Clinical Utility of Lung-Generated Pressures in Determining Valsalva Leak Point Pressure in Patients Undergoing Urodynamic Studies

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Introduction

Stress testing or measurement of Leak Point Pressures (LPP) during urodynamic studies (UDS) is commonly used in the diagnosis of stress urinary incontinence (SUI). UDS requires catheterization, which is invasive and presents risks including infection.

We previously demonstrated a strong correlation during UDS between lung-generated (Plung) and abdominal (Pabd) pressure, which is commonly used to quantify a LPP. The utility of measuring Plung is investigated here as a rapid measurement of the Valsalva leak point pressure (VLPP).

VLPP is a measure of urethral function and is defined as the intra vesical pressure at which urine leakage occurs due to increased abdominal pressure in the absence of a detrusor contraction. VLPP is a quantitative assessment that provides clinical information in determining if stress urinary incontinence is present. It has been shown to be a useful predictor of surgical success in transobturator tape procedures.

In the present study, we examine the utility of measuring Plung during urodynamics in patients complaining of SUI symptoms.

Methods

Patients presenting with lower urinary tract symptoms (LUTS), including SUI, were referred to UDS and consented to perform concurrent mouthpiece VLPP testing.

Conventional UDS including a cystometrogram was performed using the Laborie Delphis IP system and air-charged catheters (T-DOC®), with a mouthpiece configured to the system such that Plung, Pabd and Pves (bladder pressure) were measured simultaneously. The procedure included stress testing at varying bladder volumes utilizing both with and without the mouthpiece as the gold standard comparison. During the Plung maneuver, patients locked their lips around the mouthpiece and performed a minimum of three Valsalva maneuvers.

Leakage was identified by the uroflow transducer or as noted by the clinician. If a patient was unable to generate more than 30cmH2O pressure during a maneuver, this Valsalva maneuver was excluded.

Ideally, 100% agreement between the abdominal and intravesical pressure channel should be present; however at least 80% agreement between the abdominal and intravesical channels during a Valsalva maneuver was considered acceptable.

27 patients were recruited of which 21 patients were included in the analysis (18 female (86%), three male (14%)) with a mean age of 59 years (21-83). Six patients were excluded due to significant artifact (2), rectal contractions (1), or inability to generate lung pressures above 30cmH2O (3). One additional patient was excluded from test sensitivity calculations as they did not generate sufficient Valsalva pressure without the mouthpiece comparative to their Plung maneuver.

The average coefficient of determination found between Pabd and Plung pressures in this population was r²=0.79 ± 7.97 indicating a strong relationship between abdominal and lung pressures.

The average equation of this association was found to be:

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P_{\text{Plung}} (\text{cmH}_2\text{O}) = 1.09 (±0.85 \text{ SD}) \times P_{\text{Aab}} (\text{cmH}_2\text{O}) + 29.74 (±31.6 \text{ SD})
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The sensitivity of the Plung device in detecting leakage as compared to standard VLPP testing was 50%; however we observed poor bladder compliance during Valsalva and stress-induced detrusor overactivity in two patients considered false negative confounding this result. The specificity of the test was 71%.

Seven patients (35%) demonstrated leakage only upon cough and not upon Valsalva provocation (with or without the mouthpiece).

Our results confirm there is a strong correlation between lung and abdominal pressures (p<0.05) as demonstrated previously. The average equation of this association indicates a near 1:1 relationship (m=1.09).

The average Y-axis (Pabd) offset was 29.74cmH2O however this came with a wide standard deviation (+/-31.6cmH2O). Patient baseline resting pressures appear to contribute to this offset effect. Plung may offer a measure of absolute VLPP as resting pressure is always zeroed to atmosphere when not in use whereas baseline abdominal and bladder pressures are vulnerable to catheter movement, position changes and differing baselines patient to patient. The Plung measurement would remove these potential concerns associated with UDS.

Conclusion

The Plung measurement demonstrates a significant correlation with abdominal pressure during VLPP testing. Plung is a promising non-invasive measure of VLPP for what was once strictly a uroodynamically-captured parameter requiring catheterization. The utility of measuring VLPP using Plung as a diagnostic test for SUI has yet to be determined, however we foresee this as an objective tool in the office work-up of pure SUI patients where conventional urodynamics may be considered unnecessary.

Future studies should examine a larger patient population and also consider Plung applicability in measuring CLPP, as a higher degree of patients demonstrate leakage on cough versus Valsalva.

Discussion

The poor sensitivity (50%) and specificity (71%) result could be attributed to the limited sample size, however the Plung stress tests were largely performed during a second filling of the bladder which also may have influenced results. Generally, there appears to be a lack of standardized methodology of VLPP technique across research studies (including urethral catheter size, zeroing of the transducer, patient position, bladder volume, type of stress, and timing of measurement).

It should be noted Greenland et al, by using a similar mouthpiece technique, found a 50% reduction in the inter-individual variation of abdominal pressure as compared to standard verbal instruction, thus providing a potential means of better standardization of VLPP.

An inherent property of the Valsalva is that it allows for measurement of slower, sustained pressures. Coughing creates a rapid, sudden rise and generally produces higher pressures for some patients, which may be the sole condition reproducing their SUI symptoms. We found a significant proportion of patients only leaked upon cough provocation (35%) and not on Valsalva. These patients were considered true negative as measuring CLPP was not within the scope of this study. However this is a known phenomenon in reproducing stress incontinence symptoms.

Literature Cited

3. Jeong IH, Yoo CN, Kim MJ, Kim BK, Bae SW. Preoperative minimal air pressure and pressure leak point pressure as predictive parameter for bowel dysfunction: J Reproductive Medicine 2009; 54(7): 436-40.