

## **SUPPRESSION OF INVOLUNTARY DETRUSOR CONTRACTIONS AND INCREASE IN WARNING TIME USING CONDITIONAL STIMULATION AMPLITUDE INCREASE IN ADDITION TO CONTINUOUS DORSAL GENITAL NERVE STIMULATION.**

### Hypothesis / aims of study

Continuous electrical stimulation and conditional stimulation of the dorsal nerve of the penis or clitoris can both suppress involuntary detrusor contractions (IDC) and increase bladder capacity. In conditional stimulation, stimulation is only applied when an IDC occurs. Conditional stimulation provides patients with an expanded warning time and a possibility to postpone micturition from the start of the first IDC. We tried to determine whether it is possible to provide patients with an expanded warning time using conditional increases in stimulation amplitude to suppress IDC in addition to continuous stimulation at low stimulation amplitude to increase bladder volume at which the first IDC occurs.

### Study design, materials and methods

Both neurogenic and non-neurogenic patients with detrusor overactivity with or without incontinence were included. Patients were in the supine position. During stimulation cystometry, continuous stimulation was applied concomitant with bladder filling. The stimulation amplitude was conditionally increased during an IDC. Cystometry without stimulation of the dorsal nerve of the penis or clitoris was done before electrode insertion (baseline) and after stimulation cystometry (control).

A needle electrode (Foramen needle 041828, Medtronic) was inserted suprapubically, lateral from the midline, in the direction of the dorsal nerve of the penis or clitoris between the pubic bone and the base of the penis or clitoris. Electrode insertion was guided by the genito-anal reflex that was evoked by electrical stimulation (burst stimulation, burst frequency 1 Hz, 5 pulses per burst, pulse duration 200  $\mu$ s, interpulse interval 4 ms, 0-20 mA) and by sensation to this stimulation, which provided information about the position of the electrode relatively to the dorsal nerve of the penis or clitoris.

Before the start of cystometry with stimulation, the lowest amplitude a patient could sense (sensation threshold) and the maximum tolerable amplitude were determined. Continuous stimulation (frequency 20 Hz, pulse duration 200  $\mu$ s, amplitude 0-25 mA) was done at amplitudes just above the sensation threshold. Conditional increase in amplitude was applied at (sub-) maximum tolerable amplitude when an IDC occurred.

### Results

Seven males and one female with neurogenic detrusor overactivity (6) and non-neurogenic detrusor overactivity (2) were included. Two patients were excluded after the control cystometry at baseline, because IDC occurred above 500 ml bladder filling.

At least one IDC could be suppressed with conditional amplitude increase at IDC in four out of six patients (range 1-3). An example is shown in Figure 1. Complete suppression of an IDC was not possible in two patients. In one of the latter patients, detrusor pressure did not further increase during stimulation at maximum tolerable amplitude during an IDC. When stimulation was stopped, the pressure suddenly strongly increased.

The median maximum cystometric capacity did not increase during stimulation (260 ml, range 142-440) compared to baseline and control cystometry (265 ml, range 86-462). The volume at which the first IDC occurred was even lower during stimulation cystometry (201 ml, range 25-343 ml) compared to baseline and control cystometry (253 ml, range 65-446). The warning time during stimulation cystometry is higher than during cystometry without conditional stimulation amplitude increases as the difference between bladder volume of first IDC and maximum cystometric capacity is higher (median 43 ml, range 20-117) compared to no stimulation (15 ml, range 4-74). A filling rate of 20 ml/min during cystometries resulted in a median increase in warning time from 45 s to 129 s (range 12-222 and range 60-351 s, respectively).

### Interpretation of results

No increase in maximum cystometric capacity was found using both continuous stimulation and conditional increases in amplitude at IDC. Bladder capacity at first IDC even decreased during continuous stimulation. However, the study setting seemed not to be ideal to determine exact bladder capacities. Patients were in a supine position. The bladder was emptied before and after each cystometry through the catheter for urodynamics without any movement of the catheter, resulting in improper catheterisation. Varying differences between the filled volume and residual urine were observed. Volumes should therefore be interpreted with caution.

In addition, only acute stimulation effects of continuous stimulation could be derived. Because of the use of a needle electrode, chronic application of the stimulation was not possible and long-term application effects could not be observed.

Most important is the result of conditional increase in amplitude when an IDC occurs. This enabled suppression of at least one IDC in four out of six patients and lower detrusor pressures without incontinence in another patient. Micturition can be postponed in this way to provide extra time after the onset of an IDC to find a proper place for bladder emptying to prevent incontinence. As the natural filling rate is lower than the filling rate of 20 ml/min, which was used in this study, the increase in warning time will actually be higher.

### Concluding message

Conditional increases in stimulation amplitude can suppress involuntary detrusor contractions during continuous stimulation of the dorsal nerve of the penis or clitoris in patients with detrusor overactivity. This provides an expanded warning time for patients as micturition can be postponed and incontinence prevented.

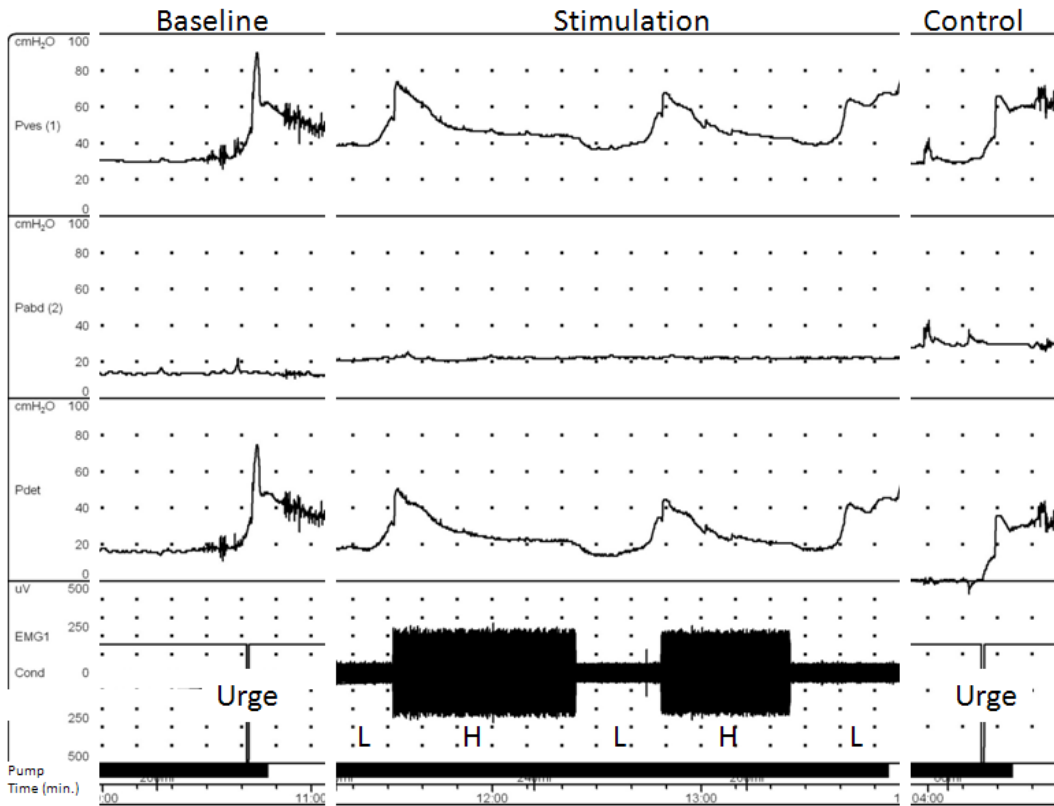


Figure 1: Example of stimulation effects in a SCI patient with NDO. Baseline and control cystometry show both an end-filling IDC with a concomitant sensation of this contraction (urge). Bladder sensations were marked by the patient using a press button connected to the conductance computer port (Cond). Continuous stimulation (L) during the second filling with conditional increase in stimulation amplitude (H) when an involuntary detrusor contraction occurred, was able to suppress three IDC. At the fourth IDC, the amplitude was not increased, which resulted in a constant IDC with leakage. Pves, vesical pressure; Pabd, abdominal pressure; Pdet, detrusor pressure; EMG1, artefact signal of electrical stimulation (L = low amplitude, H = high amplitude).

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<b>Is this a clinical trial?</b>	No
<b>What were the subjects in the study?</b>	HUMAN
<b>Was this study approved by an ethics committee?</b>	Yes
<b>Specify Name of Ethics Committee</b>	Commissie Mensgebonden Onderzoek, regio Arnhem-Nijmegen (Local human ethical committee)
<b>Was the Declaration of Helsinki followed?</b>	Yes
<b>Was informed consent obtained from the patients?</b>	Yes