Spinal Pathways Mediating Somatosensory Evoked Potentials from Cutaneous and Muscle Nerves in the Cat

By

A. Ducati * and M. Schieppati **

With 3 Figures

Summary

The Authors give evidence on the function of a pathway mediating somatosensory evoked potentials (SEPs) from muscle nerves, other than the dorsal columns: physiological and anatomical data prove its location to be in the spinothalamic tract. Previous contrasting results on the topic are discussed.

Introduction

Clinical recording of somatosensory evoked potentials (SEPs) is a functional non-invasive procedure that enables traumatic spinal cord lesions to be assessed and localized during the acute post-injury phase 3. There is, however, conflicting evidence in the literature as to the spinal pathways that conduct SEPs evoked by peripheral stimulation. Some authors 1, 2 suggest that the dorsal columns are the only pathways involved in transmitting SEPs, which would therefore be an index of functional integrity of the dorsal columns alone, and would not serve as an indication of the remaining spinal cord function. In this case the usefulness of clinical application of SEPs in acute spinal cord injuries would be greatly diminished, for the dorsal columns have an independent blood supply and are well separated from the funiculi lying in the lateral and anterior parts of the spinal cord, through which the motor pathways descend 4. However, since no study has been performed to establish whether SEPs evoked by stimulation of a pure cutaneous nerve behave differently from SEPs evoked by stimulation of a pure muscle nerve, the present
study was undertaken, with the additional aim of identifying a method that could prove useful in the clinical evaluation of patients with acute spinal cord injury.

Methods

The experiments were carried out in 12 adult cats weighing between 1.8 and 3.2 kg. All animals were lightly anaesthetized with intraperitoneal Nembutal (25 mg/kg) supplemented as necessary by small i.v. doses. They breathed spontaneously, and their temperatures were kept constant at 38°C by means of a DC heating pad. Dexamethasone 0.2 mg/kg was given i.m. at the beginning of the experiment. The left sciatic nerve was exposed, and the nerves to the triceps surae were isolated for a few centimetres; the saphenous nerve was also dissected. At the level of the knee joint, a big pool was made with skin flaps and filled with heated mineral oil. The nerves to gastrocnemius lateralis and medialis and to soleus were collected together and placed on a bipolar Ag/AgCl stimulating electrode (distance between poles 2.1 mm; cathode proximal). The saphenous nerve stimulation was performed with 0.2 msec rectangular pulses; the intensity was 1.5 times that needed to produce maximal amplitude of the first cortical evoked response. EEG and evoked cortical responses were recorded via a ball-tipped Ag/AgCl electrode placed through a drill hole in contact with the dura overlying the pericruciate sulcus, 1 mm from the midline, contralateral to the stimulated nerves. The reference needle electrode was inserted in the neck muscles. The surface potentials were fed into a conventional differential amplifier without any frequency cut-off. Two hundred consecutive post-stimulus (125 msec) responses were averaged by an Enhancetron 1024. Laminectomy C1–C7 was carried out, and after the dura had been opened, the cord was covered with mineral oil. Under microscopic control a section of the dorsal columns was taken with a sharp triangular blade; in some experiments a section was also taken of the spino-cervical tract homolateral to the stimulated nerves. Stainless steel, teflon-coated, bipolar coaxial electrodes were placed in the dorsal column and contralateral spinothalamic tract of the cervical cord, for recording from and stimulating the spinal cord pathways before and after dorsal columns section. The animals were sacrificed with a Nembutal overdose and the injured segments of the cervical cord were removed for histological examination.

Results

Basal Conditions

Waveform and latency of the responses evoked by stimulation of the cutaneous or muscle nerves in cats with intact spinal cords are slightly different (Figs. 1 A and B), the amplitude and the latency to peak of the first wave evoked through the saphenous nerve being bigger and shorter (11 msec) than amplitude and latency of the corresponding wave evoked from triceps surae nerves (13 msec). SEPs show a marked variability between individuals; nevertheless the differences in the early waves shown in Figs. 1 A and B are frequently found.