Comparison of Water and Air-Charged Transducer Catheters in the Evaluation of Cystometrogram Pressures

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Introduction and Objective
The primary objective of this study is to demonstrate the reproducibility of air-charged (AC) versus water-perfused (WP) catheters when measuring stress point pressures, such as coughs and valsalva movements, in urodynamic studies (UDS). The comparison was analyzed during a cystometrogram (CMG). We believe that a single, dual catheter, and the same experience clinician throughout the study will provide analogous point pressures for coughs and valsalva movements in both AC and WP catheters.

Methods
This IRB approved prospective study included women above the age of 21 with complaints of lower urinary tract symptoms who needed UDS as part of their diagnostic work-up. A commercially available T-DOC AC catheter was utilized to form a dual catheter to simultaneously read water and air pressures within the bladder and urethra. A transducer evaluates water pressure and sends electrical signals to a Laborie urodynamics machine. The water-filling channel serves both as a bladder filler and water pressure sensor. The patient is evaluated with an empty bladder on CMG, followed by cough and valsalva maneuvers at bladder volumes of 50 mL, 200 mL, and functional maximum capacity. A comparative analysis was performed on the maximum stress peak pressures for valsalva movements and coughs.

Results
Twenty-five women with a mean age of 57.7 years were recruited. Significant correlations were observed between AC and WP pressures as shown in Figures 1, 2. Trendline equations comparing AC and WP measurements over distinct bladder fill regions for cough and valsalva showed a high correlation (average R²=0.92, indicating that slower sustained pressures of valsalva correlate better. We did note an average bias (5.9 cmH2O for coughs and 4.8 cmH2O for valsalva) throughout the measurements. Visual impression of the two overlying measurement methods shows virtually identical tracings (Figure 4).

Conclusion
Cystometric pressures measured using air-charged catheters are comparable with water-filled catheters and clinically can be equally beneficial. Further studies will follow.
Figure 1: Cough Peak Pressure Correlation at Various Infused Volumes - Air v. Water

- Beginning (0-50mL): 
  \[ y = 0.8307x + 27.308 \]
  \[ R^2 = 0.73008 \]

- Mid-test (200-250mL): 
  \[ y = 0.8883x + 12.509 \]
  \[ R^2 = 0.93971 \]

- Functional Capacity: 
  \[ y = 0.9212x + 12.72 \]
  \[ R^2 = 0.91642 \]

- \( y = x \)

Figure 2: Valsalva Peak Pressure Correlation at Various Infused Volumes - Air v. Water

- Beginning (0-50mL): 
  \[ y = 1.0421x + 2.9741 \]
  \[ R^2 = 0.94816 \]

- Mid-test (200-250mL): 
  \[ y = 1.0032x + 4.0286 \]
  \[ R^2 = 0.98304 \]

- Functional Capacity: 
  \[ y = 1.0386x + 1.1072 \]
  \[ R^2 = 0.98861 \]

- \( y = x \)
Figure 3. The difference between the peak pressure of cough and valsalva AC and WP events during filling cystometry plotted against the average.

Figure 4. Filling cystometry tracing at an infused volume of 200mL. The top row contains two tracings overlaid representing WP (blue ‘Pura_water’) and AC (red ‘Pves_air’).