Effects of Training and Mechanical Force of Ultrasound on Bladder Filling: Repeatability of Oral Hydration Studies in Healthy Adults

Derek Sheen[1], Anna S Nagle PhD[2], Hiren Kolli[1], Naomi N Vinod[1], Hameeda A Naimi[1], Stefan G De Wachter MD PhD[3], John E Speich PhD[2], Adam P Klausner MD[1,4]

[1]Department of Surgery/Division of Urology, Virginia Commonwealth University School of Medicine, Richmond, VA [2]Department of Mechanical & Nuclear Engineering, Virginia Commonwealth University School of Engineering, Richmond, VA [3]Department of Urology, University Hospital Antwerpen, Edegem, University of Antwerpen, Wilrijk, Belgium

[4]Department of Surgery/Division of Urology Hunter Holmes McGuire Veterans Affairs Medical Center, Richmond, VA

INTRODUCTION

Currently, ICS-defined verbal sensory thresholds are the only standardized, objective measures of real time bladder sensation in the micturition filling phase. A non-invasive protocol was previously developed using 3D ultrasound along with a sensation meter to better characterize real time bladder sensation and its correlation with bladder volume/shape/rhythm. This study validates the protocol by measuring the effects of participant training and ultrasound probe pressure on bladder sensation in our oral hydration protocol.

METHODS

Ten healthy volunteers (3 male, 7 female) with no urinary symptoms based on ICIq-OAB scores were recruited into an oral hydration study. The participants drank 2L Gatorade G2 and used a touch-screen meter (**Fig. 1**) throughout 2 complete fill/void cycles per visit to record real-time bladder sensation (0-100%).

The study was repeated 3 times, once a week (visits A, B, and C). In visits A and B, ultrasound images were obtained every 5 min. The ultrasound was not used in visit C. Bladder volume measurements were taken every 5 minutes using the BladderScan. Average and SEM age and BMI of the participants were 25.6 ± 2.03 years and 24.8 ± 1.6 kg/m^2 respectively.

RESULTS

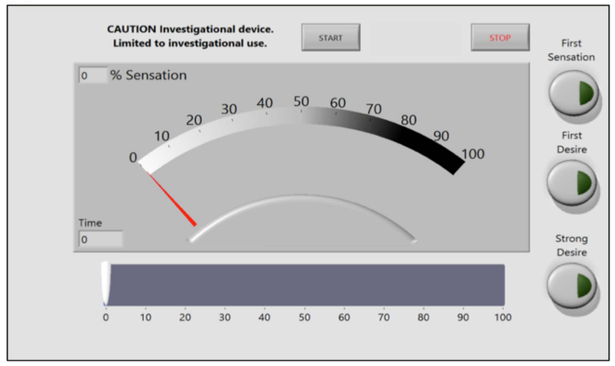

Figure 1. A. Sensation meter with Start and Stop buttons (top), slider bar interface (bottom), and VST selection (right).

Ultrasound

Bladder Scan

Comparing Capacities between Visits

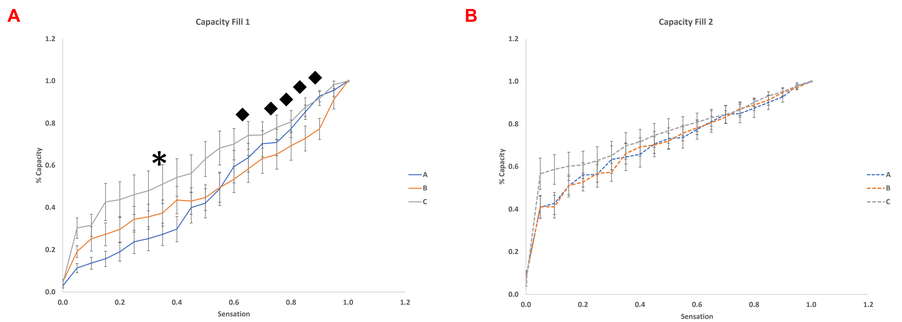

Figure 2. A. Fill 1 Capacities in Visits A-C. **B.** Fill 2 Capacities in Visits A-C. Significance denoted with asterisk (A vs B) and diamond (B vs C) with p<0.025

Effect of US and Training

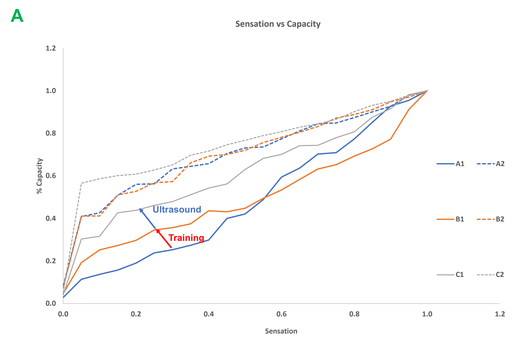

Figure 3. A. All visits and fills for capacity. Arrows indicate a leftward shift (decreased sensation).

Comparing Capacities between Fills

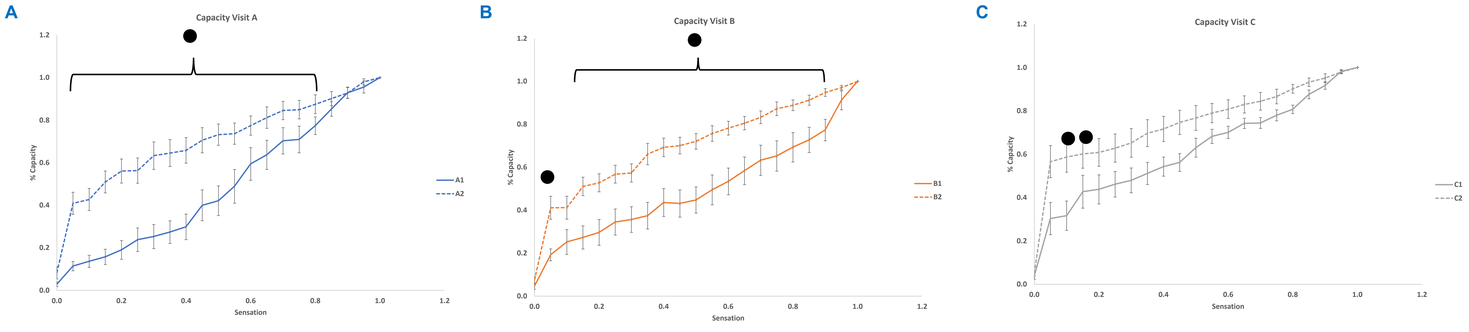

Figure 4. A. Visit A Capacities for Fills 1 and 2. **B.** Visit B Capacities for Fills 1 and 2. **C.** Visit C Capacities for Fills 1 and 2. Circle denotes significance with p<0.05

CONCLUSIONS

Our results have shown two aspects of improvement for a new non-invasive approach to allow patients who suffer from overactive bladder to feel more comfortable during the evaluation of their condition using oral hydration studies. Studying repeatability between visits and fills will make the use of this type of study more feasible.

Because both visits A and B had ultrasound, the decreased sensation (left shift) at low bladder capacities from A1 to B1 likely represents the effects of training (Fig. 6, red arrow). Training may increase the participants' awareness of their own bladder sensation, and thus increase their sensation threshold in regards to bladder capacity after going through a fill-void cycle for the first time. Looking at fully trained participants, there was a further decrease in sensation (left shift) comparing B1 to C1 where the ultrasound probe was withheld (Fig. 6, blue arrow). This indicates that the ultrasound probe may cause increased bladder sensation due to the pressure applied on a participant's bladder. Fill 2 of each visit had no significant differences between visits, showing one promising aspect of repeatability.

This validation study demonstrates that during oral hydration studies with two fills, training and ultrasound probe pressure can affect real-time bladder sensation, but this was not significant in the faster second fill. This will further clarify variables that influence non-invasive metrics for filling phase sensation.

ACKNOWLEDGEMENTS

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