

RECTAL DISTENSION INHIBITS SPINOBULBOSPINAL AND SPINAL MICTURITION REFLEXES BY GLYCINERGIC AND GABAERGIC MECHANISMS IN RATS

Aims of Study

It is known that bladder function can be modulated by a variety of afferent inputs from other pelvic organs such as the colon, rectum, vagina, or penis.¹ Clinically, there is a close relationship between dysfunction of the lower urinary tract and distal gastrointestinal tract (GI tract).² However, the precise mechanism of the distal GI tract-vesical inhibitory reflex has little understood. In the central nervous system, glycine and gamma-aminobutyric acid (GABA) are major inhibitory transmitters. Therefore, glycinergic or GABAergic neurons are likely to be involved in the distal GI tract-vesical inhibitory reflex. In order to clarify the mechanism underlying the bladder inhibition, we investigated the effect of rectal distension and intrathecal injection of bicuculline (a GABA_A receptor antagonist) and strychnine (a selective glycine receptor antagonist) on micturition reflex in rats with or without spinal cord injury (SCI).

Methods

Thirty-two female Sprague-Dawley rats weighing 250-300 g were divided into an intact group (n = 18) and a SCI group (at 4 weeks after SCI, n = 14). Rats in the SCI group were anesthetized with 2% halothane and the spinal cord was completely transected at the lower thoracic cord (T9 or T10). The rats were anesthetized by intraperitoneal and subcutaneous injection of urethane (1.2 g/kg for intact rats vs. 0.6 g/kg for SCI rats), and a polyethylene catheter (PE-50) was inserted into the bladder through the urethra. The urethra was ligated to the catheter near the external urethral meatus, and the ureters were transected at the level of the aortic bifurcation to produce isovolumetric conditions. A balloon was inserted into the rectum. Laminectomy was performed at the 3rd lumbar vertebra, and a catheter (PE-50) was inserted into the subarachnoid space. The bladder was filled with physiological saline (0.05 ml/min) to above the threshold volume inducing isovolumetric rhythmic bladder contractions. After bladder contractions had become stable for more than 30 min, the rectum was distended by infusion of water (0-3 cm³) into the rectal balloon. When isovolumetric bladder contractions were inhibited by rectal distension, strychnine (0.001-10 µg) and/or bicuculline (0.001-1 µg) was injected cumulatively at every 15-30 min through the intrathecal catheter, and changes of bladder activity were recorded.

Results

On isovolumetric cystometry, the interval (2.59 ± 0.47 min), amplitude (49.8 ± 5.70 cm H₂O), and duration (1.66 ± 0.29 min) of bladder contractions were stable before rectal distension in intact rats. Rectal distension (1.5-3.0 cm³) prolonged the interval, decreased the amplitude, and shortened the duration of bladder contraction volume-dependently, and finally abolished them. In this inhibited condition, intrathecal strychnine or bicuculline induced bladder contractions again. The interval and duration of bladder contractions returned to the control level after a single injection of strychnine (0.001-10 µg, n = 7) or bicuculline (0.01-1 µg, n = 7), dose-dependently. However, injections of both strychnine and bicuculline at a dose of 0.001 µg each were needed to recover the amplitude to the control level (n = 4). In SCI rats, the interval (0.71 ± 0.16 min), amplitude (16.8 ± 3.67 cm H₂O), and duration (0.54 ± 0.10 min) of bladder contractions were stable before rectal distension. Rectal distension (1.0-3.0 cm³) abolished bladder contractions. In this inhibited condition, a single injection of strychnine (0.001-10 µg, n = 7) or bicuculline (0.001-1 µg, n = 7) recovered the interval, amplitude, and duration of bladder contractions to the control level. There were no differences between the effects of strychnine and bicuculline on the interval, amplitude, and duration of bladder contractions by repeated measures analysis of variance (ANOVA) in intact and SCI rats.

Conclusions

These results suggest that rectal distension inhibits the spinobulbospinal and spinal micturition reflex pathways via distal GI tract-vesical inhibitory reflex. The distal GI tract-

vesical inhibitory reflex pathway involves glycinergic and GABAergic mechanisms to the same grade at the level of the lumbosacral cord. Glycine is frequently colocalized with GABA in nerve terminals in the spinal cord.³ Therefore, glycinergic and GABAergic interneurons in the lumbosacral cord may be major components of the lumbosacral inhibitory mechanism for the micturition reflex pathway. The lower urinary tract function is inseparable from the rectal function. Therefore, in the clinical practice, constipation should also be treated for the management of the lower urinary tract symptoms.

References

1. J Auton Nerv Syst 1982; 5: 23-43
2. Pediatr Clin North Am 2001; 48: 1587-1630.
3. Neuroreport 1994; 5: 2225-2228.