EARLY SACRAL NEUROMODULATION ALLEVIATE DETRUSOR OVERACTIVITY IN COMPLETE SPINAL CORD INJURY RATS

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ABSTRACT

Sacral neuromodulation (SNM) has obtained controversial outcomes when used as a treatment for neurogenic lower urinary tract dysfunction (NLUTD) in spinal cord injury (SCI) patients or animal models. In this study, we applied early SNM to complete spinal cord injury rats and using cystometry to determine the exact therapeutic effect of SNM on SCI-induced NLUTD. The results showed that early SNM increased the intercontraction intervals ($p<0.05$), bladder capacity ($p<0.05$), and reduced the frequency of non-voiding contractions ($p<0.05$) in complete SCI rats, indicating early SNM may alleviate spinal cord injury- induced detrusor overactivity.

METHODS

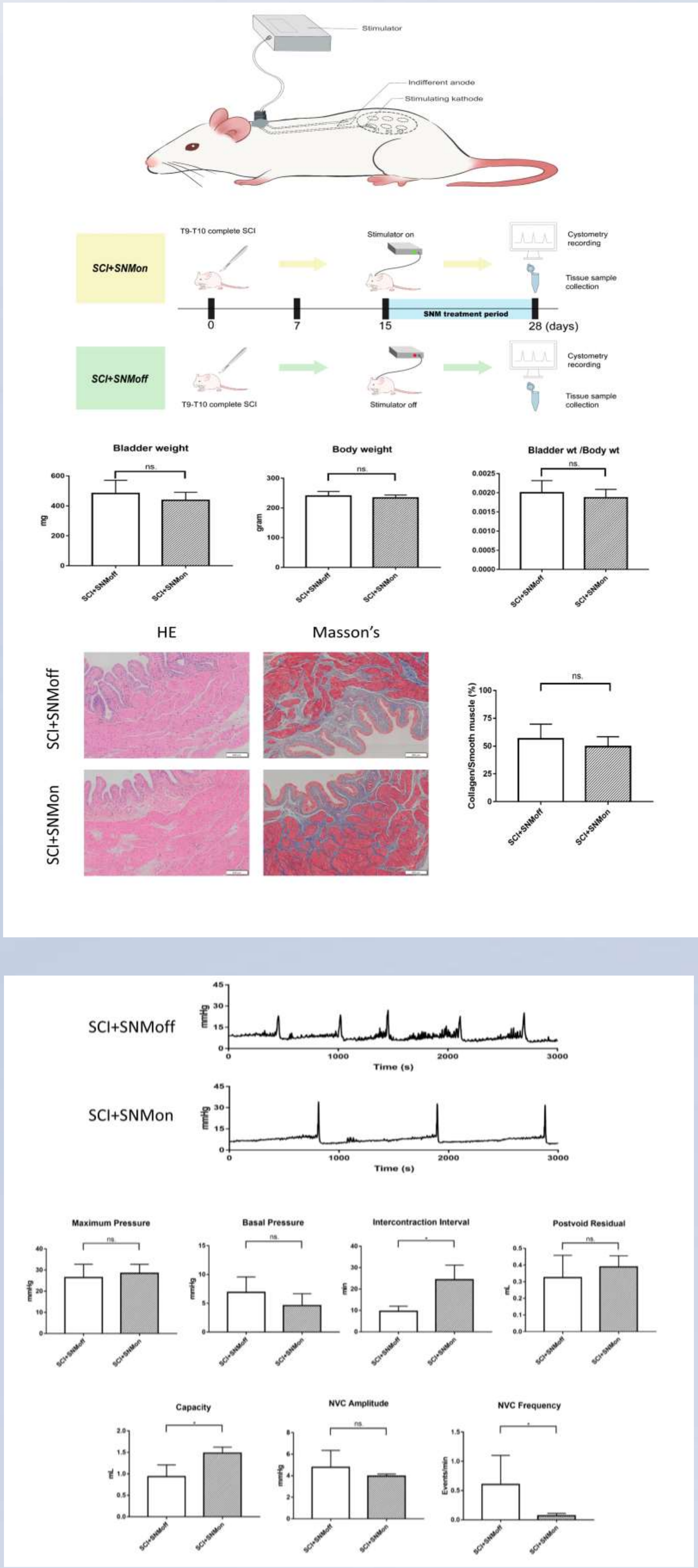
Female Sprague–Dawley rats underwent spinal cord transection at T9–T10 level. Unilateral sacral segmental stimulation with an electrode at S1 foramen was performed at early phase after complete spinal cord injury. SNM was conducted using a T9002 pulse generator (Beijing PINS Medical CO. LTD) 6 h/day for a period of 2 weeks from day 15 after SCI in the SCI+SNMon group. The stimulators used for the SCI+SNMoff group were kept powered-off during the stimulation period. For long period of stimulation, we adopted parameters with 20 Hz, 100 μs, a train duration of 30 s, a train period of 80 s, and voltage between 0.1 and 1 V, which was determined by 80% of the minimum voltage for visible tail or hindlimb movement. After SNM treatment, general charicteristics of the rats were collected and the bladders were sectioned for H&E staining and Masson staining. Anesthetized cystometry was performed after 2 weeks of SNM treatment. PE-50 tube was implanted into the dome of the bladder and the bladder was infused with warmed saline at a constant rate of 3.6 mL/h. Maximum pressure (mmHg), basal pressure (mmHg), postvoid residual (mL), intercontraction interval (min), capacity (mL), frequency of nonvoiding contractions (NVCs, times/min), and NVC amplitude (mmHg) were recorded during cystometry. Postvoid residual was measured immediately after the last voiding by disconnecting the animals from the syringe pump and manually emptying the urine volume present in the bladder.

RESULTS

No significant changes in general characteristics including body weight, bladder weight, bladder weight/body weight after SNM treatment. For H&E staining and Masson staining, no significant changes were observed in the general morphology of bladders after SNM treatment. Cystometry results showed that SNM increased the intercontraction intervals ($p<0.05$), capacity ($p<0.05$), and reduced the frequency of non-voiding contractions ($p<0.05$) in SCI rats, suggesting that SNM significantly alleviates detrusor overactivity in SCI rats.

INTERPRETATION OF RESULTS

Sievert et al [1] reported that early SNM might prevent neurogenic detrusor overactivity and urinary incontinence in SCI patients. Using a rat model, our result also supported the pespective that SNM can relieve SCI-induced detrusor overactivity. This effect was possibly due to the preservation of nerve plastivity so that the C fibers remained silent after SNM treatment. Another study lead by Keller et al. [2] found that SNM-treated SCI minipigs showed diminished detrusor-sphincter dyssynergia and urinary retention and a better-balanced distribution ratio of smooth muscles to connective tissues compared with control SCI minipigs, suggesting a relieving trend during the bladder wall scaring process. In the present study, relieved morphological appearance were not observed after SNM treatment, which may be due to different stimulation parameters used between species and relatively short intervention period in our study (2 weeks).



CONCLUSIONS

Overall, SNM significantly increased bladder capacity and reduced frequency of non-voiding contractions to relieve SCI-induced detrusor overactivity in our present study, indicating that early sacral neuromodulation provided a reletively safe method for treatment of detrusor overactivity after complete spinal cord injury.

REFERENCES

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