MECANOSENSITIVE AFFERENT UNITS IN THE LUMBAR POSTERIOR LONGITUDINAL LIGAMENT

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Introduction

Lower back pain is one of the most common physical complaints, but it is not easy to determine its origin and/or the mechanism. A detailed investigation including the verification of the contribution of each tissue around the lumbar spine to lower back pain is important for its accurate diagnosis and treatment. Recently, there have been an increasing number of reports on the sensory innervation of the lumbar posterior longitudinal ligament (PLL). To our knowledge, most of these studies investigated the morphological aspects of the PLL, and few studies have investigated functional aspects using electrophysiological techniques. In this study, our aim was to identify and characterize the mechanosensitive afferent units in the lumbar posterior longitudinal ligament in an animal model using an electrophysiological technique.

Materials and Methods

The experiments were carried out using thirteen adult cats weighing 2.3-5.6 kg (av., 3.1 kg). They were sedated by ketamine hydrochloride i.m. Anesthesia was maintained by sodium pentobarbital i.v. and pancuronium bromide i.v., using an artificial ventilation machine. Laminctomy was performed on L1 to L7, and the extent of the laminectomy was enlarged laterally to visualize the PLL at L5-L7. The L5 and L6 dorsal rootlets for electrophysiological recordings were exposed by incising the dura mata. Then, the L5 and L6 dorsal rootlets were separated and cut at their proximal ends, and each rootlet was draped over a recording bipolar electrode. To investigate the receptive fields of the mechanosensitive afferent units in the PLL, afferent impulses that were evoked by the mechanical stimulation on the PLL with a glass probe were recorded (Figure 1). When the receptive fields were identified, they were stimulated electrically with a bipolar electrode to obtain conduction velocities (CVs) and were stimulated with a set of seventeen nylon filaments to determine their mechanical thresholds.

Results

Thirteen mechanosensitive afferent units were identified in the lumbar PLL. Of these thirteen units, twelve were located around the intervertebral disc portion while the remaining one unit was located at the mid level of the vertebral body. The mechanical thresholds of these units were 20.90-67.80 g (av., 43.50 g). All of these units had a high mechanical threshold (more than 7.0 g). Only one unit had a CV of 0.5-2.5 m/sec (group IV) and the remaining 12 units had CVs of 2.5-20 m/sec (group III). (Figure 2)

Discussion

Sensory nerve fibers are classified into groups I to IV according to their diameter and CV. Mechanosensitive units classified as group III or IV and with a high mechanical threshold (more than 7.0 g) were thought to act as nociceptive units (1). On the other hand, those classified as group II or III and with a low threshold (less than 7.0 g) have been thought to act as proprioceptive units. All of the units identified in this study had a high threshold and were classified as group III or IV. Thus, all of the units identified in this study were thought to be nociceptive units. This result suggests that afferent fibers from the lumbar PLL principally contribute to the nociceptive function, not to the proprioceptive function. Our previous studies showed that the average mechanical thresholds were 7g in the lumbar facet joint units and 241g in the anterior lumbar intervertebral disc units (2,3). The results of this study suggested that the PLL had intermediate responsiveness to noxious stimuli between the facet joint and the intervertebral disc. It is thought that the lumbar PLL may be involved in the mechanisms of low back pain as a result of its reaction to instability or stress.

References

(2) Yamashita T et al., JBJS.72-A; 865-70, 1990.
(3) Yamashita T et al., Spine 18; 2252-56, 1993