

## URETHRAL PRESSURE REFLECTOMETRY DURING INTRA-ABDOMINAL PRESSURE INCREASE—AN IMPROVED WAY TO CHARACTERIZE CONTINENT AND STRESS URINARY INCONTINENT WOMEN

### Hypothesis / aims of study

The urethral pressure reflectometry (UPR) technique enables simultaneous measurement of pressure and cross-sectional area along the entire length of the urethra and avoids the common artefacts encountered with conventional methods (1). Since the first reports the technique has been further developed for use during squeeze and intra abdominal pressure increase by strain. Our aim was to assess the urethral closure mechanism by means of UPR at rest and during intra-abdominal pressure-increase by strain in SUI and continent women.

### Study design, materials and methods

Women with bothersome and urodynamic proven SUI were consecutively recruited from the outpatient clinic. Continent volunteer women with negative cough stress test and an ICIQ-UI-SF score of 0 were recruited via a clinical trial website. The assessment included comprehensive medical history, International Consultation on Incontinence Questionnaire on Urinary Incontinence Short Form (ICIQ-UI-SF), pelvic examination, cough stress test, urine flow and post-void residual urine volume (PVR) measurement, filling cystometry, urine analysis, pad-weighting test (2 x 24 hours), incontinence episode diary (7 days), 4D ultrasound assessment and UPR measurements.

UPR measurements: The UPR polyurethane bag was placed in the urethra and connected to a syringe, a computer and a probe containing an acoustic transmitter and a microphone. By means of the syringe, the pressure in the polyurethane bag was raised from 0 cm H<sub>2</sub>O to 200 thereby distending it, and the cross-sectional area within the bag (and thus the urethra) was measured with acoustic reflectometry and the urethral opening pressure (P<sub>o</sub>) obtained. The abdominal pressure (P<sub>A</sub>) was measured with an air filled catheter in the rectum.

Measurements were conducted at rest (10 times) and during intra-abdominal pressure increase by straining (10 times at various abdominal pressures). The related values of abdominal pressure and P<sub>o</sub> were plotted into an abdomino-urethral pressuregram (2) (figure 1). Linear regression of the values was conducted, and the slope of the line and the intercept with the y-axis were found. The slope is the ratio of the urethral pressure increase in relation to the abdominal pressure increase and is termed "Abdominal to urethra Pressure Impact Ratio" or "APIR". The equation of the pressuregram line was generated:

Urethral opening pressure = APIR x abdominal pressure + intercept.

This was used to calculate the urethral opening pressure at various values of abdominal pressure, e.g. 50 cm H<sub>2</sub>O (P<sub>o-Abd 50</sub>) (figure 1). The pressuregram-LPP, which is defined as the intercept with the equilibrium line of x=y (figure 1) could be calculated from the equation: Pressuregram-LPP = intercept / (1 - APIR).

### Results

25 SUI women and 8 continent volunteer women were included in the analyses. The two groups did not differ with respect to age, body mass index or menopausal status, but the SUI women had had more vaginal deliveries.

P<sub>o-rest</sub> and APIR were significantly different (p<0.0005 and p=0.002, respectively) in SUI and continent women but could not completely separate the two groups (figure 2).

The 23 SUI women who had an APIR < 1 during abdominal pressure increase by strain had a median pressuregram-LPP of 100 cm H<sub>2</sub>O. Two SUI women had an APIR ≥ 1. Hence, the pressuregram line would never intercept the equilibrium line of x=y, and leak point was "infinite" (would not be reached at any value of abdominal pressure) under the study circumstances.

Six of the continent women had APIR ≥ 1; hence the pressuregram-LPP was "infinite". In the remaining two women the pressuregram-LPP was 185 cm H<sub>2</sub>O and 840 cm H<sub>2</sub>O, respectively.

Median P<sub>o-Abd 50</sub> was 67 cm H<sub>2</sub>O in SUI and 104 cm H<sub>2</sub>O in continent women, with a complete separation of the two groups (p<0.0005) (figure 2). P<sub>o-Abd 50</sub> was highly significantly negatively correlated with ICIQ-SF, pad test and number of incontinence episodes per week (results not shown). Calculation of the receiver operating characteristic (ROC) curves of P<sub>o-Abd 50</sub> showed the area under the curve (AUC) to be 1.0.

### Interpretation of results

P<sub>o-rest</sub> is thought to represent the static contribution to the urethral closure mechanism whereas APIR presumably expresses the adjunctive closure forces (including urethral support) during intra abdominal pressure increase by strain. The urethral opening pressure at a given abdominal pressure represents the resulting joint static and adjunctive closure forces at that particular abdominal pressure, for example at 50 cm H<sub>2</sub>O. P<sub>o-Abd 50</sub> was a better measure of SUI severity than was the pressuregram-LPP which was infinite in many subjects.

### Concluding message

We conducted UPR measurements of urethral opening pressures at rest and during intra abdominal pressure increase by strain, and new parameters were obtained by use of the pressuregram: APIR and P<sub>o-Abd 50</sub>. P<sub>o-Abd 50</sub> could completely separate SUI and continent women, it showed highly significant negative correlation with ICIQ, pad test and number of incontinence episodes per week, and it was found to be an excellent measure of SUI severity.

Figure 1: Pressuregram with urethral opening pressures obtained at 10 different levels of increased intra-abdominal pressure

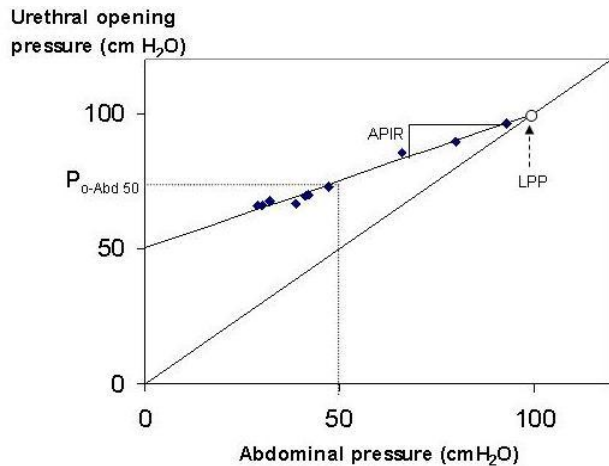
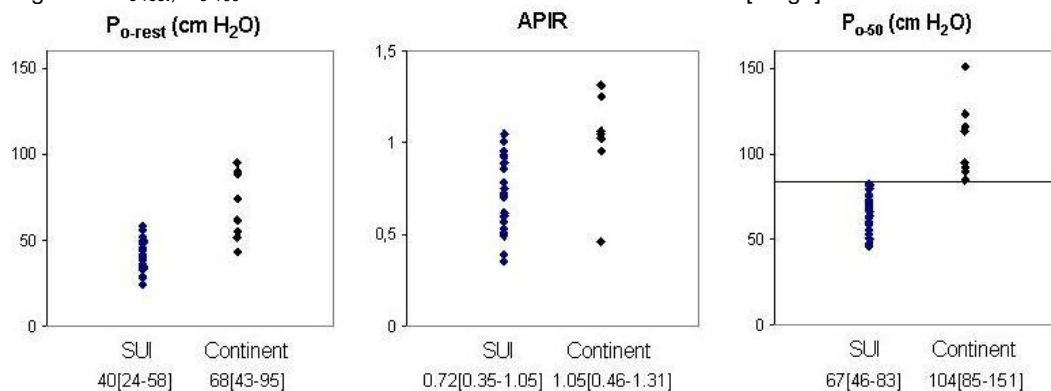


Figure 2:  $P_{o-rest}$ ,  $P_{o-100}$  and APIR in SUI and continent women. Median[range].



$P_{o-rest}$ : urethral opening pressure at rest.  $P_{o-50}$ : urethral opening pressure at 50 cm H<sub>2</sub>O abdominal pressure. LPP: leak point pressure.

APIR: Abdominal to urethral pressure impact ratio. SUI: stress urinary incontinent.

#### References

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2. Kim KJ, shton-Miller JA, Strohbehk K, DeLancey JO, Schultz AB. The vesico-urethral pressuregram analysis of urethral function under stress. *J Biomech* 1997 Jan;30(1):19-25

#### Disclosures

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