Doppler Studies of the Lower Urinary Tract

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Introduction

Ultrasound of the lower urinary tract poses problems for the sonographer. Clear views of the pelvis through the abdomen rely on the urine-filled bladder to act as an acoustic window and this is useful for delineating bladder tumours [2] and measuring post-void residuals [14]; however, by filling the bladder its structure is difficult to visualise. The retropubic position of the bladder neck and urethra make transvaginal [15], transrectal [17, 18] and transperineal ultrasound [11] the ideal methods of visualising the bladder and urethra. The transabdominal approach does not reliably image the bladder neck and urethra, particularly in the obese or in women suffering genuine stress incontinence. The transvaginal approach, when used to image urinary leakage into the proximal urethra, should be interpreted with caution, as compression of the urethra can occur [19]. The transrectal approach does not alter any urodynamic parameter, but there can be problems in visualising the bladder neck and urethra if a rectocele is present [18]. The transperineal approach has the advantage of direct contact with the distal end of the urethra, and the proximity of the probe ensures good images of the periurethral structures despite vaginal prolapse [9].

Bladder Wall Imaging

The bladder is best imaged transvaginally, not only because the higher ultrasound frequencies needed to image small structures have reduced tissue penetration, but urinary bladder volumes in excess of 50 ml reduce the bladder wall thickness [5]. This makes a transabdominal approach unrewarding. Blood flow measurements within the bladder wall are reduced at volumes greater than 30 ml, thus making it extremely important to ensure that the bladder is emptied. Most women (90%) empty their bladders to less than 10 ml [4], so that catheterisation is not usually necessary. The measurement of bladder wall thickness is performed with the woman supine. The vaginal probe is held at the introitus, and the urethra and bladder are visualised in the midline (Fig. 1). The symphysis pubis has a hyperechoic inferior edge and casts a hypoechoic shadow [16]. The urethra is identified as a hypoechoic area inferior to the symphysis pubis. Bladder wall thickness is measured in a parasagittal plane; as the urethral hypoechoic area
Fig. 1. Transvaginal view of the bladder, urethra and symphysis pubis

Fig. 2. Parasagittal transvaginal view through the bladder while taking bladder wall thickness measurements

produces a shadow over the dome of the bladder, measurements are taken from the dome of the bladder, anterior bladder wall and trigone (Fig. 2). Care must be taken to measure the thickest part of the bladder wall imaged and measurements must be made perpendicular to the epithelial surface of the bladder.