

## SACRAL NEUROMODULATION - A NEW PARAMETER TO OBJECTIFY THE MOST EFFECTIVE ELECTRODE POSITION

### Hypothesis / aims of study

In our animal-experimental studies it should be evaluated which reasons lead to the fact, that the peripheral nerve evaluation (PNE-test) in the approach of a implantation of a neuromodulator shows a positive response of only approximately 51% in spite of all primarily suitable patients. For this reason almost half of all patients will be kept of a possibly promising treatment with neuromodulation. The crucial parameter for a successful result of sacral neuromodulation (SNM) seems to be the position of the electrodes. Few parameters are used to indicate the correct electrode position: 1. contraction of the anal sphincter with a rolling-inward motion of the intergluteal fold and 2. a plantar flexion of the great toe. We tried to identify a more sensitive parameter for optimal electrode positioning.

### Study design, materials and methods

In animal models (Göttinger Minipig (n=4) and rabbit (n=6)), we performed a PNE-test with recording of the intravesical and intrarectal pressure, as well as the pressures of the urethral and the anal sphincter. The bladder was filled up to 70% of the maximum bladder capacity with body-warm 0.9% saline solution and no spontaneous contractions of the detrusor muscle appeared. Electrodes were applied bilaterally to the foramina S1-S4 and SNM was performed at 5 different electrode positions, which differed in the depth of infiltration (monophasic rectangular signal, 210us, 21Hz, 0.5V). Afterwards the electrodes were placed to the position with highest urethral sphincter response. At this level a stimulation was performed for 1 minute with measuring the urine flow and micturition volume.

In 6 patients with neurogenic and ideopathic bladder dysfunction (overactive bladder and retention) we performed a conventional peripheral nerve evaluation (PNE)-test prior to SNM with recording of the urethral and the anal sphincter pressure. Electrodes were applied bilaterally to the foramina S2-S4 and sacral nerve stimulation was performed in each foramen at 3 different electrode positions, which differed in the depth of infiltration.

### Results

In the animal model the electrode position showing the max. stimulation response of the *urethral* sphincter differed significantly from that with the max. *anal* sphincter response ( $p < 0.05$ ). A contraction of the lower extremity appropriate to the plantar flexion of the great toe in human did not correlate with the electrode position at the maximum contraction of the urethral sphincter. Stimulation at the electrode position that showed the max. increase of urethral sphincter pressure caused a relaxation of the urethral sphincter with subsequent micturition, with only slight increase of intravesical pressure after stimulation-offset. Typically, the urethral pressure dropped below the baseline measured prior to stimulation. At the position with the highest *anal* sphincter response no micturition occurred. Also in 5 of 6 patients (83%) the electrode position showing the max. stimulation response of the *urethral* sphincter differed from that with the max. *anal* sphincter response. A plantar flexion of the great toe did not always correlate (66%) with the electrode position at the maximum pressure response of the urethral sphincter. These positions also differed interindividually. The electrodes were placed at the position with highest urethral sphincter response for chronic sacral stimulation (n=5 at S3, n=1 at S2).

### Interpretation of results

These studies indicate that there is an important difference between the electrode position for stimulation response of the urethral and anal sphincter. In the animal model micturition only occurred at the electrode position of the max. urethral sphincter response. The high rate of clinical non-responders to the peripheral nerve evaluation might be caused by inappropriate parameters for electrode positioning.

### Concluding message

In the animal studies the recording of the urethral sphincter pressure response was of crucial importance for optimal electrode positioning which led into a subsequent micturition. These and the clinical results indicate the importance of simultaneously recording of the urethral sphincter pressure within the PNE-Test prior to SNM. The electrode placement at the position of the highest urethral sphincter pressure response seems to be an important criterion for optimizing the electrode positioning, which might lead to an increase of the PNE-test success rates in an on-going evaluation.

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