



Superiority of different spinal nerve roots in neuromodulation of micturition reflex in rats

MP09-10

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Aims

Electrical stimulation of peripheral nerves controlling the bladder offers an alternative, non-destructive medical treatment for urinary incontinence and retention. The aim of the present study was to identify the most efficient sensory and motor spinal nerve roots involved in micturition reflex.

Methods

Twelve SD rats underwent unilateral L5-S2 dorsal roots (DRTs) and ventral roots (VRTs) electrical stimulation (0.1-ms pulse width, 10-Hz frequency, 0.2-mA intensity, 30-second persistent period) and the bladder reflex contractions (BRCs) were recorded under isovolumetric condition. Pseudorabies virus (PRV) were injected into the bladder detrusor in six rats. L5-S2 spinal cords and dorsal root ganglions (DRGs) were harvested for immunofluorescence study.

Results

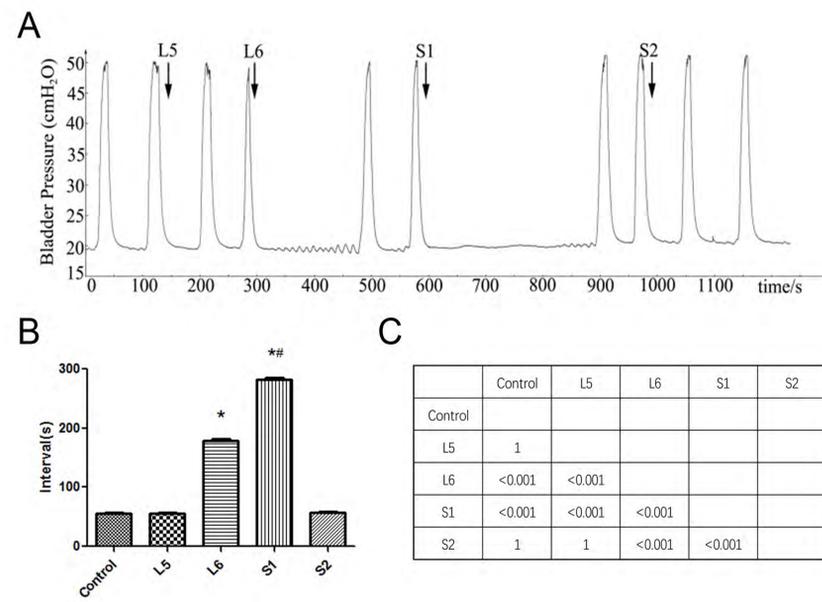


Fig 2. Effect of VRTs stimulation on bladder reflex contraction. (A) L5-S2 VRT was electrical stimulated in sequence. Repeated stimulation of L6 VRT directly caused bladder contraction, while electrical stimulation of L5, S1 and S2 VRTs were not effective. The arrow showed the stimulation. (B) Interval and amplitude of BRC during VRT stimulation. The amplitude of caused BRC during L6 VRT stimulation was lower as compared to that of the control (*P<0.01), while the interval has no significant difference. (C) The matrix presents the P-values.

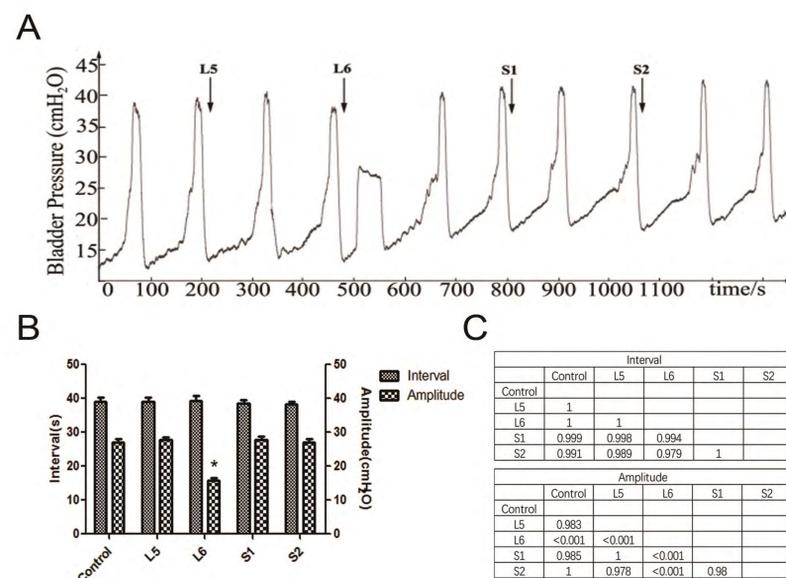


Figure 1: Effect of DRT stimulation on bladder reflex contraction (BRC). (A) L5-S2 DRTs were electrically stimulated in sequence. Repeated stimulation of L6 and S1 DRTs not only abolished BRC but also induced a poststimulation inhibitory effect, whereas electrical stimulation of L5 and S2 DRTs had no effect. The arrow shows the stimulation. (B) Interval of BRC during DRT stimulation. The BRC intervals during L6 and S1 DRT stimulation were longer than in the control (*P < .01). S1 DRT stimulation resulted in significantly stronger inhibition than L6 DRT stimulation (#P < .01). (C) The matrix presents the P values..

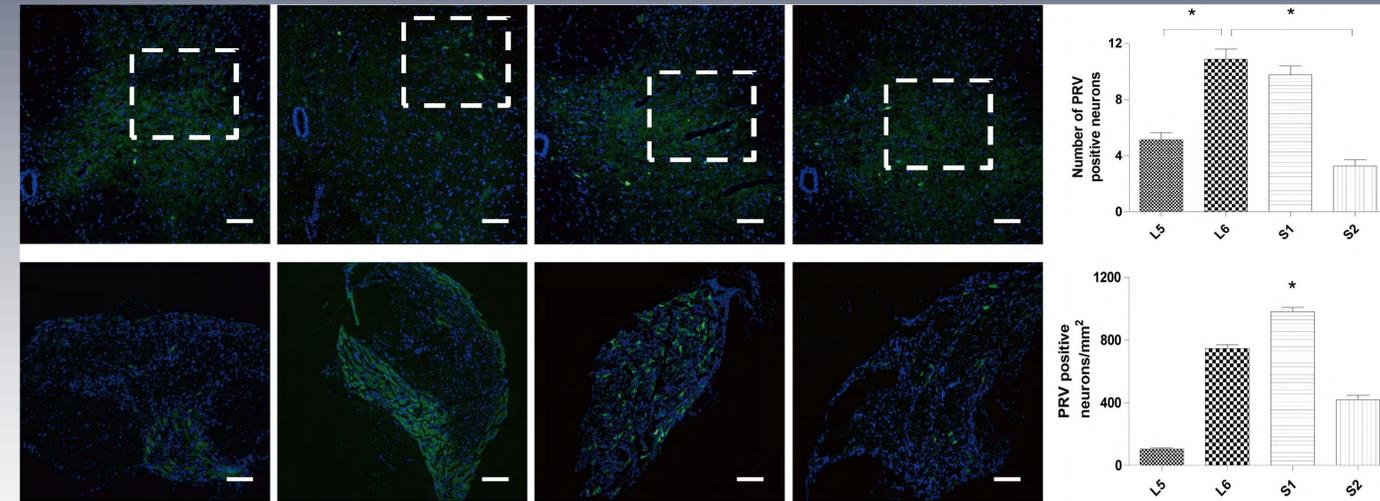


Figure 3. Result of PRV retrograde tracing. (A1-A5) PRV positive neurons in SPN of L5, L6, S1 and S2 segments. More PRV-immunoreactive cells were present in the region of the SPN of L6 spinal segment compared with that of the other segments, followed by S1, L5 and S2. (B1-B5) PRV-positive neurons in L5, L6, S1 and S2 DRGs. The S1 DRG was found to have the highest density of PRV-positive neurons, followed by L6, S2 and L5. (Scale bar=50µm, * P<0.05)

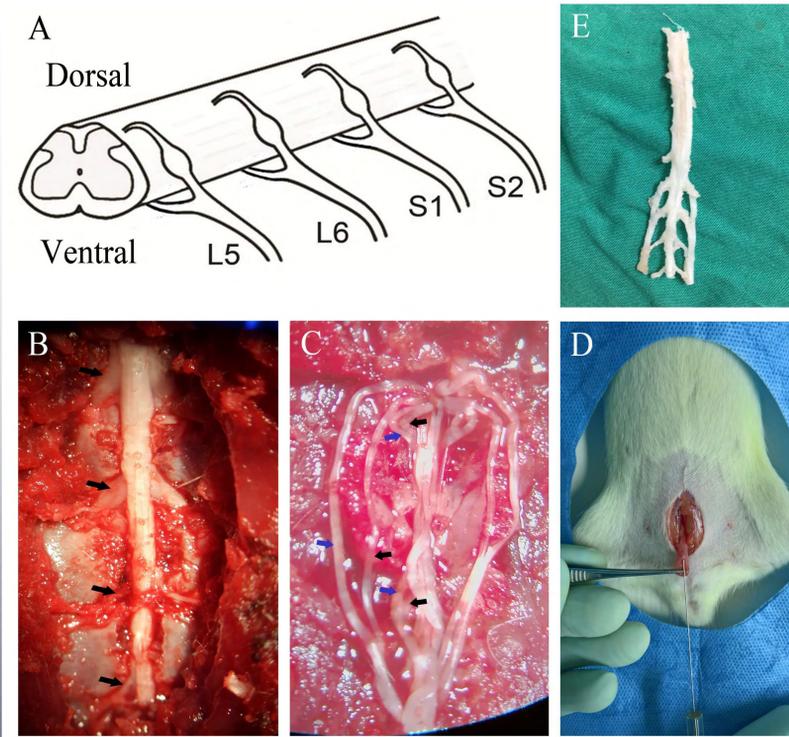


Figure 4: Images of the experiment process. (A) Anatomical schematics showed the L5-S2 VRTs and DRTs. (B) Left L5-S2 spinal nerves were shown (black arrow). (C) The VRTs and DRTs were dissected. (Blue arrow: DRTs, Black arrow: VRTs) (D) The bladder was exposed, and PRV was injected by a Hamilton syringe. (E) L5-S2 spinal segments and DRGs were removed for Immunofluorescence experiment.

Conclusions

In conclusion, various afferent and efferent nerves innervate the bladder and are involved in micturition reflex, but the L6 VRT could be the most efficient in producing detrusor muscle contraction, and the S1 DRT could have the superiority of inhibiting micturition reflex.