

DYNAMIC ASSESSMENT OF THE VAGINAL HIGH PRESSURE ZONE USING HIGH DEFINITION MANOMETRY, 3-DIMENSIONAL ULTRASOUND & MAGNETIC RESONANCE IMAGING OF THE PELVIC FLOOR

Hypothesis / aims of study

A novel technique, high definition manometry (HDM) that records 256 pressures, using tactile sensitive micro-transducers, was employed to describe the dynamic characteristics of vaginal high pressure zone (HPZ). Comparisons were drawn to anatomical characteristics obtained from 3 dimensional ultrasound (3DUS) and MR imaging (MRI)

Study design, materials and methods

Studies were performed on 16 nulliparous, asymptomatic women with a mean age of 37 years. Intra-vaginal HDM (n=11), transperineal dynamic 3DUS (n=11) and dynamic pelvic MRI (n=5) were recorded at rest and squeeze (pelvic floor contraction). HDM probe is 10 X 64 mm in diameter and length, respectively. Ultrasound (US) derived cinematic clips provided dynamic movement of the anorectal angle (ARA) during squeeze. Another set of images were obtained with a vaginal agar probe simulating the HDM probe. During MRI, a bag 100 mm length & 35 mm diameter, made of polyethylene, was filled with 50cc of water and placed in the vagina. Dynamic MRI were performed in the sagittal plane. From the HDM, vaginal HPZ was analyzed to measure length, peak pressure and location of the peak pressure in all quadrants. Dorso-ventral and cranio-caudal movement of ARA were measured from the US and MR images. Comparisons were made using paired t-test and significance was defined when P<0.05.

Results

1) HDM shows that the vaginal HPZ is highly asymmetric in both the circumferential and axial directions (figure 1). At rest, higher pressures are distributed in the anterior and posterior planes as compared to lateral ones. With squeeze, pressures increase in all quadrants significantly. The anterior pressures are significantly larger than the posterior quadrant during squeeze. HPZ length shows a significant increase in all quadrants during squeeze. **2)** During squeeze the location of posterior peak pressure, in reference to anterior pressure, moves cranially by an average distance of 7mm. **3)** Cranial distance moved by the ARA in US (figure 2) and MRI was 5 and 7 mm respectively, similar to the posterior pressure movement seen on HDM. **4)** US images with and without an agar probe in the vagina show no difference in the anatomy of pelvic structures. **5)** MR images show that the vaginal HPZ is located between the urethra and anal canal (figure 3).

Interpretation of results

1) An asymmetric pressure distribution in the vaginal HPZ suggests that the forces responsible for the genesis of vaginal HPZ are directed in the anterior and posterior direction, which is consistent with the direction of the puborectalis muscle. **2)** HDM shows that with squeeze, there is a significant cranial movement of the location of posterior peak pressures in relationship to the anterior pressure cluster. The movement of posterior pressure cluster is similar to the cranial movement of the ARA observed on the US and MRI, which suggests that the HDM may be used to measure the elevator function of the pelvic floor muscle. **3)** Location of the vaginal HPZ observed on the MR images is consistent with the hypothesis that the puborectalis muscle compresses anal canal against urethra to form the vaginal HPZ.

Concluding message

Vaginal HPZ results from the action of puborectalis component of the pelvic floor muscles. HDM may be used to measure the constrictor and elevator function of the pelvic floor. We propose that the function of continence is related to the constrictor action of the puborectalis component of the pelvic floor muscle. On the other hand, the function of organ support is related to the elevator action of the pubo-ileococcygeus muscle. Future studies using HDM probe may investigate if it is possible to divide pelvic disorders into disorders of elevator and constrictor functions.

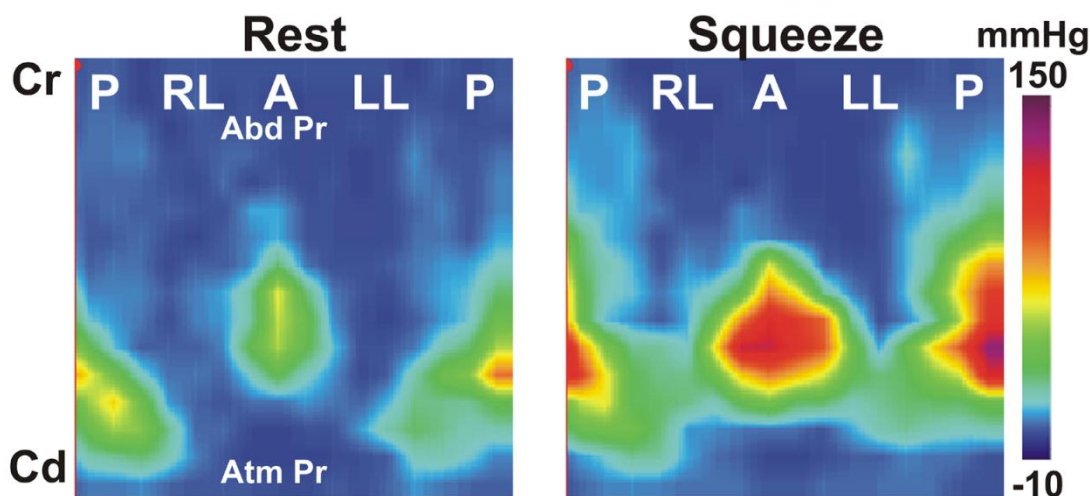


Figure 1: High definition manometry plots showing vaginal high pressure zone. Pressures are asymmetric in all quadrants. The pressures cluster in posterior (P) quadrant moves in the cranial (Cr) direction with squeeze. RL:Right lateral, LL:Left lateral, A:Anterior, Cd:Caudal, Atm:Atmospheric, Abd:Abdominal, Pr:Pressures.

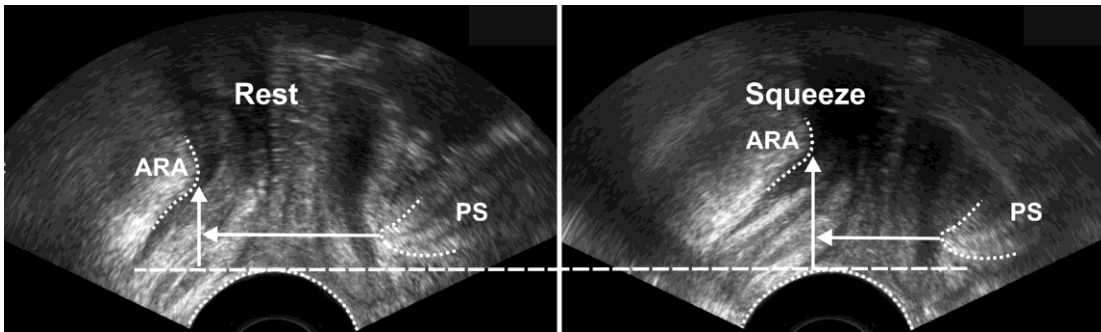


Figure 2: US images demonstrating cranial (vertical arrow) and ventral (horizontal arrows) movement of ARA. The average cranial movement of ARA (anorectal angle) is not significantly different from posterior pressure cluster movement noted on HDM. PS:Pubic symphysis.

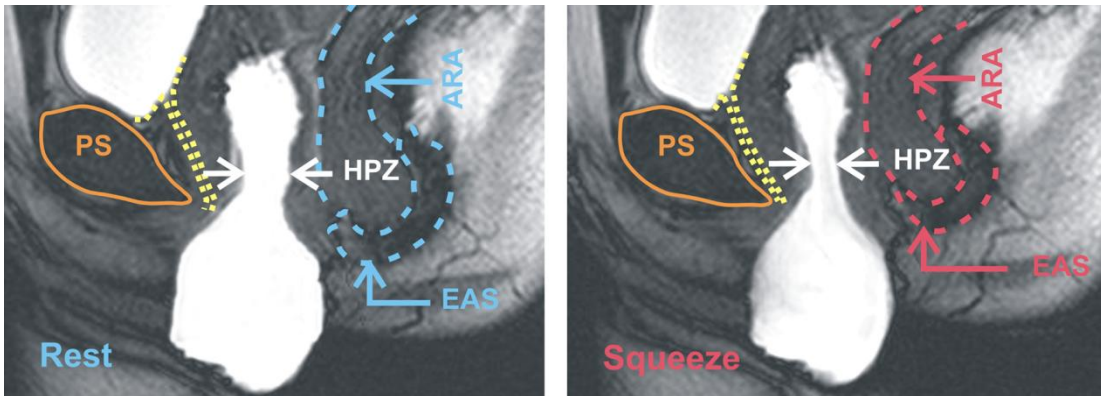


Figure 3: MRI images of pelvic floor with intra-vaginal water bag. Constriction (white arrows) on the bag represents Vaginal HPZ (high pressure zone). It is located between the anal canal (broken red and blue lines) and urethra (broken yellow lines). Distance moved by ARA (anorectal angle) in cranial direction is similar to movement of posterior pressure cluster on HDM. EAS: External anal sphincter, PS:Pubic symphysis.

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Was this study approved by an ethics committee?	Yes
Specify Name of Ethics Committee	Institution Review Board (IRB), University of California, San Diego.
Was the Declaration of Helsinki followed?	Yes
Was informed consent obtained from the patients?	Yes