Examining the use of 3D Endovaginal ultrasound (EVUS) to image the pelvic floor in patients with suspicion of urethral diverticulum or peri-urethral masses.

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Learning objectives

- The use of high frequency 3D endovaginal ultrasound (EVUS) is poorly documented in the literature. Hence, the objective of this study is to emphasise the ability of 3D EVUS to image the pelvic floor in patients with suspicion of
- urethral diverticulum or periurethral masses.

Background

Female urethral diverticulum manifests clinically as a swelling around urethra, which is also a presenting symptom of periurethral masses, including those of a malignant aetiology. Distinguishing between the two is often clinically difficult but is imperative, not only in the first instance to decide whether a gynaecology or urology referral is indicated, but also in deciding further patient management. Hence, there is an increasing requirement for radiologists to not only be familiar with its imaging features but also with the imaging techniques that are optimal for its evaluation.

Magnetic resonance imaging can provide high diagnostic accuracy, although does come with disadvantages such as lengthy scan time, increased cost and also a greater risk of image degradation due to motion artefact. Currently there is emerging technology using high- frequency 3D EVUS to assess and evaluate the structures of the pelvic floor and related pathology [1].

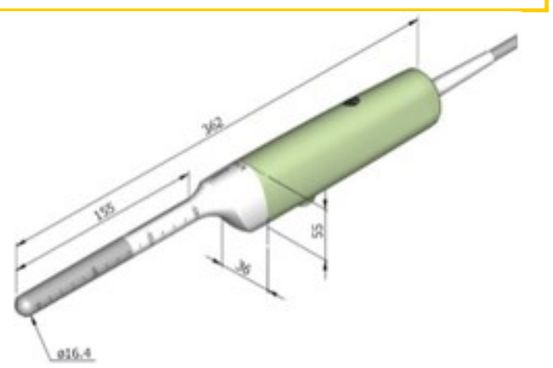


Figure 1 : The X14L4 is a high resolution transducer ideal for imaging the anterior and posterior compartments of the pelvic floor. The 360 degree transducer with built in 3D imaging can be utilised in anorectal, endovaginal and transrectal scanning. Its long linear array is ideal for dynamic endovaginal imaging of the urethra.

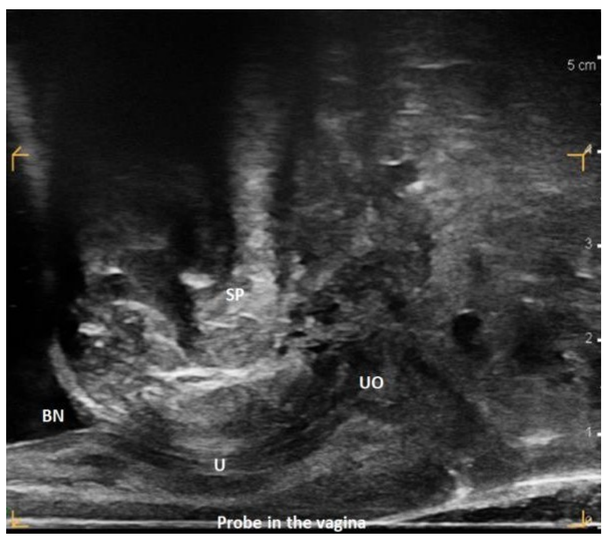


Figure 2:Normal anatomy of the urethra. 2D endovaginal US (EVUS) of the urethra in a mid sagittal plane. BN- bladder neck. U- urethra,

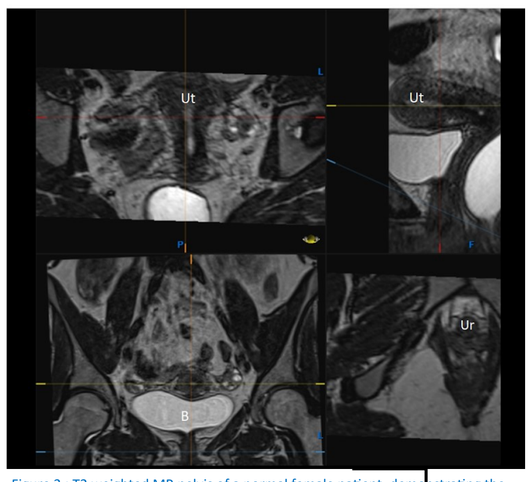


Figure 3 : T2 weighted MR pelvis of a normal female patient, demonstrating the multiplanar reformatting capabilities of the MR 'SPACE' sequence. Ut = Uterus, Ur= Urethra, B= Bladder

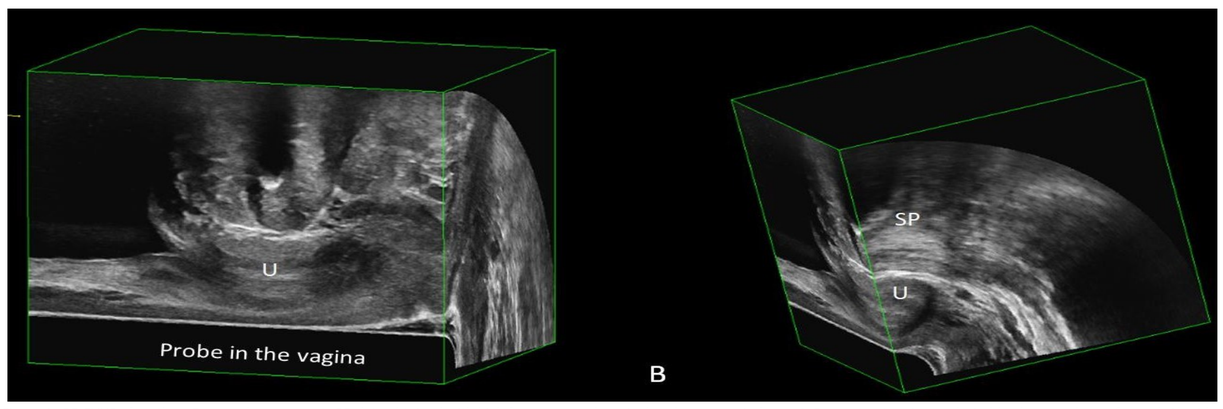


Figure 4 : 3D EVUS of urethra. Green cube represents 3D data obtained with high frequency endovaginal probe as seen in figure 1. Reconstruction in any desirable plane can be performed. A) midsagittal plane; B) midsagittal and axial plane of the urethra (U), SP- symphysis pubis

Discussion:

It has been shown that 3D EVUS measurements of sub-urethral masses taken with Pelvic floor US (PFUS) in comparison to MRI do not differ significantly (85% agreement between PFUS and MRI) and can be used interchangeably dependent on availability and expertise [3]. Uniquely 3D EVUS provides demonstration of the coronal plane, perpendicular to the transducer face, facilitating easy identification of surface irregularities [4], [Fig 3].

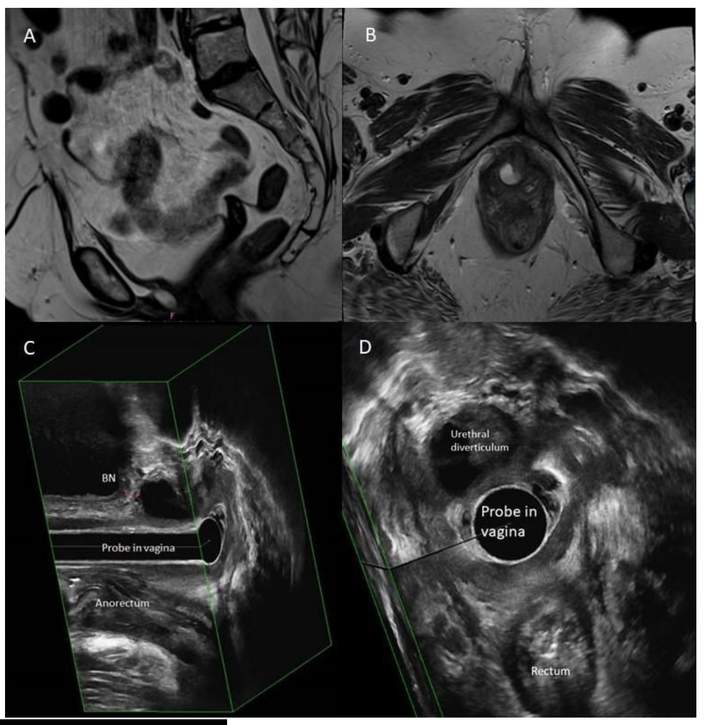
The advantages of EVUS include reduced scanning time with cost effective use of equipment and sonographer time. Offline analysis and post-processing allows further interrogation of imaging following the US procedure, decreasing time taken during scanning. 3D EVUS enables real time imaging in different orientations negating the consequences of patient movement and enabling an improved assessment of both normal anatomy and complex anatomic anomalies [5].

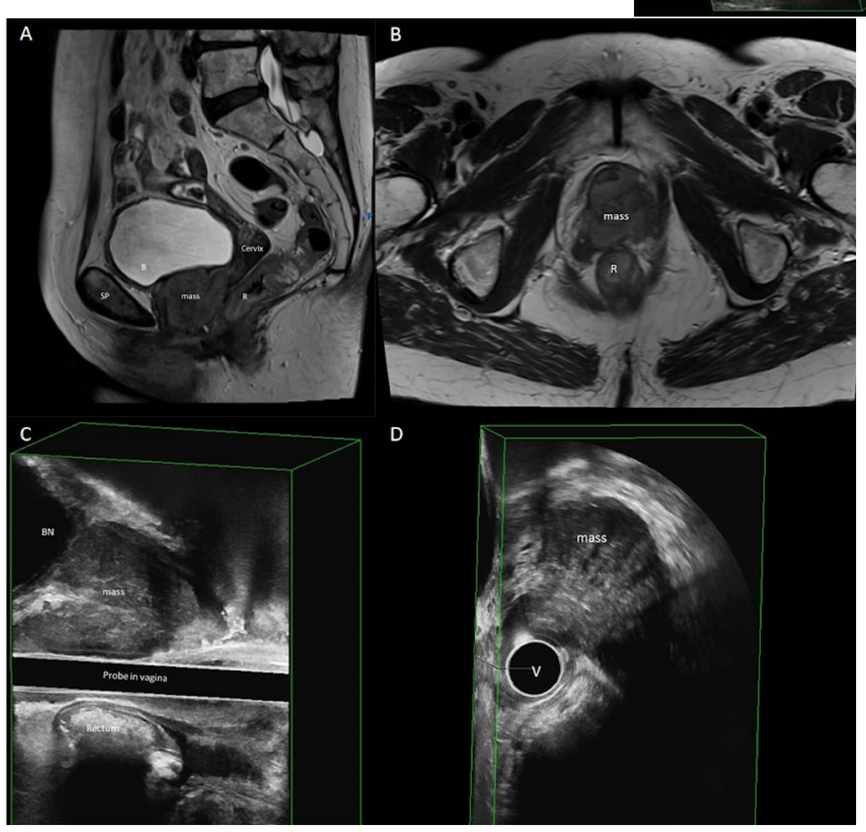
The average 3D EVUS scan was found to take a maximum of 10 minutes with 360 degree views obtained in 60 seconds by the 3D EVUS probe. In comparison to this, the optimal MRI sequence for assessing the peri-urethral area (SPACE - T2-weighted isotropic 3D fast spin echo) itself takes 6 minutes. Additional to this, the time taken to perform the remaining MR sequences mean that the total on table time frequently exceeds 30-40 minutes. This of course, does not include any acquisitions that have to be repeated due to movement artefact. As the images are not reviewed in real time, at times patients have to be recalled due to movement artefact or inadequate sequences.

The MR SPACE sequence mimics the views that are obtained through high frequency 3D EVUS, and so in centres where 3DUS is not available; MR SPACE (or comparable T2-weighted isotropic 3D fast spin echo sequence) could be used in place of standard MRI techniques in assessing peri-urethral masses.

Case review (1):
A 52 year old presented with an anterior vaginal wall swelling – MRI found likely fluid filled urethral diverticulum which was confirmed with EVUS

T2 weighted images through the pelvis. High signal mass partially encircling urethra is seen on sagittal (A) and axial (B) views.
EVUS Sagittal (C) and axial (D) views of the pelvis. A hypoechoic cystic structure is seen at the external urethral orifice on both MRI and EVUS. The connection with the urethral lumen is more convincingly seen on EVUS and thus appearances are in keeping with urethral diverticulum. The distance from bladder neck can be measured (red line).

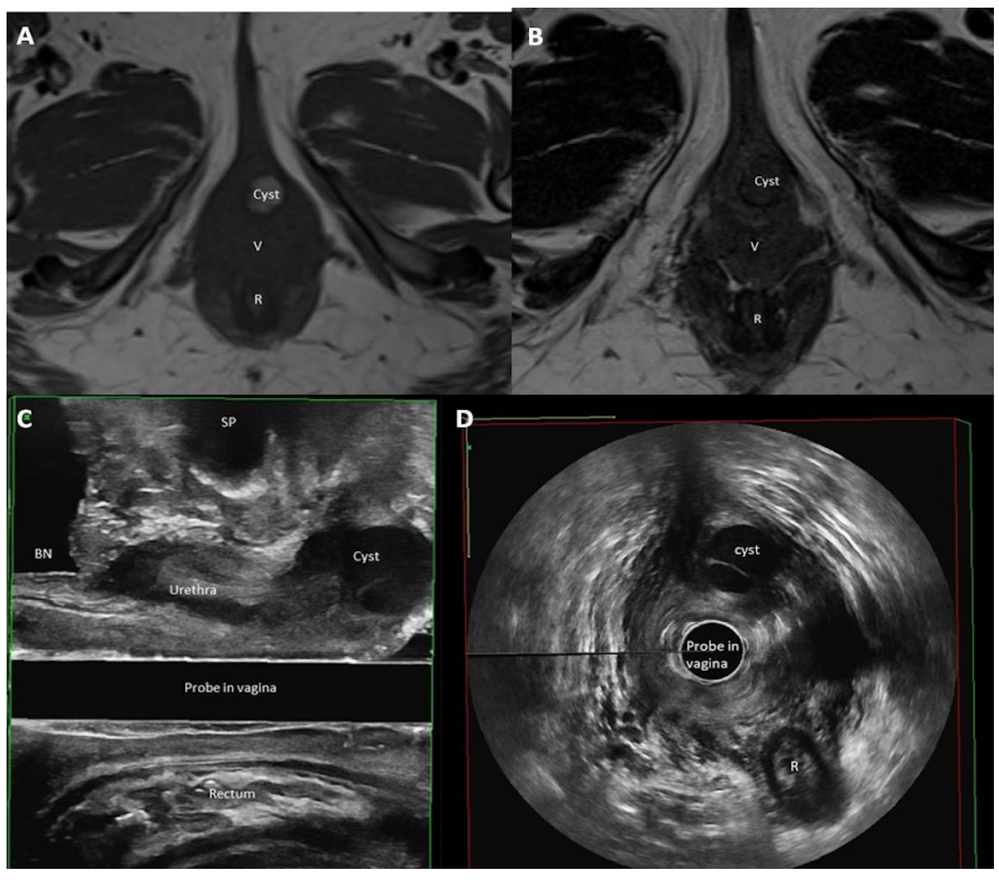




Case review (2):

A 76 year old presented with post-menopausal bleeding. Transvaginal (TV) and endovaginal (EV) US revealed both periurethral and left adnexal masses.

EVUS sagittal (C) and axial (D) views demonstrate the large soft tissue mass originating from the anterior vaginal wall and causing mass effect on the urethra anteriorly.
Pelvic MRI was performed for staging. T2 weighted sagittal (A) and axial (B) MRI imaging shows a large 3.7 x 3.8 x 4 cm periurethral mass. On MRI alone it was not clear if this was vaginal or urethral in origin. The previously reported on TVUS left sided mass was in fact an involved lymph node.
B= Bladder, BN= Bladder neck, SP = symphysis pubis, R= Rectum, V= vagina



Case review (3):
35 year old with para-urethral lump on examination.
T1 weighted (A) and T2 weighted (B) axial MRI showed 12 x 17 x 14 mm dense paraurethral cyst which returns low T2 and high T1 signal.
EVUS sagittal (A) and axial (B) views demonstrate a hypoechoic cyst at the distal urethra/ external urethral orifice. No connection with urethral lumen is seen, allowing the distinction between a periurethral cyst and urethral diverticulum.
BN= Bladder neck, SP = Symphysis pubis, R= Rectum, V= vagina

Conclusion

In our centre we have found that EVUS provides high 3D resolution and diagnostic ability; at times negating the need for more costly and time-consuming MRI. Further research is required in this area, however 3D EVUS has so far shown great potential not only as an accurate diagnostic tool, but also as an important modality for sub-urethral imaging to aid the clinical team with subsequent patient management and counselling.

References

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