INTRAMEDULLARY SPINAL CORD NEOPLASMS
DIAGNOSIS AND MANAGEMENT

THESIS

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BY
AIMAN MOHAMMED YAKOUB
M.B.B.Ch.

SUPERVISORS

Prof. Dr. HASSANEIN AL-SHARIF
Professor of Neurosurgery
Ain-Shams University

Dr. ADEL HUSSEIN EL-HAKIM
Assistant Professor of Neurosurgery
Ain-Shams University

Faculty of Medicine
Ain Shams University
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C O N T E N T S

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INTRODUCTION AND AIM OF THE WORK

Neurosurgical treatment of spinal cord tumours began with the famous case of a British Captain who was operated upon by Victor Horsley in 1887. (Stein, 1985).

In 1911, Elsberg and Beer reported the first successful removal of an intramedullary tumour. However, early attempts at removal of intrinsic spinal cord tumours were associated with high operative morbidity and mortality which led Elsberg to adopt a more pessimistic attitude towards these tumours. With the introduction of the operating microscope and with further refinement in micro-surgical techniques, it has become clear that the majority of intramedullary spinal cord tumours are amenable to complete surgical excision with acceptable morbidity and mortality and a low incidence of recurrence (McCormick et al., 1990).

Recent techniqual advances have significantly improved the results of operative treatment with intra-medullary tumours. These include the surgical laser, ultrasound surgical aspirators, localization with intraoperative ultrasound and evoked potential monitoring during surgery. Also the advent of MRI has made the diagnosis of intramedullary tumours much more accurate than other investigation modalities due to its ability to delineate the spinal cord and the exact relation of the tumour to the cord tissue (Simeone, 1990).

The aim of this work is to study and evaluate the methods of diagnosis and treatment of intramedullary tumours with special emphasis on the recent techniqual advances in diagnosis and surgery.

REVIEW OF LITERATURE

ANATOMY OF THE SPINAL CORD

The spinal cord is a cylinder, somewhat flattened from front to back, whose lower end tapers into a cone. Ventrally, it posses a deep midline groove, the anterior median sulcus, and dorsally it shows a shallow sulcus, from which a posterior median septum of neuroglia extends into its substance. The posterior median septum within the spinal cord is attached to the incomplete posterior median septum of arachnoid in the subarachnoid space.

In the foetus the spinal cord extends to the lower limit of the spinal dura mater at the level of the second sacral vertebra. The spinal dura remains attached at this level throughout life, but the spinal cord becomes relatively shorter, which is to say that the bony spinal column and the dura mater grow more rapidly than the spinal cord. Thus at birth the conus medullaris lies opposite the third lumbar vertebra and does not reach its permanent level opposite L1 or L2 until the age of twenty years. The spinal nerve roots, especially those of the lumbar and sacral segments, thus come to slope more and more steeply downwards.

The spinal cord possesses two symmetrical enlargements which occupy the segments of the limb plexuses. That for the brachial plexus is known as the cervical enlargement and that for the lumbo-sacral plexus as the lumbar enlargement. They occupy, in the cord, the segmental levels of the plexuses concerned (C5 to Th1 for the cervical enlargement and L2 to S3 for the lumbar enlargement), but their levels measured by vertebrae are, of course, quite different. Thus the cervical enlargement lies roughly corresponding to the vetebrae (C3 to Th1), but the lumbar enlargement extends only from Th9 to L1. Both cervical and lumbar enlargements are due to the greatly increased mass of motor cells in the anterior columns of grey matter in these situations (Groot and Chuside 1988).

The spinal nerve roots:

No spinal nerves lie inside the spinal theca; indeed, no nerve lies, strictly speaking, within the spinal canal. The anterior and posterior roots of the spinal nerves unite within the intervertebral foramina. Within the subarachnoid space the anterior and posterior nerve roots are attached to the spinal cord each by a series of rootlets. Each anterior root is formed by three or four rootlets which emerge irregularly along the antero-lateral surface of the spinal cord. Each posterior root is formed by several rootlets, attached vertically to the postero-lateral surface of the cord. A short distance from the cord the rootlets are found combined into a single root. The anterior and posterior roots pass from the cord to their appropriate interverte-bral foramina, where each evaginates the dura mater separately before uniting to form the mixed spinal nerve.

The ganglion on the posterior nerve root lies, in the intervertebral foramen within the little tubular evagination of dura mater immediately proximal to the point of union of anterior and posterior nerve roots. For all levels from C1 to L1 the anterior and posterior nerve roots pass in front and behind the ligamentum denticulatum, and evaginate the dura mater between the denticulations. Below L1 the anterior and posterior nerve roots pass almost vertically downwards through the subarachnoid space and form, with the centrally disposed filum terminale of pia mater the cauda equina.

In conformity with the shortness of the spinal cord, the lower a nerve root the more steeply it slopes down to its intervertebral foramen. The upper cervical roots are horizontal, the lumbar and sacral roots almost vertical.

The upper few thoracic roots slope down to their point of evagination of the spinal dura only to become kinked upwards at an angle to reach their foramen. (Last, 1988).

Internal structure of the spinal cord:

The spinal cord consists of a central mass of grey matter surrounding the central canal, enclosed in a cylindrical mass of white matter. It is almost divided into two halves by the anterior median fissure and the posterior median septum. The latter extends forward as far as the grey matter of the grey commissure, which contains the central canal. The anterior fissure does not completely separate the white matter. A narrow whit commissure lies anterior to the grey.

The grey matter: In section, it shows an anterior and a posterior grey horn. The former falls short of the surface of the cord, while the latter is connected to the surface by the gelatinous substance. Elsewhere than in the enlargement, (i.e. in the thoracic region) the anterior and posterior columns lie in line and the grey matter is truly H-shaped. In the enlargements the anterior grey column is much broadend, so that its lateral extent possesses actually a posterior border.

The medial part of the anterior column is concerned with the innervation of the longitudinal flexor and extensor muscles of the trunk. The lateral extensions in the enlargements contain the motor cells for the muscles of the limbs. Between the limb enlargements (from Th1 to L2) there is a lateral column of grey matter midway between anterior and posterior grey columns. This slight lateral projection or lateral horn, contains groups of small cells which are connector cells of the sympathetic part of the autonomic nervous system. Their axons pass out in the anterior roots and enter the mixed spinal nerves from Th1 to L2 which they leave as the white rami communicantes passing to the ganglionated sympathetic trunks. The posterior columns of grey matter contain nerve cells which are for the most part connector cells (internuncial neurones) of spinal reflex arc. The substantia gelatinosa at the tip of the posterior column, together with the overlying grey matter on its surface is concerned with the transmission of pain impulses. One group of cells, the thoracic nucleus (Clark's column), lies near the root of the posterior column; these cells are the second neurones on the spino-cerebellar pathway.

The grey commissure connects the grey matter in the right and left halves of the cord. It is the limb of the H. seen in cross section. Centrally, it contains the central canal of the spinal cord. This tiny tube lined with ependyma (a columnar epithelium with stereocilia)is the downward continuation of the cavity of the fourth ventricle. It extends, surrounded by a little grey matter, into the upper few centimeters of the filum terminale.

The White Matter: The white matter of the spinal cord contains three kinds of fibres, ascending, descending and intersegmental. The white matter is divided into three main columns by the grey matter and the attached nerve roots.

The posterior white columns lie between the posterior grey horn and the posterior median septum. The lateral white columns lie between the anterior and posterior grey columns, and the anterior white columns lie between the anterior grey columns and the anterior median fissure. The anterior white columns are joined by the white commissure. The posterior white columns are wholly occupied by ascending fibres where cell bodies lie in the posterior root ganglia of the spinal nerves. They convey ordinary cutaneous sensibility, moderate degree of temperature varieation and proprio ceptive impulses from joints, ligaments, tendons and muscles.

The fibres from the lowest parts of the body lie nearest the midline and from these levels, upwards incoming fibres are placed progressively to the lateral side. In this way fibres from the perineum and lower limb form a slender column (the fasciculus gracilis or columns of Goll) alongside the midline . Above the lumbar enlargement the incoming fibres from the trunk and upper limb form a new column lateral to this. The column is pointed below and this wedge-shape gives it the name of fasciculus cuneatus (column of Burdach). The two columns end at the posterior border of the fourth ventricle by each arborizing around a group of cells that form the nucleus gracilis and nucleus cuneatus.

The anterior white columns contain uncrossed pyramidal fibres (cell bodies in area 4 of the precentral gyrus) and the vestibulospinal fibres (cell bodies in the vestibular nucleus in the floor of the fourth ventricle).

Near the antero-lateral surface of the cord, crossed by the anterior nerve roots, is the anterior spino-thalamic tract, carrying crude touch and pressure impulses from the opposite side of the body. These are second order neurones, their cell bodies lying in and on the gelatinous substance, from these cell bodies the

Fig.1: Cross section of the spinal cord to show the main ascending and descending tracts (From Last, 1986).