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STIMULATION OF THE DORSAL NERVE OF THE PENIS, AN ALTERNATIVE FOR SACRAL AND PUDENDAL STIMULATION?

Hypothesis / aims of study

Detrusor overactivity is a urodynamic observation characterised by spontaneous or provoked involuntary detrusor contractions during the filling phase which may lead to incontinence. In detrusor-sphincter dyssynergia, there is a lack of coordination between the bladder wall and the external urethral sphincter. Both muscles contract at the same time and consequently the patient cannot empty his/her bladder completely. The above problems may result from a disturbed coordination caused by damaged connections in the spinal cord for instance as a result of traumatic spinal cord injury. When farmacotherapy or physiotherapy are unsuccessful, neurostimulation of the sacral root or pudendal nerve is often suggested. A different method, which involves stimulation of the dorsal nerve of the penis (DNP, an afferent branch of the pudendal nerve) is also applied, albeit on a much smaller scale but with good results (1).The effect seems to depend on the frequency of the stimulation (2).This method is less invasive and appears to have less side effects. We started a study in which the DNP of the rat was stimulated under different conditions, to elucidate the pathways involved and to possibly optimize this method.

Study design, materials and methods

Four intact male Wistar rats (423 ± 50 g) were anesthetized with urethane (1.2 g/kg, 50% g/v ip). The animals were kept warm on a heated pad. The abdomen was opened and the bladder, pelvic nerve (PEL) and DNP were dissected. A catheter was inserted into the bladder to both fill the bladder with saline at 0.11 ml/min using an infusion pump and to record pressure. On the left side, PEL and DNP were mounted on bipolar platinum electrodes connected to stimulators. The abdominal cavity was filled with paraffin oil to prevent tissue from drying out and for electrical isolation purposes. The bladder was filled to different volumes (range 0.2–1.1 ml). Five stimulation protocols (P1-5) were applied. To evoke bladder contractions, the PEL was stimulated with 10 or 15Hz, 4-10V, 400μs bipolar pulses (P1). During spontaneous contractions, the DNP was stimulated with 3, 10 and 30Hz, 1-7V, 400μs bipolar pulses (P2). In one animal, DNP was stimulated after cessation of a preceding PEL stimulation (P3). In the fourth protocol, PEL was stimulated first and the stimulation of DNP was added while stimulation of PEL continued (P4).The DNP was stimulated first and the stimulation of PEL was added while stimulation of DNP continued in the fifth protocol (P5).In one animal, the DNP was stimulated during spontaneous contractions after the PEL on the left side had been transected. Stimuli on/off and bladder pressure were read into a PC using Labview®. Data were analyzed using Matlab®.

Results

Stimulation of the PEL (P1) always resulted in a pressure rise reaching a plateau (mean $\Delta p \pm$ SD: 29.3 ± 12.3 cm H_2O, n = 7+5+5+7) (Fig. 4B). The correlation coefficient (Pearson) of filled bladder volume and pressure rise was 0.41 (p = 0.059). Stimulation of the DNP during spontaneous contractions (P2) resulted in a pressure decrease to base line at 3Hz (n=2+2+2+0), 10Hz (n=5) and 30Hz (n=5+5) (Fig.1). In all measurements pressure decreased to base line level, even if DNP stimulation was stopped before base line was reached. The one example of an evoked contraction inhibited by stimulation of the DNP (P3) is presented in Fig. 2. When PEL was stimulated first and stimulation of DNP was added (P4), bladder pressure continued to rise to a plateau or leveled off earlier but did not decrease as long as PEL was stimulated (Δp = 33.0 ± 6.2 cm H_20, n=4+1+6+3) (Fig. 3). When DNP was stimulated first and stimulation of PEL was added (P5), pressure increased to a plateau (Δp= 30.0 ± 6.7 cm H_20, n=4+1+1+3) (Fig. 4A). Comparison of the pressure increases with P1, P4 and P5 showed no significant differences (ANOVA, p = 0.537). Stimulation of DNP after transection of the left PEL resulted in inhibition of spontaneous contractions as before.

Interpretation of results

The inhibition caused by stimulation of the DNP does not depend on the duration of the stimulation; once the inhibition has started it continues, even if the stimulation is turned off. We have no data to suggest that the inhibition is volume dependent. Since 'pre'stimulation of DNP did not prevent PEL evoked contractions and transection of PEL did not influence the DNP evoked inhibition, we conclude that the pathway of inhibition does not involve PEL.

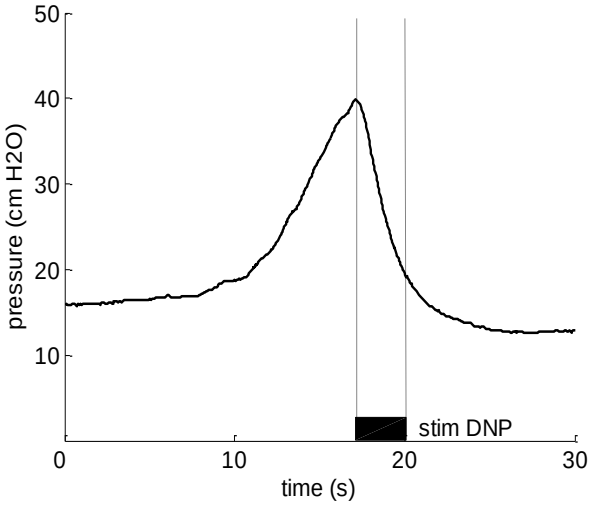

Fig 1. *Inhibition of a spontaneous bladder contraction by stimulation of DNP (volume 0.6 ml)*
DNP: 30Hz 5V 400µs

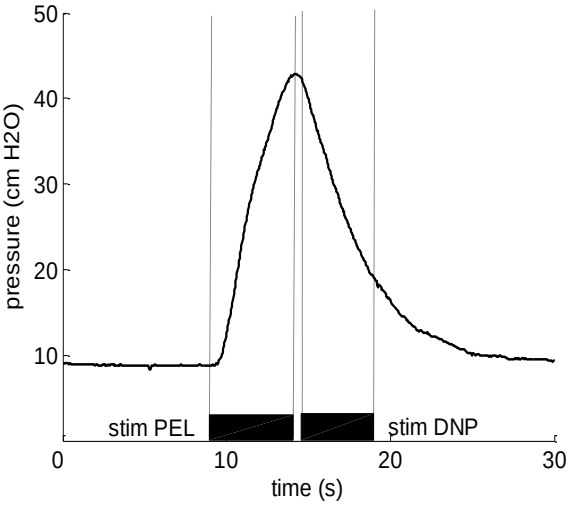

Fig 2. *Evoked bladder contraction inhibited by stimulation of DNP (volume 0.4 ml)*
PEL: 15Hz 10V 400µs
DNP: 30Hz 5V 400µs

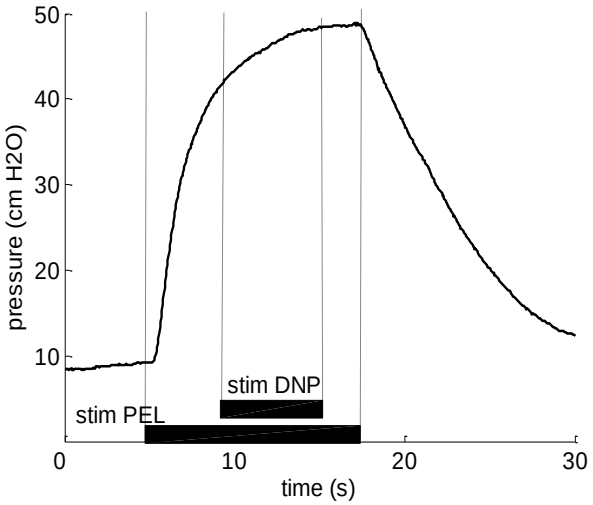

Fig 3. *Bladder contraction during stimulation of PEL+DNP (volume 0.7 ml)*
PEL: 15Hz 5V 400µs
DNP: 30Hz 7V 400µs

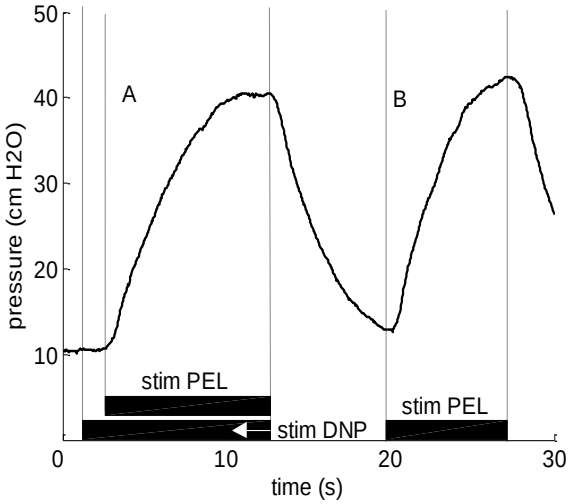

Fig 4. *Bladder contraction during stimulation of DNP+PEL (A) and PEL (B) (volume 0.5 ml)*
DNP: 30Hz 5V 400µs
PEL: 15Hz 10V 400µs

Concluding message

In the Wistar rat, stimulation of the dorsal nerve of the penis leads to inhibition of spontaneous contractions of the urinary bladder. Pelvic nerve evoked contractions are inhibited only if the stimulation of the pelvic nerve stops before the stimulation of the dorsal nerve of the penis begins. Experiments will be continued to clarify which nerve pathways are involved.

References

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2. J Physiol 577(1): 115 - 126 (2006)

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Is this a clinical trial?	**No**
What were the subjects in the study?	**ANIMAL**
Were guidelines for care and use of laboratory animals followed or ethical committee approval obtained?	**Yes**
Name of ethics committee	**Approval for the animal experiments was obtained from the local Dier Experiment Commissie (Animal Experiment Committee)**