

QUANTIFIABLE DECREASES IN SPHINCTER FUNCTION WITH AGING: BIOMECHANICAL RELATIONSHIPS BETWEEN URODYNAMIC PRESSURES IN CONTINENT AND STRESS INCONTINENT WOMEN

Hypothesis / aims of study

It has been previously reported that the number of striated muscle fibers present in the female urethral sphincter decreases with age (1, 2). This implies that the amount of pressure a woman could generate in response to an increase in abdominal pressure would also decrease with age. The main goal of this study was to quantify the effects of aging on the amount of urethral pressure generated in response to the increase in abdominal and transvesical pressure that occurs during coughs and valsalva manoeuvres.

Study design, materials and methods

Standardized urodynamic data, including intravesical (Pves), abdominal (Pabd), and urethral (Pura) pressures, were acquired from 2 well-characterized groups of women: (1) *continent women* had no incontinence symptoms or urodynamic findings of any incontinence subtype; (2) *stress incontinent women* had symptoms of stress incontinence and confirmatory urodynamic stress incontinence. Urodynamic pressure data, including Pabd, Pves and Pura, were obtained during cough and valsalva manoeuvres at 0.2 second intervals at maximum cystometric capacity (MCC). The ratios of Pura/Pabd (UPAP) and Pura/Pves (UPVP) were calculated for every time interval during each event and the maximum and minimum ratios for each type of event in each participant was determined. Similarly, the maximum and minimum values of Pura-Pabd and Pura-Pves were calculated for each type of event in each participant. The calculated variables were then statistically analyzed by the method of repeat measures mixed models, both as a complete set and separately based on whether it was obtained from a continent or stress incontinent woman and whether the data was obtained during a cough or valsalva manoeuvre. Least squares means were computed for the calculated variables in each category and a coefficient for the continuous variable of age was determined providing an estimate of the change in the maximum and minimum ratios per year. The least squares means of the calculated variables assigned based on continence status and type of event were compared using a Tukey-Kramer adjustment for multiple comparisons. A p value of less than 0.05 was taken to indicate a significant difference. Data is presented as mean (range).

Results

Urodynamic data was obtained from 14 continent women (Age = 43.5 yrs (26-79 yrs) MCC = 455mL (300-659mL)) and 12 stress incontinent women (Age = 49yrs (36-63yrs) MCC = 483mL (316-712mL)). No significant difference was found in age or MCC between the two groups. When the complete study population was considered, both the maximum and minimum UPAP and UPVP ratio decreased significantly with increasing age. Maximum and minimum UPAP decreased by 0.038 and 0.007 per year increase in age, respectively when the entire study population was considered. Similar results were observed for maximum and minimum UPVP which decreased by 0.05 and 0.005 per year increase in age, respectively for the complete study population. When the participants were split into continent and stress incontinent groups, there was a significant decrease in the maximum and minimum UPAP and UPVP with age in the continent group. However, neither maximum nor minimum UPAP nor UPVP of stress incontinent women changed significantly with age. Minimum UPAP and both maximum and minimum UPVP were significantly lower in stress incontinent patients ($p < 0.05$). The type of event (cough or valsalva) was also found to significantly affect only the minimum UPAP and both maximum and minimum UPVP which were significantly lower during coughing events than during valsalva manoeuvres. The maximum Pura-Pabd decreased by 1.39 cmH₂O/year increase in age while the minimum difference decreased by 0.7 cmH₂O/year. Similarly, the maximum Pura-Pves decreased by 1.37 cmH₂O/year increase in age while the minimum difference decreased by 0.72 cmH₂O/year. Women with stress incontinence were also found to have significantly lower maximum and minimum Pura-Pabd and Pura-Pves. The minimum Pura-Pabd and the maximum and minimum Pura-Pabd and Pura-Pves were significantly lower during coughing. Increasing age correlated with a significant decrease in both the maximum and minimum Pura-Pabd and Pura-Pves in the continent group. However no such correlation was found in the stress incontinent group.

Interpretation of results

A larger Pura generated for a given Pabd (i.e. a larger UPAP ratio) indicates the ability of the urethral sphincter to increase Pura to counteract the rise in Pabd and prevent a leak from occurring. The same is true with regard to the UPVP ratio. In addition, if the UPVP ratio remains greater than unity, then Pura will always remain greater than Pves implying a positive pressure gradient cannot develop and a leak will not occur. However, if the minimum value of UPVP is less than unity, then Pura will be less than Pves for at least a brief period during the event; a positive pressure gradient will develop and a leak will occur. In both cases a larger ratio in a given woman indicates the ability of the urethral sphincter complex to prevent leaks when Pabd increases.

Similarly, the larger the difference between Pura and Pabd and Pura and Pves the better the ability of the sphincter complex to prevent leaks with rises in Pabd. The greater the difference between Pura and Pves, the greater a safety threshold a woman has to prevent leaks. If this difference is greater than zero a positive pressure gradient will not occur and no leak will occur. However if the minimum of this difference becomes less than zero a positive pressure gradient will develop for at least a brief period during the event and a leak will occur.

The main finding of this study is that all of these parameters decrease as a woman ages. This means that as a woman ages her ability to increase Pura in the face of rising Pabd decreases indicating that the performance of the urethral sphincter complex degrades with age, and this is exaggerated in women with stress incontinence.

Concluding message

Age is a significant contributory factor to the degradation of urethral function in women. The findings of this study suggests that women experience a quantifiable decrease in urethral function as they age, decreasing the response of the sphincter complex to increases in Pabd. This can help explain how the risk of developing stress incontinence also increases in all women as they age (3). The ratios and differences in this study may serve clinically as predictive factors for future development of stress incontinence. Future work following a larger patient population over a longer period of time would be needed to test this theory.

References

- 1) *Am J Obstet Gynecol* (2002) 186:351-355.
- 2) *Ann. N.Y. Acad. Sci* (2007) 1101:266-296
- 3) *European Urology* (2000) 37:637-643

<i>Specify source of funding or grant</i>	NIH - NIDDK 5 K24DK064044-04 NIH - NICHD 5 K23HD047325-05
<i>Is this a clinical trial?</i>	No
<i>What were the subjects in the study?</i>	HUMAN
<i>Was this study approved by an ethics committee?</i>	Yes
<i>Specify Name of Ethics Committee</i>	Loyola University Chicago Institutional Review Board 106703
<i>Was the Declaration of Helsinki followed?</i>	Yes
<i>Was informed consent obtained from the patients?</i>	Yes