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URODYNAMIC RATIOS: A NOVEL CONSIDERATION FOR FEMALE STRESS CONTINENCE

Hypothesis / aims of study

There are few absolute urodynamic pressures that clearly distinguish stress continent from stress incontinent women. While the clinical diagnosis of urodynamic stress incontinence is clearly defined, etiologic research into this condition has been hampered by a lack of insight into clinically-relevant differences between these two groups. The aim of this analysis was to determine whether the urodynamic ratios of urethral pressure/abdominal pressure (UPAP) and urethral pressure/ intravesical pressure (UPVP) differentiate stress continent and stress incontinent women as they age.

Study design, materials and methods

Standardized urodynamic data, including intravesical pressure (Pves), abdominal pressure (Pabd), and urethral pressure (Pura) 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 stress events (cough and valsalva) at maximum cystometric capacity (MCC). The ratios of Pura/Pabd (UPAP) and Pura/Pves (UPVP) were calculated at 0.2 second intervals during each event. The maximum and minimum ratios for each event in every subject were used to explore the time at which the maximum and minimum UPAP and the maximum and minimum UPVP occurred during each event.

The maximum UPAP and maximum UPVP ratio is the time point in the event where the greatest difference exists between Pura and Pabd or Pves, respectively. The maximum ratios can provide insight into when in the time course of an event the woman is least susceptible to urinary leakage. The minimum values of these ratios represent the point in an event where the differences between Pura and Pabd or Pves are the smallest, corresponding to the point where the woman is most susceptible to stress urinary incontinence.

The method of repeat measures mixed models, was used to identify whether, age, parity, continence status, the type of event (cough/valsalva), or MCC exhibited a significant correlation with the maximum or minimum ratios. Least squares means were computed for the calculated variables exhibiting a significant correlation with the maximum and minimum ratios. A p value of less than 0.05 was interpreted as a significant correlation. Parity was considered either a continuous or a dichotomous variable in two separate statistical analyses. Predictive models were then developed relating the maximum and minimum UPAP and UPVP to those variables that were found to have a significant correlation. Data is presented as mean (range).

Results

Fourty seven coughs and 42 valsalvas were obtained at MCC from 24 continent women: 3.6 events/subject (1-9 events/subject); age = 39 yrs (20-79 yrs); MCC = 457mL (271-659mL); vaginal parity = 1 birth (0-4 births). Fourty nine coughs and 40 valsalvas at MCC were obtained from 15 stress incontinent women: 5.9 events/subject (2-12 events/subject); age = 50 yrs (36-63 yrs); MCC = 479 mL (301-712mL); vaginal parity = 2 births (0-4 births).

For continent episodes, most of the maximum ratios occurred at either the very beginning of a cough or valsalva event or at the very end (79% for UPAP, 77% UPVP) which coincided with Pabd being at or returning to baseline levels. For incontinent episodes, most ofthe maximum ratios were similarly timed (61% UPAP, 60% UPVP). For incontinent events, such timing occurred in 10% for both minimum UPAP and UPVP ratios. Conversely, for continent episodes, the minimum ratios rarely occurred at the beginning or end of the event (4% UPAP, 2% UPVP).

The minimum ratios (both UPAP and UPVP) occurred at the time at which maximum Pabd was reached ($\pm$ 0.4 seconds) in 67% and 64% of the events in which continence was maintained respectively. In events where continence was not maintained minimum UPAP and UPVP occurred within 0.4 seconds of the maximum Pabd in 42% and 49% of events respectively.

Statistical analysis indicated that both age and continence status affected the ratios. Both the maximum and minimum UPAP and the maximum and minimum UPVP declined exponentially with age. MCC was significantly correlated with maximum UPAP, whereas age, continence status, event type (cough/valsalva) and MCC were correlated to minimum UPAP. The same variables in addition to age exhibited significant correlations with the maximum and minimum UPVP ratios. Parity (as either continuous or dichotomous variable) was not significantly correlated with any ratio, although there was a trend towards significance for minimum UPAP (p=0.06) when parity was treated as a continuous variable.

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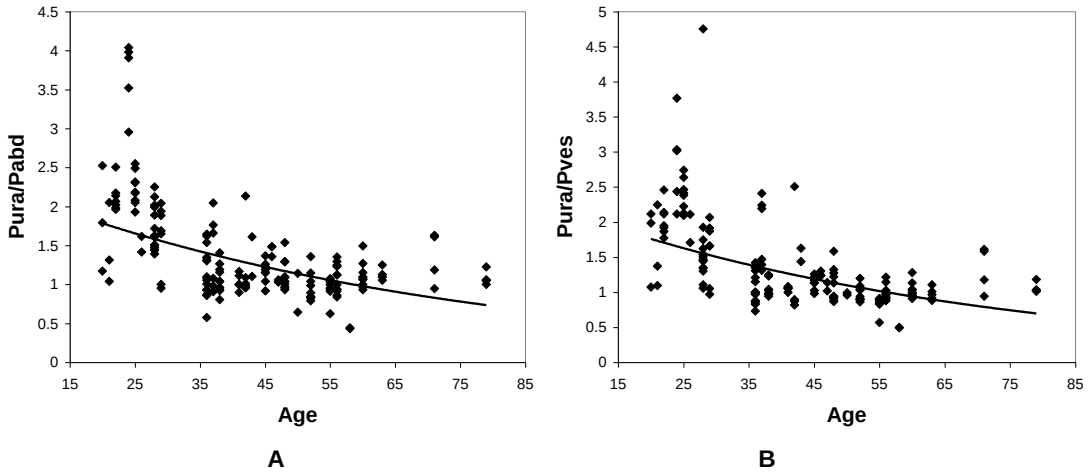

Figure 1. Graphs illustrating the exponential decline of minimum UPAP **(A)** and minimum UPVP **(B)** with increasing age. Each symbol represents the minimum of each ratio for a single cough or valsalva event

Interpretation of results

From the above data, age stands out as the variable that is most strongly correlated with UPAP and UPVP. All of the ratios were found to decrease exponentially as the patient ages, indicating that as a woman ages, the urethra is less able to generate pressure in response to a given abdominal pressure and decreases both while the woman is at rest and during an event such as a cough or valsalva. This finding supports the previously reported findings that the number of striated muscle fibres present in the female urethral sphincter decreases with age (1,2). Timing of maximum and minimum ratios relative to maximum Pabd does not distinguish between continent and incontinent women. However, findings may also provide additional information regarding the spectrum of continence, identifying women at higher risk of developing stress urinary incontinence with age.

Concluding message

This novel use of urodynamic data to calculate ratios provides insight into the urethral response to intraabdominal increases in pressure. The minimum UPVP ratio measured during a cough or a valsalva can provide insight into how close a woman comes to leakage during continent events. While considered continent if a women has a ratio that approaches one, she may be etiologically likely to experience stress urinary incontinence with minor decrements in urethral function.

References

1. Am J Obstet Gynecol (2002) 186:351-355
2. Ann. N.Y. Acad. Sci (2007) 1101:266-296

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What were the subjects in the study?	**HUMAN**
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Specify Name of Ethics Committee	**Loyola University Stritch School of Medicine Institutional Review Board**
Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**