CO₂ Laser-Induced Pain-Related Somatosensory Evoked Potentials

Conventional somatosensory evoked potentials (SEPs) or conduction studies of the peripheral nerves are examined following transcutaneous electrical stimulation applied to the trunk of the peripheral nerves. The signals following electrical stimulation ascend through large myelinated fibers relating to cutaneous, vibratory and proprioceptive sensation. However, some patients show a relatively preserved cutaneous or vibratory sensation but a marked impairment of pain-temperature sensation, and vice versa, that is, dissociated sensory loss. Therefore, one of the biggest challenges to those studying clinical neurophysiology is to record pain-related SEPs (pain SEPs), that is, responses resulting from impulses ascending through small myelinated fibers relating to pain-temperature sensation. Pain SEPs induced by CO₂ laser stimulation were reported by Mor and Carmon (1) in 1975, and then several reports included findings of pain SEPs in normal subjects (2–6) and patients with neuropathy (7, 8), myelopathy (9–11) or cerebral lesions (12), and confirmed that pain SEPs following CO₂ laser stimulation were generated by ascending signals mediated through Aδ fibers and the spinothalamic tract.

For example, we examined pain SEPs and conventional electrically-stimulated SEPs (electric SEPs) in 30 patients with peripheral neuropathies in whom the histopathological examination of the sural nerve was done (7, 8). Results of pain SEPs showed a positive relationship with clinical impairment of pain sensation and densities of small myelinated fibers of the sural nerve. In contrast, results of electric SEPs showed a positive relationship with clinical impairment of deep and tactile sensations and with densities of large myelinated fibers of the sural nerve. In the last month’s issue of this Journal, a patient with peripheral neuropathy caused by cisplatin for the treatment of testicular tumor is reported by Yamamoto et al (13). On neurological examinations, sensory impairment was present in the extremities distal to the elbow and mid-thigh in a distally accentuated manner. Vibratory and joint position sensations were more severely reduced than superficial sensation. Pinprick and cold sensations were rather accentuated. Tendon reflexes were generally absent. These findings suggested selective damage of the large myelinated fibers and preserved small myelinated fibers. No significant response was recorded following upper and lower limb stimulation of electric SEPs, but pain SEPs following either upper or lower limb stimulation were normal. These electrophysiological findings were clearly compatible with the clinical findings of this patient. Yamamoto et al have also reported the usefulness of pain SEPs in patients with stroke (14) and dementia (15).

The pain SEP is the only noninvasive and objective method currently available to investigate the physiological condition of the sensory pathway responsible for pain sense, and is especially useful when combined with the conventional electric SEPs.

Ryusuke Kakigi, MD
The Department of Integrative Physiology,
National Institute for Physiological Sciences,
38 Saigo-naka, Myodaiji-cho, Okazaki, Aichi 444

References

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