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Evaluation of pelvic floor muscle damage after childbirth by 3D/4D transperineal ultrasound

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Pelvic floor defects are a frequent pathology, causing dysfunctions severe enough to require surgery in one out of ten affected women. DeLancey in his study published in the American Journal of Obstetrics and Gynecology in 2005 states that in the United States a prevention rate of 25 % could save 90,000 women each year from experiencing pelvic floor dysfunction.

While vaginal delivery has been established as the most important risk factor of pelvic floor dysfunction, levator ani muscle (LAM) damage is not the only factor associated with this pathology. Other lesions may predispose the development of pelvic floor dysfunction, such as nerve or ligament damage, which may cause impairment of the different pelvic compartments. The failure to detect the lesions that occur during vaginal delivery has hampered prevention and treatment of pelvic floor defects. This is currently changing thanks to electromyography studies, functional evaluation of the pelvic floor and the advent of ultrasound and magnetic resonance imaging (MRI) of pelvic floor muscles.

Transperineal ultrasound studies determined a prevalence of lesions in the LAM of 13 % to 36 %. Delivery by forceps is one of the most important risk factors for the occurrence of these lesions. Research indicates that LAM avulsions are present in 35 % to 64 % of all women who have had a forceps delivery.

Acute levator ani muscle lesions can be diagnosed clinically by direct visualization and digital examination when levator avulsion is associated with a large vaginal tear. Technological advances have made 3D ultrasound available as a diagnostic tool. This modality is less expensive and more widely available than MRI and provides real-time images. Furthermore, 3D ultrasound offers the possibility to obtain multiplanar images, allowing the visualization of the puboviscerale muscle in different planes in the same way as MRI.

Previously, pelvic floor ultrasound was limited to the mid-sagittal plane (Fig. 1). The introduction of 3D and 4D images in real time however allows the visualization of the axial plane (Fig. 2) for the morphological analysis of the levator ani muscle and the urogenital hiatus. 3D/4D images are obtained with the same technique as 2D images. A transducer with a recommended capture angle of 85° is recommended in order be able to capture the levator hiatus completely. All three orthogonal images are complemented by a rendered image, i.e. a representation of all semitransparent voxels obtained from a definable box (Fig. 3).

The mid-sagittal image includes the pubi symphysis in front, the urethra and bladder neck, vagina, cervix, rectum and anal canal. Behind the anorectal junction, a hyperechogenic area indicates the

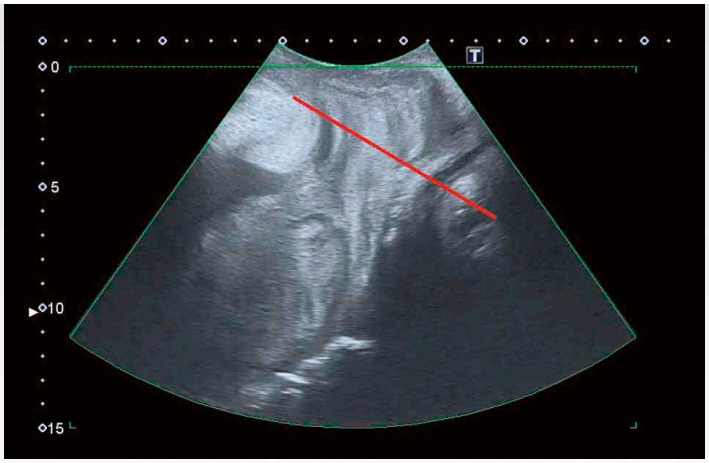

Fig. 1: The plane of minimal dimensions is defined as the plane delimited from the most caudal point of the pubic symphysis to the anorectal angle, indicated by the red line.

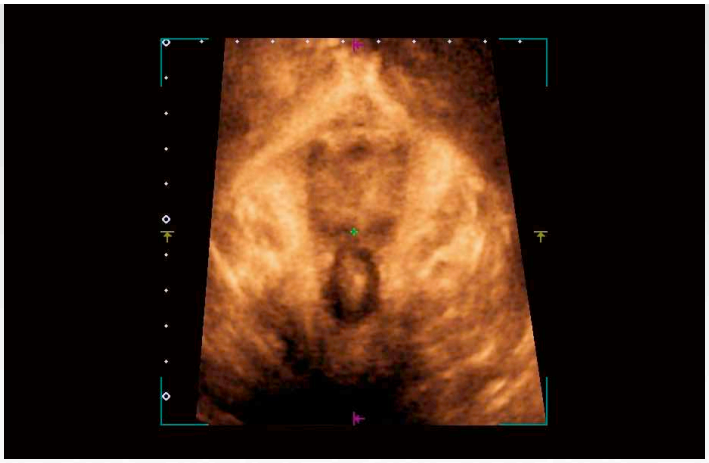

Fig. 2: The axial image shows the plane of minimal dimensions, visualizing pubis, urethra, vagina, anal canal and LAM.

central part of the levator plate, i.e. the puborectalis/pubococcygeus or pubovisceral muscle (Fig. 1). To avoid false negatives, the pressure exerted by the transducer on the perineum should be as soft as possible in order to allow full descent of the pelvic organ and the visualization of existing defects.

Levator avulsion is defined as the detachment of muscle from the pubis lower branch and the pelvic wall (Fig. 4a and Fig. 4b). LAM damage however can occur in any part of the muscle.

Muscle avulsion is a consequence of excessive stretching of the levator ani during the second stage of labor.

In most papers the levator ani muscle is shown using a single axial plane cut. Since the puborectalis muscle has a curved shape, with its angle located at the perineal body level a single plane image however may lead to an incorrect analysis. Hence the importance of multiview studies. Using multiple axial slices at intervals of 2.5 mm (corresponding to 5 mm in caudal direction and 12.5 mm in cranial direction to the plane of minimal dimensions, making a total of 8 axial cuts) has been described in many papers, and is currently considered a useful tool for the diagnosis of avulsions (Fig. 5a and Fig. 5b).

Conclusion

Our study group has been able to demonstrate that 3D/4D transperineal ultrasound is a useful tool to diagnose LAM avulsion which allows the early introduction of a prevention strategy with the aim to reduce possible future pelvic floor defects.

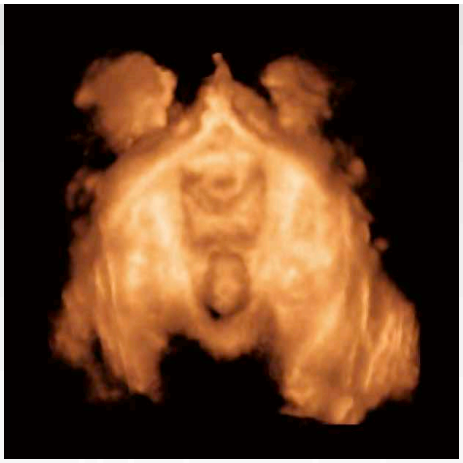

Fig. 3: The three-dimensional rendered image shows the LAM's volumetric image.

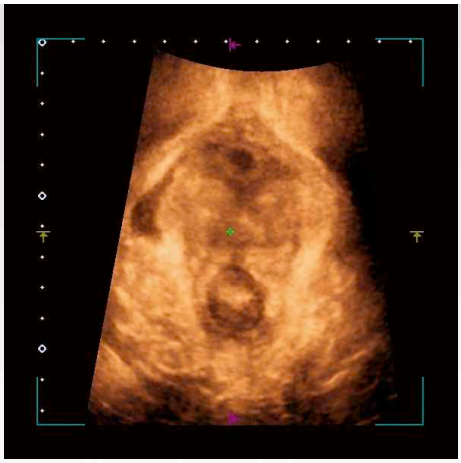

Fig. 4a: LAM right avulsion displayed in the plane of minimal dimensions.

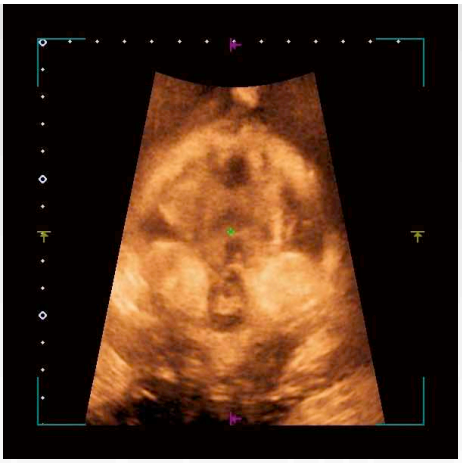

Fig. 4b: LAM bilateral avulsion displayed in the plane of minimal dimensions.

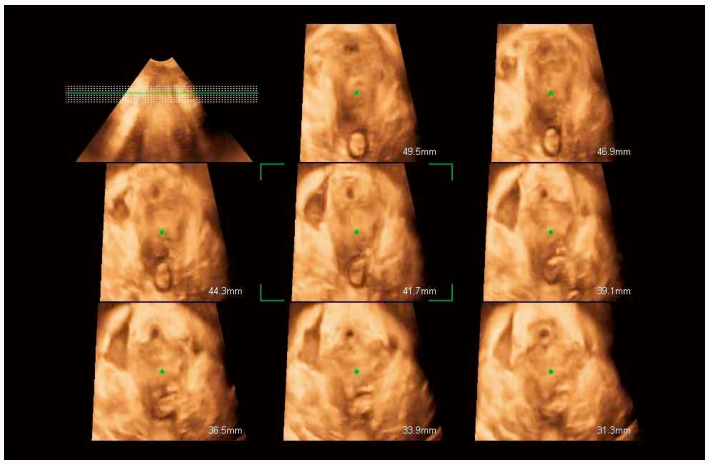

Fig. 5a: LAM right unilateral avulsion visualized using multiview from the plane of minimal dimensions with 2.5 mm cuts.

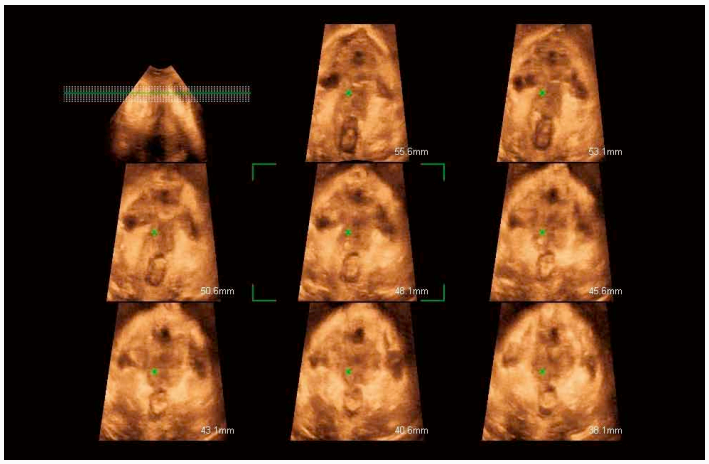

Fig. 5b: LAM bilateral avulsion visualized using multiview from the plane of minimal dimensions with 2.5 mm cuts.

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10/2013 MWPUL0023EUC
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