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NEW INSIGHT INTO THE FUNCTION OF THE STRIATED URETHRAL SPHINCTER IN MEN USING A NOVEL ELECTROMYOGRAPHY ELECTRODE DURING DYNAMIC TASKS

Hypothesis / aims of study

The function of the striated muscles of the urethra (striated urethral sphincter [SUS]) in men is debated. Two opposing views have been proposed. The first proposes that the SUS provides tonic control at rest with little contribution to dynamic functions. The second proposes that SUS contributes to phasic control when bladder pressure is transiently increased. Debate is limited by lack of methods to adequately study this muscle system. We favoured the second hypothesis and developed a novel method to record SUS activity in a stable manner during dynamic tasks in upright positions and a method to dynamically challenge the continence apparatus to study this question. We hypothesised that SUS would be active during postural tasks that challenge the spine when intra-abdominal pressure (IAP) is increased for spine stability, to both maintain continence and contribute to the IAP increase.

Study design, materials and methods

Five healthy male subjects aged 34.8±5.8 years with no history of urinary tract disorders volunteered. Electromyographic activity (EMG) of the SUS was recorded with a novel catheter electrode. This electrode was fabricated from a 6 Fr urinary catheter with recording surfaces made from 4 strands of stainless steel wire threaded through small pinholes ~15 and 25 mm from the end of the catheter (1). Wires were threaded down the catheter's lumen. Suctioning the catheter to the mucosa via the urine ports stabilised the electrode position. The electrode was inserted using a conventional aseptic technique for self-catheterisation. EMG data were bandpass filtered between 3 and 2000 Hz, amplified 2000 times, and sampled at 10 kHz. IAP was recorded with a nasogastric catheter with 2 pressure transducers; one placed in the stomach and the second in the oesophagus. Recordings were made with the participant standing at rest and during a postural task to investigate the relationship between SUS EMG and a task that involves increased IAP. The postural task involved a repetitive arm movement with incremental increase in movement frequency (and thus arm acceleration and the associated reactive moment on the body) between 15 deg flexion and 15 deg extension. Arm acceleration was measured from an accelerometer placed at the lateral epicondyle. Movement was performed without breathing and the speed of arm movement was increased from 0.5 Hz to "as fast as possible" over 10 s. Times of peak acceleration in each direction and the associated RMS EMG amplitude of SUS and IAP amplitude over 100 ms windows were calculated. Regression lines were fitted to the relationship between EMG or IAP, and peak arm acceleration.

Results

The EMG electrode provided clear recordings of single motor unit activity during voluntary and postural efforts. No action potentials were identifiable when participants stood in a relaxed position. When participants moved the arm with increasing frequency (and acceleration), there was an incremental increase in activity of the SUS. There was a high linear correlation (range R^2=0.74-0.89) between arm acceleration and both SUS EMG and IAP amplitudes with both directions of arm movement.

Interpretation of results

This study confirms the viability of our new electrode to record SUS activity in dynamic tasks in men. The findings support the hypothesis that SUS activity does not maintain continence at rest. The relationship between arm acceleration and SUS activity was consistent with the hypothesis that contribution of the SUS is necessary to both maintain urinary continence when IAP and bladder pressure are increased. Not only is this EMG activity necessary to maintain continence, it is also important to note that IAP would not increase without maintenance of the integrity of continence. This can therefore be considered as evidence of a contribution of the SUS to the maintenance of continence as IAP fluctuates with necessity to generate the trunk moments associated with rapid volitional arm movements.

Concluding message

This study provides compelling evidence of the contribution of SUS to phasic control of continence when IAP is transiently increased, but not when standing at rest. The data also show evidence of a postural function of the SUS which in this task is consistent with the role on control of continence.

References

1. Stafford R, Sapsford R, Ashton-Miller, J. Hodges PW (2010) A novel trans-urethral surface electrode to record electromyographic activity of the male striated urethral sphincter. Journal of Urology, 183:378-385.

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