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COMPARISON OF REAL-TIME BLADDER SENSATION DURING NON-INVASIVE ACCELERATED HYDRATION AND URODYNAMICS FOR PATIENTS WITH OVERACTIVE BLADDER

Hypothesis / aims of study
This study aimed to compare real−time bladder sensation generated through the use of a novel sensation meter in overactive bladder (OAB) patients undergoing an accelerated hydration protocol with a different group of OAB patients undergoing urodynamic studies (UDS). The purpose of the comparison was to potentially identify sensation patterns that might be useful to non-invasively sub-type different forms of OAB.

Study design, materials and methods
Two different groups of OAB patients were enrolled in separate IRB approved studies involving the use of our novel sensation meter during accelerated hydration [1] or during UDS. The ICIq-OAB survey question 5a ("Do you have to rush to the toilet to urinate?") was used to categorize participants: those who answered 3 ("most of the time") or 4 ("always") were considered to have OAB. In the accelerated hydration study, OAB participants drank 2L of Gatorade-G2® as rapidly as possible and then completed two fill/void cycles while recording real-time sensation. In the UDS study, participants underwent cystometric filling at a rate of 10% expected capacity per minute based on the maximum voided volume recorded on a three day bladder diary. All participants recorded real−time sensation (0-100% scale) using a touch-screen sensation meter [1]. A two-tailed power study with significance level of 0.05 and power of 80% was performed in R using previously published data [2] comparing bladder volumes in OAB patients at different sensations resulted in a sample size of 7 (6.22) people in each group would be required, but this study aimed to recruit 14 in each group to account for participants who may fail to complete the protocol or to have non-evaluable data.

Results
In the accelerated hydration study, filling duration decreased (61.0 ± 19.0 min vs 22.3 ± 22.2 min, $p < 0.0001$) and voided volume did not significantly change (298.3 ± 182.0 ml vs 326.06 ± 219.0, $p = 0.50$) from fill 1 to fill 2 ($n = 12$), demonstrating that the second fill had a faster overall fill rate. Duration was shorter in UDS ($n = 13$) than either hydration fill (11.3 ± 2.0 min, $p < 0.0001$). The UDS fill volume (550.4 ml) was less than the total volume of the hydration fills, but this was only significant compared to fill 1 ($p = 0.033$ compared to fill 1, $p = 0.064$ compared to fill 2). During accelerated hydration there was a left-shift in the sensation-capacity curve from fill1 to fill2 at 15-20%, 35-40%, and 85% sensation levels (Fig. 1A). During UDS, the sensation-capacity curve was significantly lower than hydration fill 1 at 75-95% sensation (Fig1B). Percent capacity was also significantly lower for UDS when compared to hydration fill 2 at lower sensation levels (45-55% and 65% sensation) (Fig. 1C).

Interpretation of results
The left shift seen in the OAB group from fill 1 (slow fill) to fill 2 (faster fill) was a surprising result as increased tension (and thus increased afferent nerve activity) would be expected at a faster deformation rate in a soft tissue. This suggests that the roles of desensitization and training may play more important roles than bladder muscle biomechanics in individuals with OAB. Interestingly, our previously published study showed the opposite result (right-shift) during hydration for asymptomatic volunteers (1). The UD curve (fastest fill) initially lay between the curves for hydration fill 1 and fill 2 and was generally closer to fill 1 despite utilizing a much faster fill rate. This, again, may indicate that the identified left shift is an effect of desensitization and/or training as opposed to a biomechanical viscoelastic change. A study in rats showed a large increase in fill rate in a second cystometric bladder fill rate sometimes decreased afferent nerve response, demonstrating desensitization [3]. These results may indicate that desensitization is common in humans with OAB and may provide rationale for more behaviour-based rather than pharmacologic treatments in this population.

Concluding message
This study demonstrates the value of non−invasive hydration as a means to characterize real-time bladder sensation in participants with OAB. Accelerated hydration data in OAB patients were largely consistent with UDS. Differences between fill 1 and fill 2 reveal dynamic characteristics of the bladder that cannot be identified by a single UDS fill and suggest that bladders in subjects with OAB may undergo acute changes in bladder compliance, tone, training, sensitization, and other factors. This type of real-time sensation metrics could ultimately be used to identify sub-groups of OAB patients that would respond better to behavioural interventions (right-shifted sensation-capacity curve in fill 2 vs. 1) and those that might have purely biomechanical defects (left-shifted sensation-capacity curve in fill 2 vs. 1).

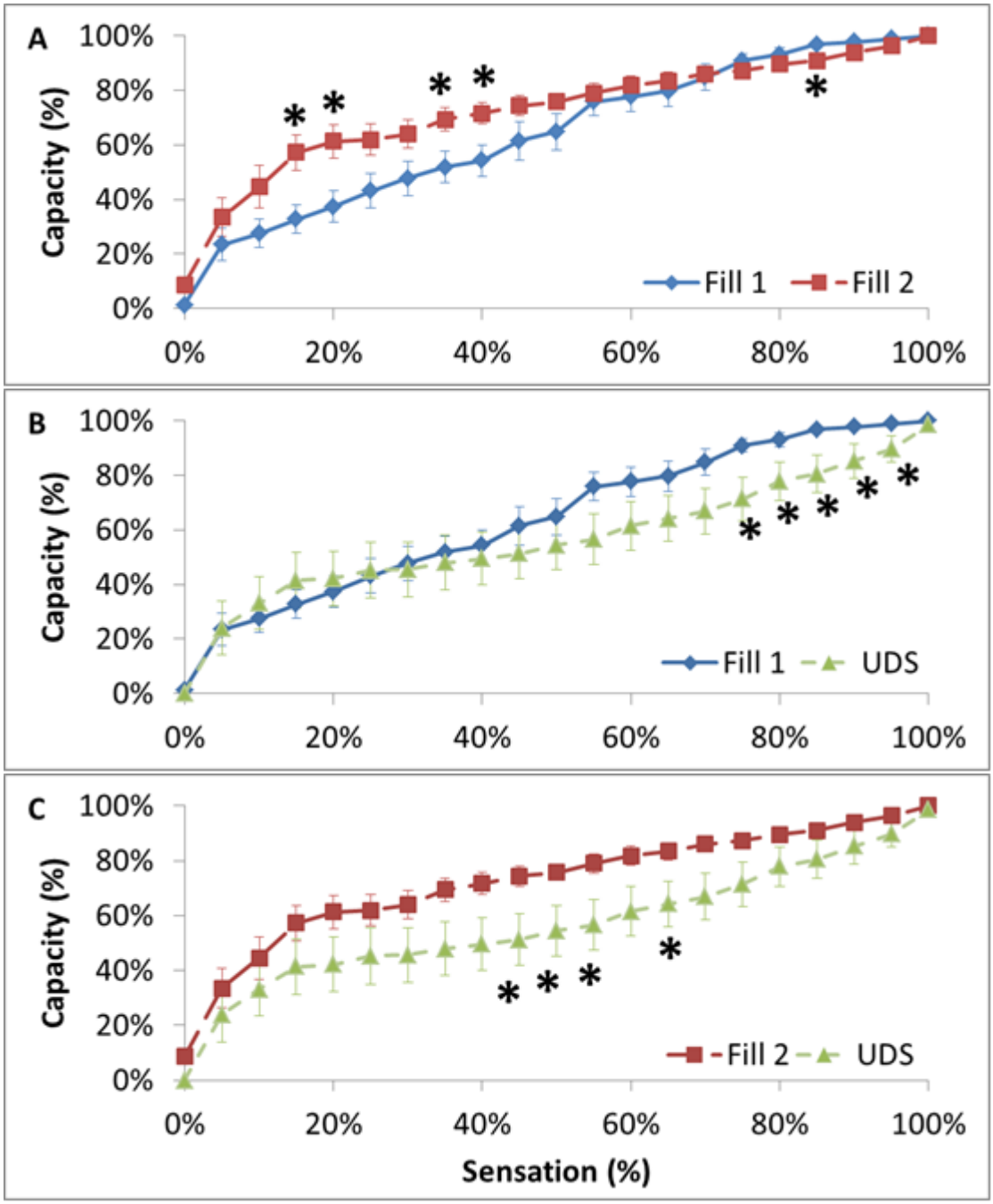

Figure 1. Normalized filling capacity as a function of %sensation calculated. A) Hydration study participants had a left shift from fill 1 (slow fill, solid line) to fill 2 (faster fill, dashed line). UDS participants (fastest fill, short dash line) differed from fill 1 at the end of the fill (B) and from fill 2 in the middle of the fill (C). Stars denote significant differences between fills.

References

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Disclosures

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