

DETECTION OF NEUROGENIC DETRUSOR OVERACTIVITY BY MONITORING URETHRAL SPHINCTER EMG

Hypothesis / aims of study

Neurogenic detrusor overactivity (NDO) is frequently associated with urethral sphincter overactivity, resulting in detrusor sphincter dyssynergia (DSD). This combination often leads to high intravesical pressures followed by incontinence and low bladder capacity. If left untreated the high pressures may cause upper urinary tract damage.

NDO is conventionally managed by anticholinergic medication. However, many patients are refractory to this treatment or have dose limiting side effects. In these cases, ablative surgery is usually considered in order to preserve kidney function. An alternative treatment option is electrical stimulation. It has been shown that electrical stimulation of pudendal nerve afferents can inhibit bladder contractions in patients with NDO and that bladder capacity can be increased by continuous [1] as well as conditional stimulation [2]. Our future goal is the development of an implantable neuroprosthesis to treat NDO. However, the need for a non-catheter based monitoring of bladder activity is essential if event driven stimulation is to be used. The objective of this study was to evaluate the feasibility of NDO detection by monitoring urethral sphincter EMG.

Study design, materials and methods

The study was approved by the local Ethics Committee and informed consent was obtained from all patients. A urodynamic study using slow artificial bladder filling (≤ 20 ml/min) was performed on 23 neurogenic patients (13 males, 10 females). Vesical pressure (P_{ves}) and abdominal pressure (P_{abd}) were measured using an 8Fr double lumen water filled catheter and a 9Fr water filled rectal balloon catheter, respectively. Two insulated fine wire electrodes were inserted into the periurethral musculature for EMG recording of the external urethral sphincter (EUS).

Inclusion criteria were a history of NDO and DSD, bladder capacity below 500 ml and age above 18 years. Participants were not asked to discontinue medication prior to participating in this experiment. A correlation analysis between P_{det} and EUS EMG was performed. The time delay (Δt) between the onset of the first detrusor contraction and the onset of EUS EMG activity was calculated together with the increase in detrusor pressure (ΔP) related to this delay (Figure 1).

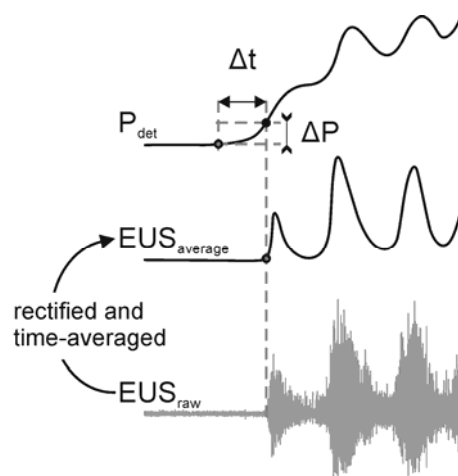


Figure 1. Calculation of Δt and ΔP

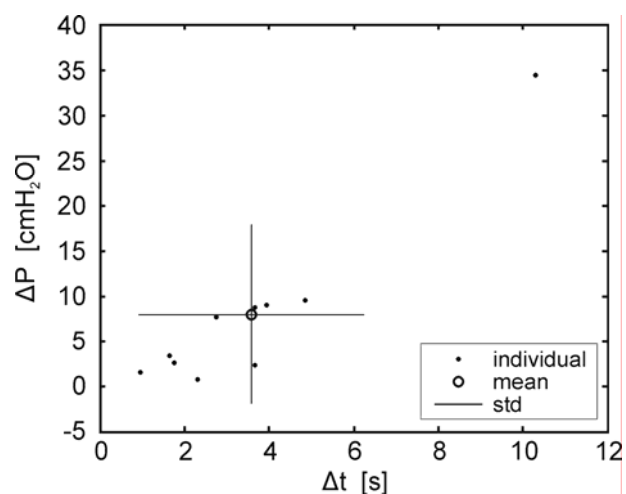


Figure 2. Results from 10 patients with strong

Results

Of the 23 patients enrolled in the study, 12 showed both NDO and DSD. Eight patients showed no NDO during the slow artificial bladder filling or they had too large a bladder capacity, two showed no sign of DSD and recordings in one patient failed due to technical reasons. Of the 12 patient with both NDO and DSD, 10 patients had a strong correlation between detrusor pressure and urethral sphincter EMG. The strong correlation allows the use of EMG as a predictor for detrusor contractions. In these 10 patients, the average delay between the onset of a detrusor contraction and the onset of EUS EMG activity was 3.6 ± 2.7 s. The average pressure increase related to this delay was 8.0 ± 9.9 cmH₂O (Figure 2).

Interpretation of results

Pressure activated electrical stimulation of pudendal nerve afferents with a threshold of 10 cmH₂O has previously been shown to inhibit bladder contractions sufficiently early to prevent leakage as well as to maintain a safe storage pressure [3]. In the current study, in 9 out of 10 patients the onset of EUS EMG activity occurred before the detrusor pressure exceeded 10 cmH₂O (see figure 2). Thus, stimulation could be applied earlier in these patients if activation was based on a rise in EMG activity rather than on a rise in pressure.

Concluding message

This study demonstrates the feasibility of using sphincter EMG to estimate the onset of a detrusor contraction in selected patients. In 9 out of 10 patients with strong correlation between NDO and DSD, the detection was sufficiently early in time to suppress NDO before the detrusor pressure becomes too high. An automatic, event driven stimulation scheme with a catheter based monitoring of bladder activity have shown that the method of conditional stimulation works [3].

However, the catheter based monitoring is not feasible in an implant but monitoring striated sphincter activity may be a viable solution. Although the setup in this experiment is not suitable in a clinical setting, the method is promising and warrants further investigation.

References

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- [2] Conditional stimulation of the dorsal penile/clitoral nerve may increase cystometric capacity in patients with spinal cord injury, Neurourol Urodyn, 2003. 22(2): p. 130-137
- [3] A portable device for experimental treatment of neurogenic detrusor overactivity, Neuromodulation, 2003. 6(3): p. 158-165

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