Do urethral dynamics differ between voluntary and evoked coughs?

**Introduction**

Stress urinary incontinence (SUI) is often provoked by coughing. Pelvic floor displacements during voluntary coughs are routinely assessed in clinical and research settings as a method to investigate pelvic floor function in men and women who complain of these symptoms. Although some data of pelvic floor muscle activation are available for men, there has been limited investigation of the control of continence during coughing in men. Recent studies of urethral dynamics with transperineal ultrasound imaging (US) have highlighted unique strategies in men that involve motion of both the urethrovessical junction (UVJ) and mid urethra during voluntary efforts [2]. Motion of these regions is yet to be studied in natural tasks such as coughing. Furthermore, it is not clear whether a voluntary cough is an adequate surrogate for the involuntary or spontaneous coughing associated with symptoms. A key issue is that, unlike a spontaneous cough, a voluntary cough enables greater potential to prepare for the mechanical forces.

**Aims**

1. To investigate the dynamics of urethral displacement in men during voluntary coughs.
2. To compare urethral dynamics between voluntary and evoked coughs.

**Methods**

**Participants:** 13 healthy men aged 28-42 years with no history of urological or neurological disease.

**Transperineal US:** Participants sat in a semi-reclined position and the urethra was imaged using real-time US (in video format) with a transducer placed on the perineum in the mid-sagittal plane; frequency 7.0 MHz (Logiq9 ultrasound, GE Healthcare).

**Coughing:** Intra-abdominal pressure (IAP) was recorded with a nasogastric pressure catheter and myoelectric activity of the abdominal muscles was recorded with surface electromyography (EMG). A pneumotachometer was recorded the onset and amplitude of expiratory airflow. For voluntary coughs participants inhaled deeply and then performed a strong voluntary cough, for 3 repetitions. Evoked coughing was stimulated by inhalation of nebulised capsaicin dissolved in saline, for 3 repetitions [1].

**Analysis:** Recordings of IAP, EMG and US data were synchronised via a footswitch. Single frame images were analysed using a method described previously to calculate urethral displacements that have been argued to be associated with activation of striated urethral sphincter (SUS), levator ani (LA) and bulbocavernous (BC) muscles [2]. Timing and amplitude of urethral displacements were calculated with variables which characterised cough generation including time of onset of IAP increase, time of initiation of expiratory airflow associated with the cough, time and amplitude of peak air flow, and time and amplitude of peak IAP.

**Characteristics of voluntary and evoked coughs**

**Coughing involved three phases:** inspiration ($I_o - P_e$), pressurisation ($P_e - E_o$) and expulsion ($E_o - end$ cough). Raw data from a representative participant are shown in Figure 2.

**Figure 2:** Representative raw data of cough and urethral mechanics during voluntary and evoked coughing

**Differences in urethral dynamics between cough types**

**Main findings:**

- Peak IAP and expiratory flow was greater during evoked coughs; inspiratory phase was shorter
- Greater IAP was accompanied by greater dorsal displacement of MU (shortening of SUS) and caudal displacement of vUVJ/dUVJ (lengthening of LA)
- Peak MU displacement occurred at a similar time to max vUVJ/dUVJ descent during voluntary coughs, but after it during evoked coughs
- Challenge to maintain continence appears greater during evoked coughs

**Conclusions**

Data reveal complex interaction between muscles involved in continence in men. Spatial and temporal differences in urethral dynamics and cough mechanics between cough types suggest voluntary coughing may not adequately assess capacity of the continence mechanism.

**References**


**Funding provided by the Australian Research Council**