SOMATOSENSORY EVOKED POTENTIALS

in

ORTHOPAEDIC SURGERY

"An Essay"

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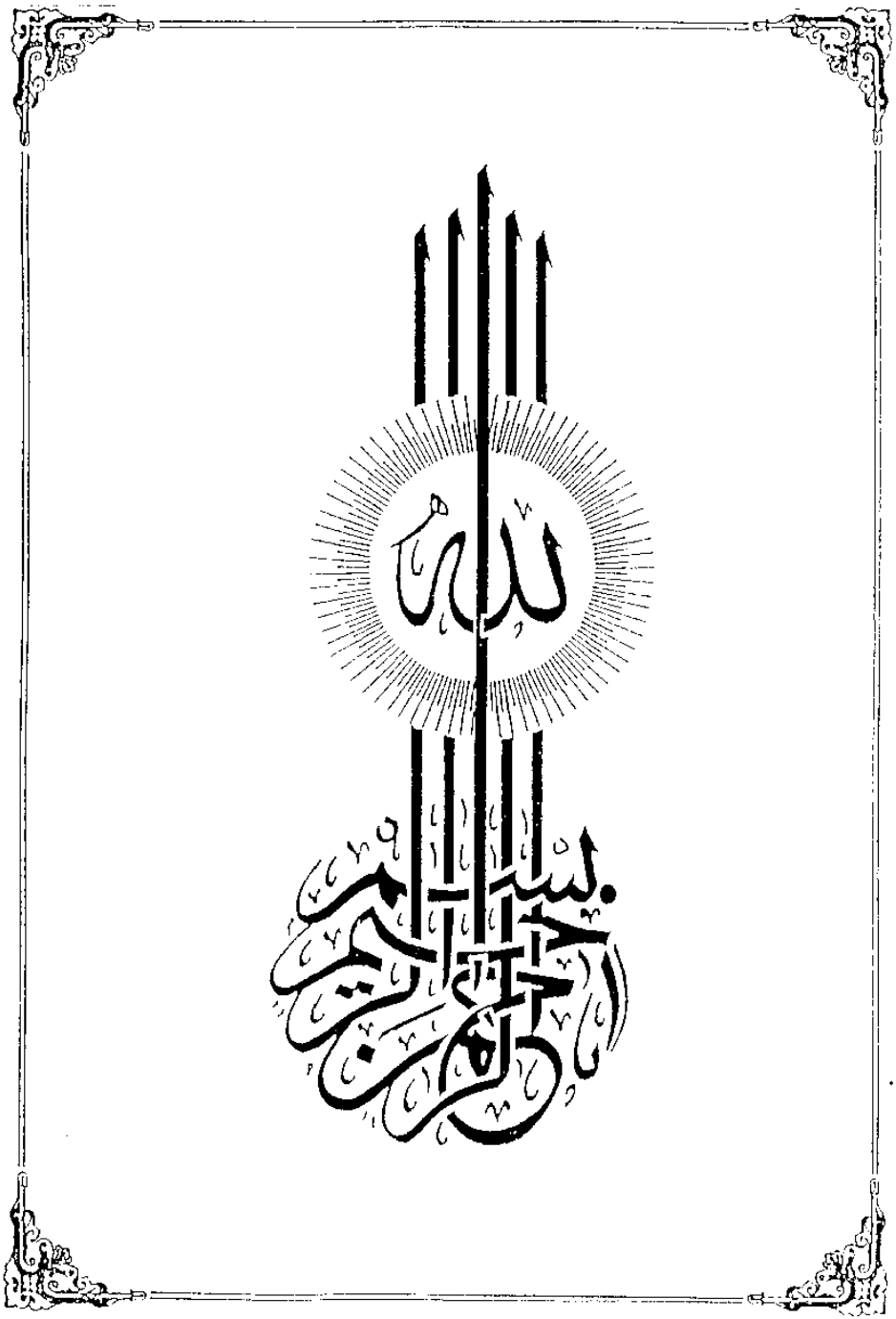

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INTRODUCTION

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The evoked potentials are small electrical events arising from neural Tissue occuring in response to abrupt stimulation, in current clinical application this usually involve stimulation of the visual, auditory and somatosensory systems. (C. William Erwin, Anderia Brendle 1985).

Evoked potential studies evaluate the electrical events in a sensory system that result from the application of a stimulus. Nearly any sensory system can be monitored.

Evoked potentials achieve a leading rool in diagnositc neurology because of its capacity to detect subclinical lesion in sensory system.

Intra-operative monitoring of neurophysiologic events is expanding in scope and becoming of practical importance at all level of neurosurgery and orthopaedic surgery concerned with nervous system.

Monitoring of the integrity of sensory system during procedure that carries a risk of inadvertant injury is feasible and practical.

The possibility of an increase in neurologic deficit as a complication of spinal surgery has long been a major concern. although the precise incidence of this complication is not known, occasional increase of neurologic deficit as a result of either open or closed procedures on the traumatized spine has been documented. It would therefor be desirable to have a

reliable method for monitoring spinal cord function during operative procedures so that the neurologic dysfunction can be identified as soon as it occurs and perhaps be reversed

In recent years two promising technique have emerged they are intra operative monitoring of the neural electrical activity (somatosensory evoked poteatial) and the intra operative wake - up test (charles A rockwood 1984).

Recently the evoked potentials Monitoring both in intensive care setting and in operating room become of relativily common use. Thus the indication for evoked potential monitoring are :

- a desire to follow the integrity of sensory pathway during surgery.

- a desire to lacalize sensory structures during surgery, for example in patient undergoing procedures to straighten the spines, somato sensory evoked responses (SS Eps) are monitored to provide evidence of the integrity of the dorsal column.

Using similar procedure we have monitored the integrity of the sciatic nerve during hip replacement in a patient who had suffered with a shortening of the leg for some time (J.W. Mc sherry 1984).

Carotid endartrectomy and spinal reconstruction are more common procedure and can be made safer by neurophsiologic monitoring (c. willams, erwin andrea 1985).

A surge in neurophysiologic monitoring has come about because of the widspread proliferation of evoked potential

hardware, which is often used with an integral computer that is capable of rapid data analysis.

The clinical application of evoked potentinls is based on their ability :

1. To demonstrate abnormal sensory function when the history and/or neurological examination are equivocal (Chiappa 1982).

2. To reveal the presence of clinical unsuspected malfunction in a sensory system when demylination disease is suspected because of symptoms and/or signs in other area of the C.N.S. (Halliday et al., 1973).

3. To monitor objective changes in a patient status e.g. patient with coma and head injuries (Maccabee et al., 1983).

Latencies and amplitudes of the various waves provide numerical data, sometimes the absence of a wave or an abnormal configuration of its potential field also provides useful information (Picton 1984).

ANATOMY OF THE SPINAL NERVES

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The spinal nerves are formed by the union of the ventral and dorsal spinal nerve roots which attached in series to the sides of the spinal cord.

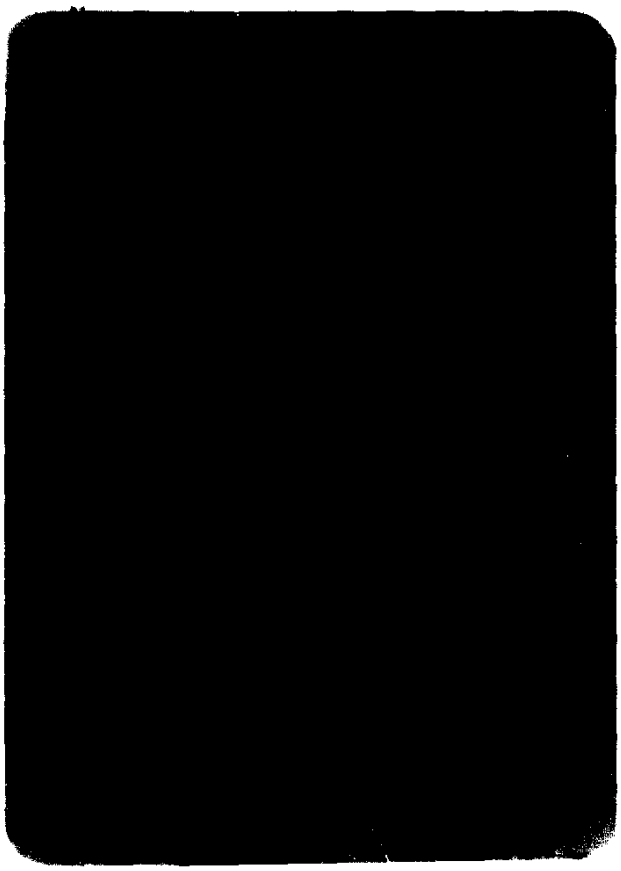
There are 31 pairs of these nerves grouped as follows : cervical 8. Thoracic 12, Lumbar 5, sacral 5, coccygeal 1 They emerge through the intervertebral foramena. The first cervical nerve escape from the vertebral canal between the occipital bone and the atlus therefore it is called the suboccipital nerve, the eight issues between the seventh cervical and first thoracic vertebrae. (Fig. 1-a).

Each nerve is connected with the spinal cord by ventral and dorsal roots, the latter being characterised by the presence of spinal ganglion.

- The ventral (anterior) roots contain the axons of cells in the anterior and lateral grey columns of the spinal cord.

- The dorsal (posterior) roots contain the processes of cells in the spinal ganglia which are swellings on the roots, each root consists of two fascicles medial and lateral each of which diverges into rootlets entering along the posterolateral suclus.

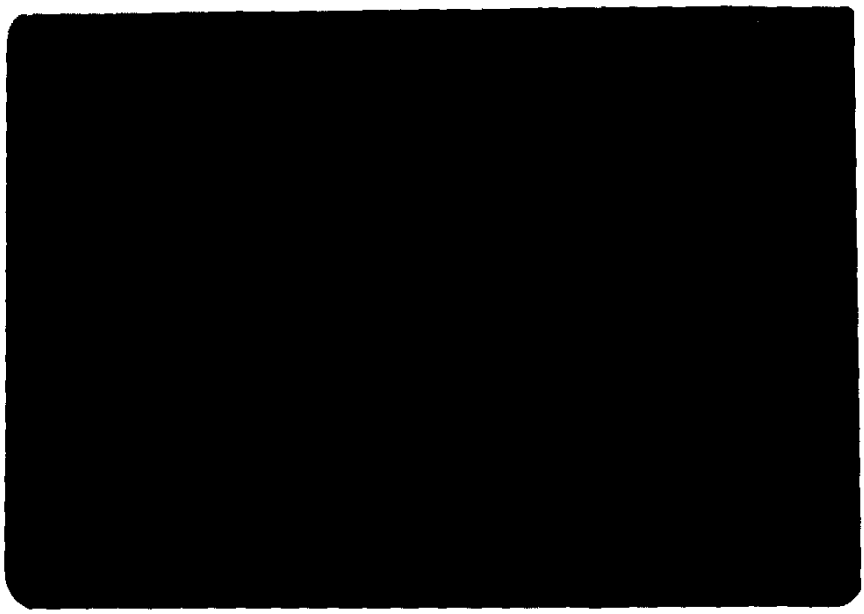
The spinal ganglia : are collections of nerve cells on the dorsal roots of the spinal nerves, it is bifid medially where the two bundles of the dorsal nerve root emerge from it to approach and enter the cord.

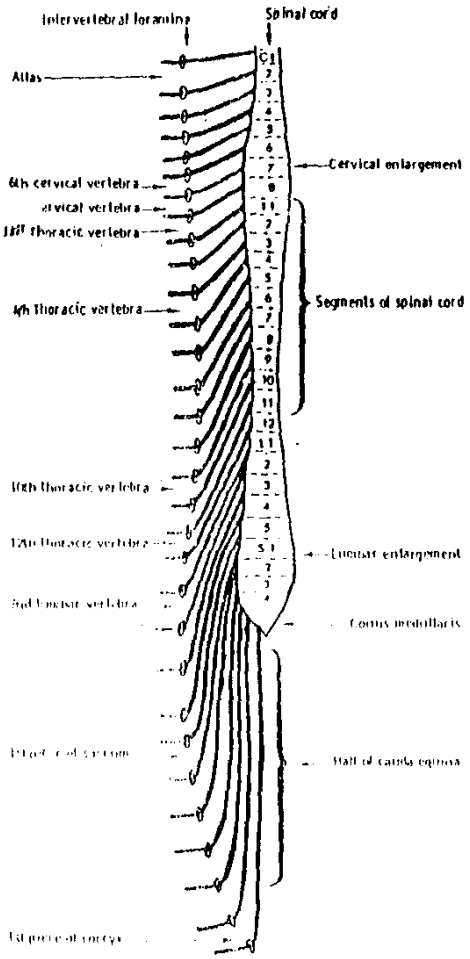


The ganglia are usually in the intervertebral foramena, immediately lateral to the sites where the nerve roots perforate the dura matter. each nerve root receives a covering from the pia matter, and is loosely invested by the arachnoid mater, the latter being prolonged as far as the point where the roots pierce the dura mater.. The two roots pierce the dura mater separetely each receiving a sheath from this membrane where the root join to form the spinal nerve, this sheath is continuous with the epineurium of the nerve. (GRAY's Anatomy 1980) (Fig. 1-b).

- The root of the lower lumbar and upper sacral nerves are the largest and their individual filaments the most numerous of all the spinal nerves, while the roots of coccygeal nerve are the smallest. The root of the lumbar, sacral and coccygeal nerves descend with an increasing degree of obliquity to their respective exits and since the spinal cord ends near the level of the lower border of the first lumber vertebra, the length of successive roots rapidly increases. The term "cauda equina" is applied to this collection of nerve roots.

The largerst nerve roots and consequently the largest spinal nerves are attached to the cervical and lumber swelling of the spinal cord, these nerves are distributed to the upper and lower limbs. Immediately beyond the spinal ganglia, the ventral and dorsal nerve roots unite to form the spinal nerve which emerges through the intervertebral foramen, gives off "recurrent meningeal branches", and then divides immediately into a dorsal and ventral ramus. Sato (1974) has described a trifurcation of the spinal nerves at some cervical and thoracic levels. The third

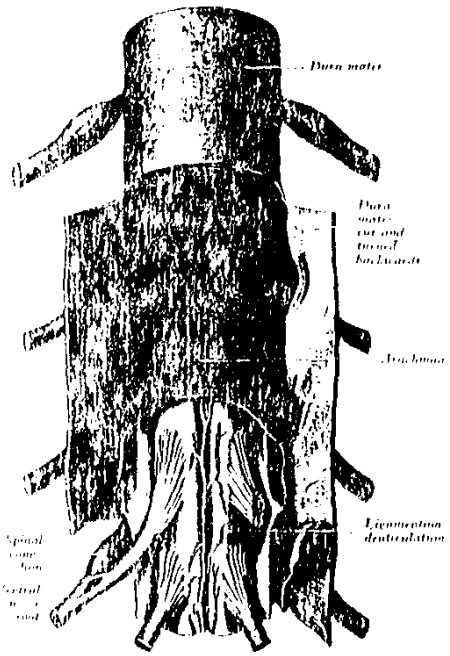




DIAGRAMMATIC REPRESENTATION OF SPINAL CORD, SPINAL SEGMENTS & INTERVERTEBRAL FORAMINA

(Note for clarity, the spinal nerves are shown by single lines. In fact, between the cord & the intervertebral foramina, each nerve consists of separate ventral & dorsal roots)

Fig 1- A



A part of the spinal cord exposed from the ventral aspect, showing its meningeal coverings.

Fig 1- B

branch being a ramus intermedius.

At or immediately distal to its origin the ventral ramus of each spinal nerve is joined by "ramus communicants" from the corresponding ganglion of sympathetic trunk.

In the intervertebral foramen the spinal nerves have important relations.

Anterioly are the intervertebral disc and adjacent regons of the bodies of the vertebrae.

Posteriorly : are the synovial zygapophysial joints superiorly, and inferiorly: are the vertebral notches of the pedicles of the adjoining vertebrae.

Each nerve accompanied by a spinal artery, a plexus of small veins and its own meningeal branch or branches (Gray's Anatomy 1980).

The nerve roots may be compressed or otherwise irritated in their course from the spinal cord to their exit through the intervertebrel foramina, in the cervical region, disease of a vertebral body, degeneration of an intervertebral joints may affect nerve roots as they traverse the intervertebral foramen, causing pain diminished cutaneous sensibility and some muscle weakness in the field of supply.

In the lumbar region, posterior protrusion of the intervertebral disc or rupture of its annular fibres with herniation of the nucleus pulposus is very common, affecting