseptic agent. Some units advocate the use of an enema and recommend urination in order to empty the rectum and bladder and allow the patient to bear down freely.⁴ However, the presence of stool in the rectum may aid visualization of a rectocele.³ The use of small bowel contrast (50-ml Gastrografin®; Bayer Healthcare, Newbury, UK, diluted 1:1 with water ingested 1 h prior to examination) and vaginal and rectal filling with ultrasound gel have also been described, although this is not our routine practice.⁵

A transvaginal ultrasound scan is performed using a rotating single crystal probe. The vaginal probe must be kept in a neutral position to avoid excessive pressure on surrounding structures and distortion of anatomy. Initially, the probe is held still (facing anteriorly) to obtain two-dimensional anterior views during squeezing, relaxing,

Figure 1. The normal anatomy during anterior transvaginal scanning. The probe sits in the vagina facing anteriorly to reveal the bladder (B) (dark and large region indicating that it is full of urine), the high-reflective bladder neck (BN) which appears like a white birds' beak, rhabdosphincter (a dark oval area outlined by white dotted line), urethra (U) and the pubic symphysis (PS) in the midsagittal plane.

bearing down and coughing. The probe is kept in the same position to obtain a 360° cross-sectional image at rest. Next, the probe is rotated within the vagina to face posteriorly, and the patient is asked to squeeze, relax, bear down and cough. A single-element multifrequency transducer with a built-in two-dimensional mover may also be used to acquire cross-sectional images.

Figure 2. Poor bladder neck support (54-year-old female with stress urinary incontinence) (the ruler along the bottom of each image shows centimetre intervals). The bladder neck (BN) is 3 cm above the pubic symphysis (PS) at rest. During coughing, the BN descends to less than a centimetre above the PS indicating that BN descent is >2 cm. The rhabdosphincter is outlined with a white dotted line, the urethra is seen as the dark thin line marked (U) and the full bladder is marked with a (B).

Figure 3. The presence of a transvaginal tape (TVT) (white arrow) in a 45-year-old female (parity 2) presenting with symptoms of an overactive bladder having had a TVT 2 years previously. The synthetic tape is white compared with the surrounding soft tissues. It is lying in the correct position, at the mid-urethra (U). The bladder (B) and pubic symphysis (PS) are marked. BN, bladder neck.

Transperineal ultrasound is performed using a conventional curved array probe with frequencies of 3–6 MHz and a field of view of at least 70°. The transducer is rested on the perineum to obtain dynamic

Figure 4. Normal posterior transvaginal appearances: the rectum (R), anal canal (A) and anorectal junction (ARJ) are visualized. The puborectalis (PR) appears a white bundle of fibres lying directly behind the rectum, and the perineal body (PB) is a white solid structure, which lies between the probe and the anal canal at the caudal aspect of the image. The internal anal sphincter (IAS) and longitudinal fibres are also marked.

Figure 5. Posterior vaginal scans showing intussusception in a 60-year-old female with previous obstetric trauma presenting with obstructive defaecation. There is infolding of the rectal wall (intussusception outlined) during coughing with associated reverberation echoes. The perineal body is marked (PB). Sometimes, less reverberation echoes are seen and the actual infolding is more obvious. If there is poor propulsion or a weak cough, it will not be possible to demonstrate intussusception even if present during defaecation.

midsagittal views whilst the patient is squeezing, relaxing, bearing down and then squeezing, relaxing and coughing. Undue pressure on the perineum must be avoided in order to allow pelvic organ descent and the full development of any prolapsing structures, whilst still

Figure 6. Posterior vaginal scanning shows a rectocoele in a 73-year-old multiparous female presenting with incomplete evacuation requiring vaginal digitation to aid emptying. The arrow shows the bulge of the rectal wall impinging upon the perineal body (PB). The presence of the vaginal probe splints the rectocoele such that it will not protrude any further anteriorly, and the rectocoele appears to be flattened. The puborectalis (PR), rectum (R), anorectal junction (ARJ) and anal canal (A) are also marked. The rectocoele is often only seen during bearing down or coughing, and simultaneous intussusception or infolding of the rectal wall may also be seen.

Figure 7. Posterior vaginal scanning demonstrating an enterocoele in a 59-year-old female with post-defaecatory soiling. During bearing down, the enterocoele enters the rectovaginal space and appears as a hyperechoic area between the probe and the rectum (R) such that the rectum is displaced posteriorly. It is not possible to delineate between a sigmoidocoele and enterocoele during ultrasound scanning. The anal canal (A), anorectal junction (ARJ), puborectalis (PR) and perineal body (PB) are also marked.

maintaining tissue contact.^{3,4} The pelvic tilt can be improved by drawing the heels close together and towards the buttocks.⁴

Transvaginal ultrasound

Anterior views

Normal anatomy Anterior transvaginal views (Figure 1) allow anatomical visualization of the bladder, muscle layers of the bladder (usually <5 mm), bladder neck, urethra, rhabdosphincter and

Figure 8. Normal superior endovaginal scan showing the base of bladder anteriorly and rectum posteriorly.

Figure 9. A normal endovaginal scan at the upper portion of the urethra. The fibres of the levator ani (LA) and puborectalis (PR) are now visible. The obturator internus (arcuate line insertion of the levators) is also marked.

pubic bone. The bladder neck is a highly reflective, hyperechoic funnel and the urethra is a hypoechoic funnel, which contrasts

Figure 10. Normal appearances of the endovaginal scan at the level of pubic symphysis (PS) (at 12 o'clock). The pubic arch, deep transverse perineii (deep TP) and puboanalis (PA) are visualized. The symmetry of the pubic arch indicates that the scan is aligned and has been performed correctly with the probe held in a neutral position. The symmetrical insertion of the muscle fibres of the pelvic floor into the pubic arch in both Figures 9 and 10 indicate that the levator plate is intact.

Figure 11. The most inferior portion of a normal endovaginal ultrasound scan shows the anal canal and bulbospongiosus (BS).

sharply with the surrounding periurethral tissue.⁶ The pubic symphysis is consistently seen (identification rate 100%) as a hypoechoic oval in front of the bladder reflecting the fibrocartilaginous disc which connects the bony structures of the pubic arch.⁷ During the Valsalva manoeuvre, the bladder neck should not descend >2 cm in relation to the pubic symphysis.⁶ Care must be taken for both the examiner and patient to remain still during lifting up, bearing down and coughing to allow accurate measurement.

Figure 12. It is useful to assess the symmetry of the cross-sectional images when assessing levator muscle integrity and also to look for the insertion of fibres of the levator ani into the pubic rami on either side. The alignment of the rectum, vagina and urethra is assessed by simply drawing tangential line from the pubic symphysis through these structures. This image shows a levator plate injury in a 43-year-old female presenting with straining, constipation and pelvic pain since giving birth (spontaneous vaginal delivery). There is loss of normal levator muscle integrity on the left (outlined) compared with the right where the levator anatomy is preserved. Consequently, there is a shift of the urethra (small circle) and rectum (large circle) to the left. The pubic arch is still symmetrical, which indicates that the asymmetry visualized is due to levator plate injury rather than rotation of the scan.

Figure 13. Endovaginal scan shows a tension-free vaginal tape obturator (TVTO) in place. The synthetic mesh is a white hyperechoic area, looping around the back of the urethra to form a hammock.

Pathology Though there is no definition of “normal”, bladder neck descent >2 cm, which indicates pelvic floor insufficiency (Figure 2). Bladder neck hypermobility may indicate urinary incontinence, and bladder wall thickness may represent detrusor instability.⁸

Ultrasound is useful for the visualization of synthetic mesh implants from previous surgeries, which is helpful for the evaluation of complications (synthetic mesh cannot be properly visualized using radiography, CT or MRI).^{4,8,9} Mesh is highly echogenic on ultrasound and appears “light” compared with urine, soft tissues and gas, allowing the assessment of position, migration and erosion.⁹ For example, anterior transvaginal scanning may show the position of a transvaginal tape in relation to the urethra (proximal, distal or bladder neck) during coughing (Figure 3). The presence of mesh in the urethral lumen or bladder may indicate mesh migration and

Figure 14. Normal sagittal transperineal scans: pubic symphysis (PS), bladder, vagina (V), uterus (U), anal canal (A), rectum (R), anorectal angle (ARA) and puborectalis (PR).

Figure 15. A rectocoele on sagittal transperineal ultrasound scanning during the Valsalva manoeuvre. The rectum is bulging anteriorly into the vagina. The oval denotes the perineal body (PB). The puborectalis (PR), anal canal (A), anorectal junction (ARJ) and rectum (R) are also marked, and a cystocoele is present.

erosion, although erosion itself does not appear to be associated with particular ultrasound findings.^{9,10}

Posterior views

Normal anatomy Posterior transvaginal ultrasound enables visualization of the following structures in the midline: rectum, anorectal junction and anal canal, posterior midline portion of the puborectalis sling muscle (a hypoechoic bundle of fibres lying behind the anorectal junction) and perineal body (a hypoechoic structure anterior to the anal canal) (Figure 4).

Pathology Posterior transvaginal scanning during the Valsalva manoeuvre may demonstrate infolding of the rectal wall, with or without subsequent reverberation echoes, which indicates the presence of intussusception (Figure 5). It is not known how to accurately grade the severity of intussusception based on ultrasound alone, and assessment with defaecatory imaging (proctography or MRI) can further delineate functional anatomy.

During the Valsalva manoeuvre, a rectocoele is seen as the protrusion of the anterior rectal wall with impingement onto the perineal body (Figure 6). The ultrasound probe will splint any rectocoele and therefore will underestimate the size of the rectocoele. An enterocoele may also be visualized between the rectum and the probe during the Valsalva manoeuvre (Figure 7).

Three-dimensional cross-sectional view

Normal anatomy The four anatomical levels demonstrated by transvaginal scanning are as follows. At the highest level, the rectum lies posteriorly and bladder neck sits anteriorly (Figure 8). As the scan moves caudally, the upper part of the urethra (anterior) and levator ani (lateral) are visualized (Figure 9). The pubic bone comes into sight at 12 o'clock and is attached to the levator ani, which runs laterally in continuity with the puborectalis sling muscle in the posterior portion (Figure 10). The levator ani is visible as a multilayer hyperechoic sling at this level.¹⁰ The most caudal portion of the scan reveals the superficial perineal muscles, the perineal body and lower anal canal (Figure 11). Alignment of the pelvic organs (bladder neck or urethra, vagina and rectum or anal canal) indicates that the levator plate is intact, and the arched symmetrical appearance pubic bone is a useful landmark to check that scan has been performed in a neutral position.

Figure 16. An enterocoele on transperineal scanning. An enterocoele descends from above the rectal ampulla to fill the rectovaginal space, whereas a rectocoele originates from the rectal ampulla and bulges across and over the perineal body (PB). The puborectalis (PR), anal canal (A), anorectal junction (ARJ) and rectum (R) are visualized.

Pathology A levator plate injury appears as a complete or partial loss of normal muscle, which may result in a malalignment of the pelvic floor organs (Figure 12). Cross-sectional images are also useful for assessment of synthetic mesh implants (Figure 13).

Transperineal ultrasound

Normal anatomy

Sagittal transperineal scanning allows simultaneous visualization of the anterior (pubic symphysis, urethra and bladder), middle (vagina, uterus and perineal body) and posterior (rectovaginal septum, rectum and anorectal junction) compartments in the midline (Figure 14). The anorectal angle is measured between the posterior wall of the rectum and the longitudinal axis of the anal canal and should open up during straining.¹

Pathology

Rectocoele A rectocoele appears as an out-pouching of the anterior rectal wall, into the vagina, which may be present at rest but become more evident during straining (Figure 15). The rectovaginal septum cannot be reliably identified and so its assessment is not considered clinically relevant. The depth of herniation into the vagina is the distance from the perineal body to the anterior extent of the rectocoele.¹ A rectocoele usually contains faecal material and associated bowel gas, resulting in specular echoes and reverberations, and the distension of the rectocoele on ultrasound may depend upon the presence of trapped stool.⁴

Enterocoele/sigmoidocoele An enterocoele or sigmoidocoele characteristically appear as a hyperechoic mass descending from above the rectal ampulla into the vagina or rectovaginal space on transperineal scanning (Figure 16). The small bowel may be visible owing to peristalsis, but it is not possible to distinguish between the two entities or demonstrate their functional implications during ultrasound, and defaecation proctography can be used for additional assessment. Enterocoele may be graded according to severity (Grade I, the most distal part descends into the upper third of the vagina; Grade II, the distal part descends into the middle third of the vagina; and Grade III, the distal part descends into the lower third of the vagina).¹ A peritoneocoele is defined as an enlarged rectovaginal space (>2 cm).

Cystocoele A cystocoele is described as prolapse of the bladder onto the vagina (Grade I), into the vagina (Grade II) or through the vagina (Grade III) according to the Green classification (Figure 17).¹¹

SUMMARY

Although total pelvic floor ultrasound cannot replace defaecatory imaging, there is increasing evidence that it provides a useful first-line assessment tool for pelvic floor dysfunction to complement current routine investigative practice.^{2,3} It may be used in outpatients to guide initial management and highlight those patients who would benefit from further investigation with defaecatory imaging.

Figure 17. A Grade 2 cystocoele is seen as the descent of the bladder into the vagina during coughing in a 56-year-old multiparous patient. The bladder neck is outlined (white bird beak shape) and the bladder (B), vagina (V), rectum (R) and puborectalis (PR) are also marked.

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