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URETHRAL MOTION POFILE: A NOVEL METHOD TO STUDY URETHRAL MOBILLITY

Abstract Text:

Hypothesis / aims of study

Lack of urethral support or urethral hypermobility has been widely accepted as a factor in the pathogenesis of Urodynamic stress incontinence (1). However specific details on urethral mobility appear lacking in the literature. There has been no published data on a methodology to study urethral mobility and hence support in a systematic manner. The objective of this study was to establish a methodology for describing urethral mobility and to determine the urethral motion profile in a cohort of young nulligravid women using 3D ultrasound. Since stress urinary incontinence is associated with childbirth (2), we also investigated urethral mobility before and after childbirth using the same methodology.

Study design, materials and methods

3D translabial ultrasound volume datasets of a cohort of 51 nulligravid female Caucasian volunteers (aged 18-24 years) were assessed. Volumes had been acquired at rest and on Valsava maneuver after voiding whilst supine (3). Due to corrupted datatets (n=2) and suboptimal acquisition (n=5), only 44 pairs of volume datasets could be evaluated.

Using a co-ordinate system based on the dorsocaudal margin of the pubic symphysis, manual measurements were obtained on a desktop using a 4D sonoview software. The urethra was divided into 5 equal segments with 6 points (Point 1 to 6) marked evenly along the urethra from bladder neck to external urethral meatus in the mid-sagittal view. Measurements were taken both at rest and on maximal Valsalva. Mobility vectors for these points were determined by the formula $\sqrt{\{(Vy-Ry)^2+(Vx-Rx)^2\}}$ describing the difference between point coordinates at rest and on Valsava. Reproducibility of the methodology was determined by independent measurements of 20 datasets by the second observer.

To study the effect of childbirth on urethral mobility, the antepartum (36-38 weeks) and postpartum (3-5 months) volume datasets of 110 nulliparous women (aged 17-38 years) were analysed. Using the method described above, changes in urethral mobility were defined as the difference between antepartum and postpartum mobility vectors.

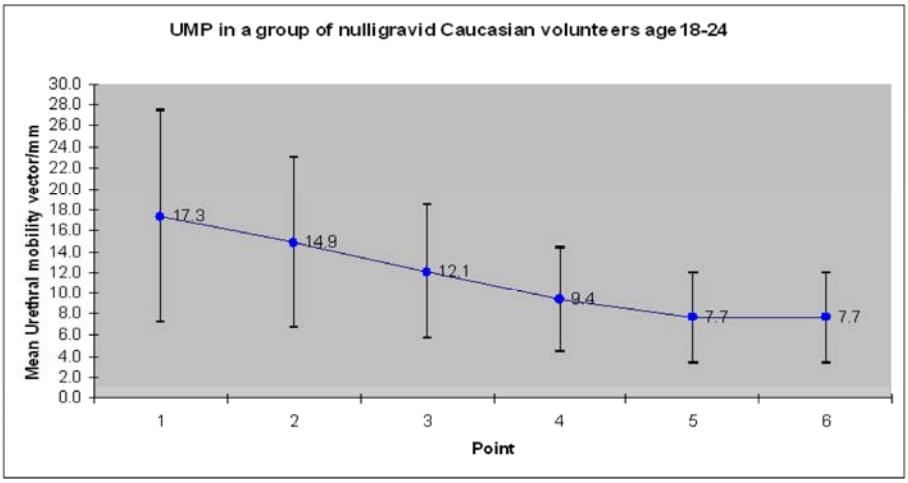

Figure 1: Mean urethral motion profile in nulligravid Caucasian volunteers aged 18-24 (n= 44)

Results

The intraclass correlation coefficients (ICC) of x and y co-ordinates was excellent (0.93 to 0.99). The ICC of urethral mobility vectors was good (0.78). Mean mobility vectors of Point 1 to 6 were 17.3 (±SD 10.1), 14.9 (± 8.1), 12.1 (±SD 6.4), 9.4 (±SD 5), 7.7 (±SD 4.3) and 7.7 (±SD 4.3) mm (see Figure 1). The distal urethra was shown to be much less mobile than the proximal part of the organ in this cohort of young nulligravid women ($P< 0.001$ on ANOVA).

In the second part of the study, 110 patients were seen 2-4 weeks before before and 3-5 months after childbirth. Thirty-seven datasets were excluded because of corrupted datasets, incomplete volume acquisition and/or levator coactivation, leaving 73 datasets. Of these 73, 40 women had been delivered by normal vaginal delivery, 8 by vacuum extraction and one by forceps. There were 24 cases of Caesarean Section, 7 electively, 14 in 1st stage and 3 in 2nd stage. Again, both before and after childbirth, the distal urethra was the least mobile, although measurements at 36-38 weeks were clearly higher than in the nulligravid cohort described above. We observed an increase in segmental urethral mobility after childbirth which reached significance for 5 out of 6 segments (see Figure 2). There was a trend towards more marked changes being seen after vaginal operative delivery. However, likely due to inadequate sample size, statistical significance could not be demonstrated.

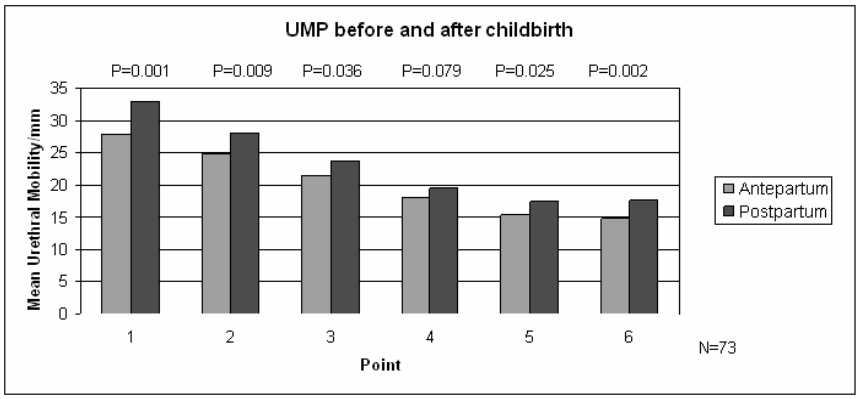

Fig. 2 Changes in urethral mobility 2-5 months after childbirth.

Interpretation of results

In our study of a cohort of young nulligravid women, we found that the proximal urethra is more mobile than the distal urethra. Point 5 and 6 were the least mobile which means that the distal urethra is more firmly tethered than the proximal part of the organ. As urethral tethering implies the transmission of force, for instance during coughing, this is an important finding for urethral continence. Loss of urethral tethering may lead to abnormal urethral mobility, abnormal pressure transmission and stress urinary incontinence.

Childbirth seems to increase segmental urethral mobility, with most marked changes after instrumental delivery, likely representing a greater disturbance to urethral support. A larger sample size will be required to investigate this issue further.

Concluding message

Urethral mobility can be studied using 3D translabial ultrasound. The distal part of the urethra seems the least mobile, indicating a locus of urethral tethering. This may play an important role in pressure transmission and hence, female urinary continence. There is an increase in urethral mobility after childbirth, suggesting an alteration in urethral support.

References

1. Am J Obstet Gynecol 1994; 170(6):1713-23
2. Int Urogynecol J 2000; 11:301-319
3. Ultrasound Obstet Gynecol 2004; 23 (6): 615-625

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HUMAN SUBJECTS: This study was approved by the Sydney West Area Health Service HREC and followed the Declaration of Helsinki Informed consent was obtained from the patients.