COMPARISON OF WEIGHTED AND WEIGHTLESS TRANSDUCTION MEDIUMS FOR USE IN UROLOGICAL CATHETER MANOMETER SYSTEMS

Mitchell Cooper, Paul Zaszczurynski, BS[1], Paul Fletter, BS[2] and Margot Damaser, PhD[3] (Presented By: Mitchell Cooper)
[1]Cleveland Clinic Foundation, Cleveland, OH; [2]Cleveland Louis Stokes VAMC, Cleveland, OH; [3]Cleveland Clinic Foundation, Cleveland, OH

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Introduction and Objective: Pressure measurement using a catheter system is essential to the diagnosis of voiding dysfunction. In a clinical setting, patient movement and urodynamic pumps can introduce hydrostatic and noise artifacts into measurements. Therefore, a complete characterization of a catheter system includes its response to artifacts as well as its frequency response. The objective of this study was to characterize and compare two commonly used clinical catheter systems: water-filled catheters, which transduce pressure via a weighted medium; an air-charged catheters, which transduce pressure via a weightless medium.

Methods: We characterized frequency response using both a transient step test, which exposed the catheters to a sudden change in pressure; and a sinusoidal frequency sweep test, which produced a pressure signal with constantly increasing frequency. The response of the catheters to motion artifacts was tested using a vortex shaker, and the response to hydrostatic pressure changes was tested by moving the catheter tips to calibrated heights.

Results: Water-filled catheters acted as an underdamped system, resonating at 10-15 Hz and attenuating signals at frequencies higher than 18 Hz. They demonstrated significant motion and hydrostatic pressure artifacts. Air-charged catheters acted as an overdamped or critically damped system, and attenuated signals at frequencies higher than 5-8 Hz. They demonstrated significantly less motion and hydrostatic pressure artifacts than water-filled catheters.

Conclusions: Air-charged catheters are significantly less sensitive to artifacts but attenuate signals at lower frequencies than water-filled catheters. Although cough and valsalva recordings have frequency components in the 14 and 7 Hz bands, respectively (Kim et al., J Biomech. 34:687,2001), the significance of these frequency components is not known. Future work needs to be done to characterize the frequency spectra of urodynamic recordings. Clinically, coughs and valsalvas create bladder and body movement and induce hydrostatic and pressure artifacts. Knowledge of the characteristics of the pressure-measuring system is essential to finding the best match for the specific application. This is especially true in studies where proactive maneuvers are required, such as heel bouncing and patient repositioning.

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