Analysis of the pelvic-to-external urethral sphincter reflex in intact and acute spinalized rats

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The lower urinary tract has two main functions: storage and periodic elimination of urine. These functions are regulated by a complex neural control system located in the brain and spinal cord which coordinates the activity of the two components of the lower urinary tract: (1) the reservoir (urinary bladder) and (2) the outlet (bladder neck, urethra and urethral sphincter). Normally these structures exhibit reciprocal activity. During urine storage the reservoir is quiescent and intravesical pressure remains low whereas activity in the outlet gradually increases during bladder filling to maintain continence.

The relationship between the bladder and external urethral sphincter (EUS) is controlled by reflex pathways in the lumbosacral spinal cord that are activated by primary afferent input from the bladder or the urethra. Bladder afferent axons pass through the pelvic nerves and urethral afferent axons pass through the pelvic and pudendal nerves. This study was conducted to examine the reflexes that mediate bladder and sphincter coordination. The physiological properties of the pelvic nerve afferent to EUS reflex (pelvic-to-EUS reflex) were recorded in intact rats. Reflex responses consisted of a large early component and a small late component when the bladder was distended. However, the late component was not present when the bladder was empty. The stimulus threshold is 0.8 volts at 1 Hz with 0.05 ms pulse duration, and the latency of early component was 19.61 ± 0.16 ms during different frequencies of stimulation between 0.5~5 Hz. The small late component gone after acute spinal cord transection indicated the late responses of the pelvic-to-EUS reflex were mediated by supraspinal reflex pathway.

Furthermore, the time-frequency Analysis by Matlab was utilized to verify the early and late components of the reflex. The frequencies of early component were between 100~600 Hz at consistent latency in both animal models. Only late component was induced by stimulus in intact rats, and the frequencies were variable from 100 Hz to 1000 Hz at different latencies. The firing amplitude was markedly smaller in spinalized rats than intact animals. The early and late components of the pelvic-to-EUS reflex were recognized by time-frequency analysis at timing, frequencies and amplitude.