A STUDY OF SPINAL CORD TUMORS

Dissertation submitted in partial fulfilment of

the requirements for the degree of

M.Ch. (Neuro Surgery)

BRANCH – II (3 Years)

THE TAMIL NADU

DR. M.G.R. MEDICAL UNIVERSITY

CHENNAI

AUGUST 2014

CERTIFICATE

This is to certify that this dissertation entitled, **"A Study of Spinal Cord Tumors"** submitted by **Dr. P. John Paul** in partial fulfilment of the requirements for the award of the degree of M.Ch in Neuro Surgery by The Tamil Nadu Dr. M.G.R. Medical University, Chennai, is a bonafide original work done by him in the Department of Neuro Surgery, Madras Medical College, Rajiv Gandhi Govt. General Hospital, Chennai, during the academic year 2011-2014.

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DECLARATION

I solemnly declare that this dissertation **"A Study of Spinal Cord Tumors"** was done by me in Madras Institute of Neurology , Madras Medical College, Rajiv Gandhi Government General Hospital, Chennai under the able guidance and supervision of Professor of Neurosurgery , Madras Institute of Neurology, Madras Medical College, Rajiv Gandhi Government General Hospital, Chennai during the period between January 2012 to December 2013.

This dissertation is submitted to the Tamilnadu Dr.M.G.R Medical University , Chennai in partial fulfilment of the university requirements for the award of the degree of M.Ch., Neurosurgery.

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INSTITUTIONAL ETHICS COMMITTEE
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CERTIFICATE OF APPROVAL

To
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Dear Dr. P. John Paul,

The Institutional Ethics Committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled **"A Study of Spinal Cord Tumors"** No.39032014

The following members of Ethics Committee were present in the meeting held on 11.03.2014 conducted at Madras Medical College, Chennai-3.

1.	Dr. C. Rajendran, M.D.	-- Chairperson
2.	Dr. R. Vimala, M.D. Dean, MMC, Ch-3.	-- Deputy Chairperson
3.	Prof. Kalaiselvi, MD Vice-Principal, MMC, Ch-3	-- Member Secretary
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6.	Prof. V. Padmavathi, M.D. I/c Director of Pathology, MMC, Ch-3.	-- Member
7.	Thiru. S. Govindasamy, BABL	-- Lawyer
8.	Tmt. Arnold Saulina, MA MSW	-- Social Scientist
9.	Thiru. S. Ramesh Kumar, Administrative Officer, MMC, Ch-3.	-- Layperson

We approve the proposal to be conducted in its presented form.

Sd/Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information / informed consent and asks to be provided a copy of the final report.

13/3/14

Member Secretary, Ethics Committee

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CONTENTS

Abstract

Key words: Spinal cord, clinical, radiological, pathological correlation

Aims and Objectives:

1. To study the correlation between clinical presentation and radiological level of lesion.
2. To study the correlation between radiological features and histopathology of spinal cord tumors.
3. To study the correlation between clinical presentation and histopathology of spinal cord tumors.

Materials and Methods:

78 patients with spinal cord tumours who were treated in Madras Institute of Neurology, Government General Hospital, Chennai. during the period January 2012 to December 2013 have been studied.

Inclusion criteria for the study are:

1. All cases of spinal cord tumors
2. All spinal compressive myelopathy patients with suspected spinal malignancy.

Exclusion criteria in this study are as:

1. Disc disease related spinal cord compressive lesions
2. Post traumatic spinal cord compressive lesions
3. Post inflammatory spinal cord compressive lesions

Results:

In spinal cord tumours even after a thorough clinical examination and radiological investigations the surgeon many a times finds surprises in the operative field. An attempt has been made in this study to find the correlation between clinical, radiological, and pathological diagnosis of spinal cord tumours. 95% of clinical diagnosis correlated with the radiological findings for all types tumours. With regards to schwannomas the clinical and radiological correlation was more than 92 %. On analysing the correlation with regard to different levels, the correlation of level of lesion in the age group of 30 to 45 years was more than 90 %. This was possible due to predominantly the nerve root involvement in these tumours which helped to locate the correct level of these tumours .Among the different age groups, the 45 to 60 age group showed the least correlation for the level of tumour , which was also true with the less than 15 years age group . 86 % of lesions correlated clinically with radiological findings in case of diagnosis of level of intradural extarmedullary tumors. But in cases of intra medullary tumors, the clinical and radiological correlation was low. In this situation the advantage of MRI in locating the plane of lesion is well established .With regard to the pathology of the tumors, the clinical and histopathological (HPE) correlation was around 90 %. In this study the radiological and HPE correlation was, less than that obtained by clinical examination, which clearly brings out the superiority of clinical examination for

diagnosis of spinal cord tumors .Intramedullary tumors showed less than 90 % clinical and radiological correlation with regards to the level of the lesions. Surprisingly the clinical level of lesion fairly correlated with the pathology of lesion in intramedullary tumors. This study included only 10 cases of intramedullary tumors.

Conclusion:

Clinical and radiological correlation in assessing the level, plane and pathology of lesions was better in adults than in children and old age people. Clinical and radiological correlation for assessing the level and plane of lesions was better with cervical lesions followed by lumbar and thoracic cord lesions for assessing the plane of lesion radiological examination had a better correlation than clinical evaluation .In clinical and radiological correlation for assessing the level of lesion males had better correlation than females. Clinical and radiological correlation for assessing the pathology of tumors has revealed the fact that clinical examination is superior in assessing the pathology of spinal cord tumors. This factor can be explained by the fact that the detailed clinical examination which is preceded by a detailed history has brought out the natural course of the tumors which has greatly helped in predicting the pathology of the suspected tumour even before radiological investigations. To conclude, clinical examination still holds a pivotal role in the diagnosis of spinal cord tumors even in this era of sophisticated investigations.

INTRODUCTION

Primary CNS spinal tumors constitute 15 % of all primary CNS tumors. Unlike intracranial tumors most primary spinal tumors are benign . Most spinal cord tumors present by compression rather than invasion [3].

Spinal cord tumors may be extradural or intradural. Intradural tumors can be further classified as extramedullary or intramedullary . The ratio of intradural to extradural tumors is 3:2. The ratio of intramedullary tumors is high in children which is upto 50 %. It is 30 % among the adult population[3].

Spinal cord tumors mostly occur in the middle age group . Except for the female preponderance in case of meningiomas , the sex ratio is almost equal . Spinal cord tumors most commonly occur in the thoracic region., next comes cervical region[4]. Tumors in the lumbosacral region are rare. Nerve sheath tumors are the common intradural extramedullary tumors and they constitute 30 % of cases. Meningiomas account for nearly 25 % .The most common intramedullary tumors are astrocytomas and ependymomas . Other intramedullary tumors are hemangioblastomas ,dermoids , epidermoids , lipomas and secondaries . Ependymomas apart from intramedullary location can present at the conus medullaris . Here it can be both extra and intramedullary with an exophytic component extending into cauda equina .

Spinal cord tumors produce a spectrum of signs and symptoms based on the level and plane of lesion which aid in the clinical localization[1,2]. Surprisingly this hard done precise clinical localization few times does not exactly correlate with the radiological findings including the one obtained from various MRI sequences available at present. Also there are variations in the findings observed intraoperatively and in the histopathology[4]. So this study is done to analyse various factors that affect the clinical, radiological and pathological features of the patients with spinal cord tumors .

AIM OF THE STUDY

1. To study the correlation between clinical presentation and radiological level of lesion.

2. To study the correlation between radiological features and histopathology of spinal cord tumors.

3. To study the correlation between clinical presentation and histopathology of spinal cord tumors.

REVIEW OF LITERATURE

Based on the anatomical location, spinal cord tumors can be classified into extradural and intradural. Intradural tumors can be further classified as intramedullary and extramedullary tumors.

EXTRADURAL TUMORS :

Elsberg series report the extradural tumors to constitute nearly 20 % of the spinal cord tumors. Other series report 55 % incidence of extradural tumors. Schwannomas are the most common primary spinal cord tumors followed by meningiomas and lipomas. On the whole secondary deposits are the most common extradural tumors [3]. Secondary deposit without involvement of the adjacent bone also occur. Primary may be from lypmhomas elsewhere or lung, breast and prostate.

INTRADURAL EXTRAMEDULLARY TUMORS:

Intradural extramedullary tumors constitute nearly 68 % of spinal cord tumors . Other series report 40 % incidence . Schwannomas and meningiomas form the major bulk of these tumors.[5] Meningiomas and neurofibromas are usually intradural. Sometimes they breach the confines and become partly or wholly extradural . Intradural extramedullary ependymomas occur in the cauda equina region. It is because of the existence of filum terminale in that area. Other tumors are neurofibromas, lipomas and secondary deposits. Secondary deposits constitute 4 % of all intradural extramedullary tumors.

INTRAMEDULLARY TUMORS :

Majority of the intramedullary tumors are malignant which constitute nearly 15 % of all spinal cord tumors . Most common tumors in the intramedullary location are , astrocytomas and ependymomas. The behaviour of these tumors is slightly benign when compared to their cranial counterpart . These intramedullary tumors may sometimes breach the limits of the cord substance and can become extramedullary in location. Myxopapillary ependymoma, a common variety has CSF spread.[7]

Epidermoids, dermoids and lipomas mark the developmental group. They belong to the intramedullary category mostly. Dermoids and epidermoids are rare before late childhood. They have slight female preponderance. Most common sites are cervical and upper thoracic cord. Conus lesions also occur frequently. They are mostly intradural extramedullary in location[6].

Lipomas are usually associated with spinal dysraphism. The peak incidence is in 2nd to 5 th decades . They are located in the intradural extramedullary plane mostly and present in the cervico thoracic level . Other tumors like hemangiomas, AV malformations and hemangioblatomas also occur in the intramedullary region. [20,21]

Rarely glioblastoma multiforme , teratoma also occur. 2% of secondary deposits occur intramedullary location . The peak incidence for intramedullary tumors is 3 rd to 5 th decade . They can also present as cystic tumors[7].

CLINICAL SYMPTOMS AND SIGNS OF SPINAL CORD TUMORS

Most spinal cord tumors produce a combination of local or segmental and distant symptoms and signs.[1,2]

Segmental involvement of the dorsal root entry zone causes specific sensory defects. The anterior horn cells and root involvement causes lower motor neuron defects. Distant features are related to involvement of the long tracts. These ascending and descending tracts interrupt the function below the tumor.

In the corticospinal tract this results in upper motor neuron defects. In the spinothalamic tract, a decrease in pain and temperature sensation occurs. In the dorsal columns, a decrease in position and vibration sensation occurs.

Descending autonomic pathways are located between the corticospinal and spinothalamic tracts. Their involvement results in both sympathetic and parasympathetic disturbances below the lesion.

The volume of the tumor in both the longitudinal and transverse orientation dictates the degree of involvement of these systems, the factors are;

1. Age
2. Vascular Distribution
3. Relative size of the spinal column
4. Tethering structures

The above factors modify the clinical course.

Large tumours either intrinsic or extrinsic with severe spinal cord compression produce very few abnormalities. This has always been a surprise to the surgeon.

Specific syndromes related to rostrocaudal site of tumor can be identified.

Lesions of the upper cervical spine, foramen magnum region produce a unique syndrome characterised by;

1. A disproportionate loss of position and vibration sense in the upper extremities when compared to lower extremities.
2. Atrophy of the intrinsic muscles of the hands.

This is based on the hypothesis that postulates the interruption of the venous channels by high cervical lesions. This leads to venous infarction and central necrosis at lower levels. This explains the atrophy of intrinsic muscles of hand.[5,6]

Intramedullary tumours produce a cape like sensory loss with pain. It is due to involvement of the middle and lower cervical regions by intramedullary tumors. This involves the upper extremities most often the shoulders or fingers. Horner's syndrome may be seen.

Involvement of the upper thoracic region evokes pain in a girdle type distribution. It is sometimes mistaken for angina pectoris or pleurisy. Similarly in the middle and lower thoracic regions pain may simulate an abdominal lesion.

Tumors of the lumbosacral or conus medullaris regions of the spinal cord affect autonomic system. The parasympathetic innervations of the bladder, bowel and sexual organs are involved. Involvement of the lumbosacral interface may lead to a fascinating neurological picture. This causes upper motor neuron deficits in the sacral myotomes and lower motor neuron deficits in the affected lumbar myotomes. Cauda equina tumours may selectively impair the function of a single dorsal root. This may occur for many months.[7,8]

It seems in general, intramedullary and extramedullary tumors produce different syndromes. In practical experience, it is often difficult to differentiate these two conditions on clinical grounds alone. However certain guidelines are often helpful in clinical localisation of these type of tumors.

PAIN

Oppenheim distinguished three clinical stages of spinal cord compression

1. Radicular pain and segmental motor and sensory disruption
2. Incomplete transection (Brown Sequard syndrome)
3. Complete cord transection

Pain is an important early sign of cord compression and may be classified as one of three types

1. RADICULAR PAIN is characterised as a unilateral, lancinating, dermatomal pain. It is often exacerbated by cough, sneeze or valsalva maneuver. Radicular pain is common with extra dural growths. It is rare in intramedullary lesions. An example of an extramedullary lesion causing root pain is neurilemmoma.

2. VERTEBRAL PAIN is characterised by an aching pain localised to the point of spine involved. It is often accompanied by point tenderness. Spinal pain is common with neoplastic or inflammatory extradural lesions. It is infrequent with intramedullary or intradural extramedullary lesions.

3. FUNICULAR PAIN is described as a deep ill defined painful dysaesthesias. It is usually distant from the affected spinal cord level. It has poor localising value. It is probably due to involvement of spinothalamic tract or posterior columns. [2]

DISTURBANCES OF MOTOR FUNCTIONS

Upper motor signs tend to occur late with intramedullary tumors and early with extramedullary tumors. The coexistence of upper and lower motor neuron signs is suggestive of an intramedullary tumor but does not rule out an intradural extramedullary tumor.

SENSORY DISTURBANCES

A descending progression of paresthesia is more common with intramedullary tumors. An ascending progression of paresthesia is more common with extramedullary tumors.

Dissociated sensory loss and sacral sparing are characteristic of intramedullary tumours. With intramedullary tumours vibratory sensation is more impaired than position sense.

DISTURBANCES OF SPHINCTER FUNCTION

Tumours arising in conus and cauda equina cause early loss of spinchter control. An associated saddle anaesthesia is also common.

AUTONOMIC MANIFESTATIONS

Horner's syndrome may be associated with either extramedullary or intramedullary tumors. Vasomotor or sudomotor testing has no localising value . Sexual dysfunction is infrequent.[2,5]

RADIOLOGY OF SPINAL CORD TUMORS

MRI

MRI has become the imaging modality of choice for spinal cord tumors. MRI provides information sufficient for definitive patient management. The advantages of MRI are well known such as the lack of ionizing radiation and multiplanar imaging. MRI images have superior soft tissue contrast and high lesion detection sensitivity.

INTRAMEDULLARY TUMORS

Astrocytoma and Ependymoma :

MRI is non specific in distinguishing astrocytomas from ependymomas. Both astrocytomas and ependymomas have low to intermediate signal intensity on Tl weighted images. Both produce fusiform swelling of the cord usually over several segments. [4,5]

Ependymoma is most common in the lower cord, conus and filum. Presence of ependymoma indicates the need for screening of entire neuraxis. Ependymoma is usually associated with CSF seedling.

Focal markedly hypointense areas in the superior and inferior margins of tumors are due to pseudocapsule. This develops secondary to old hematomas at tumor cord interface. It is more frequently seen in ependymomas. Nearly 60 to 65 % of Ependymomas are associated with syrinx . Presence of polar cysts occur in ependymomas .

Ependymomas tend to enhance more markedly and more uniformly. They do so with sharper margins than do astrocytomas . Ependymomas tend to occupy the whole width of the spinal cord. Astrocytomas tend to be eccentrically. In some instances astrocytomas are exophytic and are poorly marginated . Astrocytomas enhance heterogeneously with contrast. They may be associated with intratumoral cysts and necrosis. Nearly 20 % of astrocytomas are associated with syrinx .

Hemangioblastoma :

They often exhibit the typical cyst with associated mural nodule. This enhances brightly with gadolinium. They often have associated draining veins or feeding arteries which appear as flow voids. Almost all are intramedullary. They abut the pial surface and there is often associated edema. They are

located dorsally or dorsolaterally .They are associated with large cysts and a disproportionate syrinx. Sometimes they are associated with a cystic cap. 33% of hemangioblastomas are associated with Von Hippel Lindau disease.[5,6]

Metastasis and Lymphomas :

Intramedullary metastasis are non specific in their appearance. MRI demonstrates cord widening, increased signal intensity with T2 weighting. There is contrast enhancement of the lesion. Leptomeningeal enhancement also occurs.

INTRADURAL EXTRAMEDULLARY TUMORS

Nerve sheath tumors :

Schwannomas and neurofibromas have similar appearances on MRI. On T1 images they tend to be smoothly rounded iso or slightly hypo intense to the cord. They show increased signal intensity on T2 weighted images. On post gadolinium neurofibromas have a central nonenhancing T2 dark focus.

These tumors compress and displace the cord. They cause widening of the adjacent CSF spaces . They consistently enhance with contrast. This property helps in detection of even small tumors . Nerve sheath tumors may grow through and expand neural foramina resulting in a dumbell shape.

Cystic degeneration or fatty degeneration is seen with schwannomas. This feature may be a useful characteristic differentiating them from meningiomas or neurofibromas. Due to their slow growth , bone remodelling may occur around them .

For lesions that extend into the plexus , an MR neurography can localise the extent of lesion.[4]

Meningiomas :

Meningiomas also appear as rounded, sharply marginated masses. They displace and compress the cord. They are iso to hypo intense in Tl and hyperintense on T2 weighted images. They are highly vascular and they usually intensely enhance with contrast.

Nerve sheath tumors tend to be anterolateral. They may extend through the neural foramen. Nerve sheath tumors may be attached to a nerve root free from the dura. Meningiomas tend to be posterolateral. They are dural based and occasionally have a dural tail. Calcification is not uncommon.

Peritumoral hypointensity is seen in meningiomas. This is due to the CSF spaces around them.

EXTRADURAL TUMORS

MRI with contrast is superior to CT Myelography for extradural tumors. MRI identifies soft tissue extension, paraspinal lesions and cord compression. Secondaries usually show contrast enhancement. The high signal intensity of the marrow fat many times outlines the marrow replacing lesions.

CT myelography :

Usually this is done as an investigation for spinal cord tumors if the patient is extremely claustrophobic or there is an absolute contraindication for MRI . Sometimes myelography with water soluble non ionic positive contrast material is used with CT myelography to confirm the diagnosis. In cases of complete block a cisternal myelography is necessary to determine the upper level of lesion.[6,7]

An intramedullary lesion produces a fusiform enlargement of the spinal cord. This enlargement occurs over several segments. The subarachnoid space is narrowed on both sides. Its outer margins are close to the bony margin of the spinal canal.

In intradural extramedullary tumors, myelography shows outer margins of the subarachnoid space. This is close to the bony margin of the spinal canal. The subarachnoid space on the side of the tumor is widened. This produces a

cup deformity at the head of the contrast column. This is called the "Meniscus sign".

In extradural tumors the outer border of the subarachnoid space is displaced away from the bony margin. This is usually on the side of the tumor. On an AP view lesions situated anteriorly or posteriorly produce a picture of a transverse serrated block. This gives a "brush border appearance".

PATHOLOGY OF SPINAL CORD TUMORS

Nerve sheath tumors usually arise from the dorsal roots. They arise at the various segmental levels of the spinal cord. The nerve root is intimately involved in the tumour matrix. So it can rarely be spared in the surgical removal of the tumour. Tumors that have a dumbbell configuration, have an attachment to dura. They derive blood supply from the dura.[4,5]

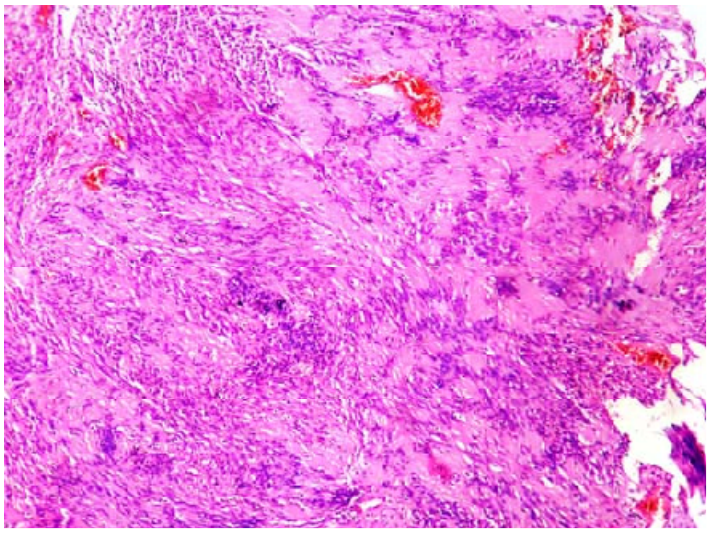


Fig 1 : Schwannoma

Meningiomas may arise in any age group. But mostly occur between the 5th and 7lh decades . About 75% to 85% of meningiomas occur in women. Meningiomas are most common in the thoracic region. They presumably arise from arachnoid cluster cells. Therefore they are located in the exit zones of nerve roots. They may also occur in the entry zones of the arteries into the spinal canal.

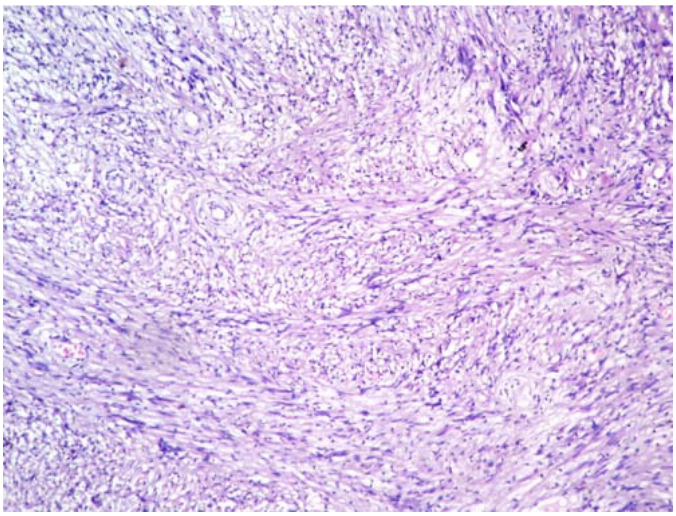


Fig 2 : Clear cell Meningioma

Ependymomas are mostly intramedullary. But about 40% arise from the filum terminale. In the conus region they may be partially intramedullary. Sometimes they breach and become partially exophytic. Grossly at operation it may be hard to distinguish a nerve sheath tumor and ependymoma. Nerve sheath tumors are attached to a nerve root of the cauda equina. Ependymoma appears as a globoid mass attached to a thin filum. Myxopapillary ependymoma occurs in conus / filum and is classified under WHO grade 1.[2,5]

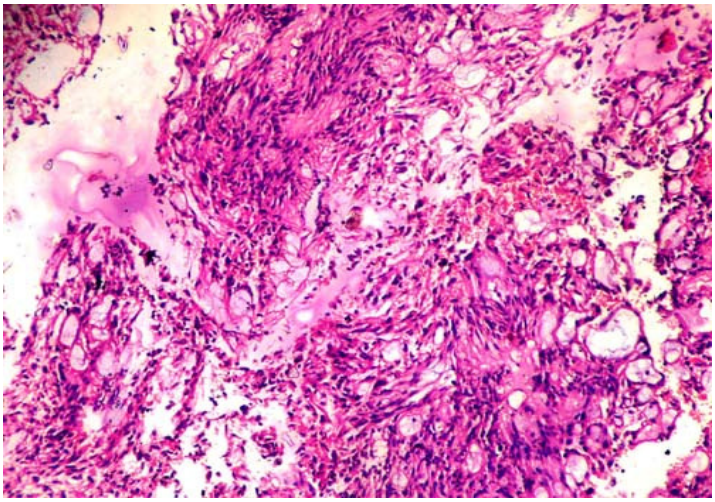


Fig 3 : Myxopapillary ependymoma

Astrocytoma is relatively avascular tumor and is always intramedullary. Astrocytoma is usually not distinguishable from neural tissue in colour and contour. It can be soft without calcification. About 20% of intra medullary astrocytomas are malignant.

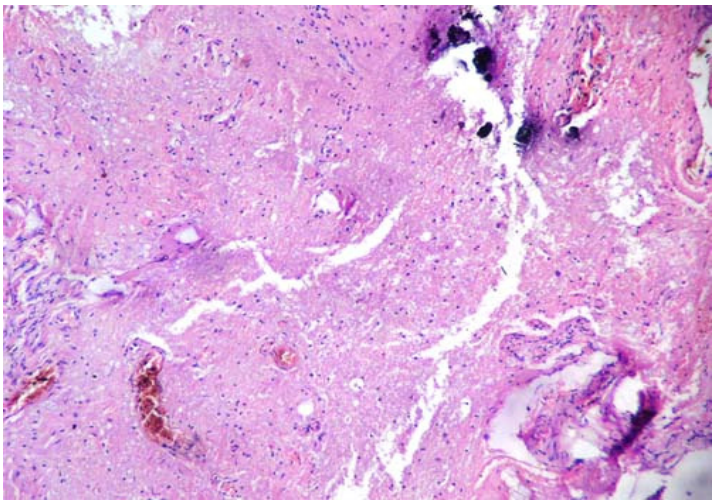


Fig 4 : Astrocytoma

Uncommon intradural tumors include the dermoids and epidermoids. Lipomas and teratomas also occur. The rare teratomas are intramedullary .The dermoid and epidermoid tumors occur in intramedullary location in the region of the cauda equina. Hemangioblastomas may occur as solitary tumors. They also occur as a part of the broader spectrum of the von Hippel-Lindau syndrome. They most commonly involve the cervical or thoracic region. They are the most vascular variety of intradural tumors. They may be wholly intramedullary. But most frequently they gain the dorsal surface of the spinal cord and become visible upon exposure of the involved area. They are non infiltrating and well demarcated lesions.[3]

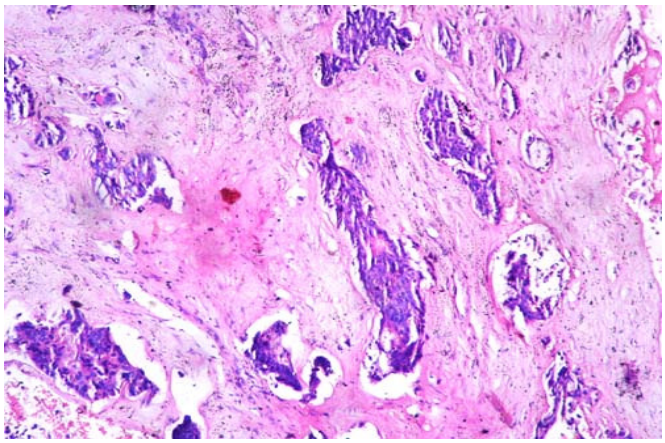


Fig 5 : Secondaries

Rare types of spinal tumors include

1) intramedullary carcinomatous deposit,

2) mixed tumors that include malignant elements of a variety of tumors

3) neurenteric cysts

They often compress the cord from a symmetrical ventral location mimic an intramedullary tumor.

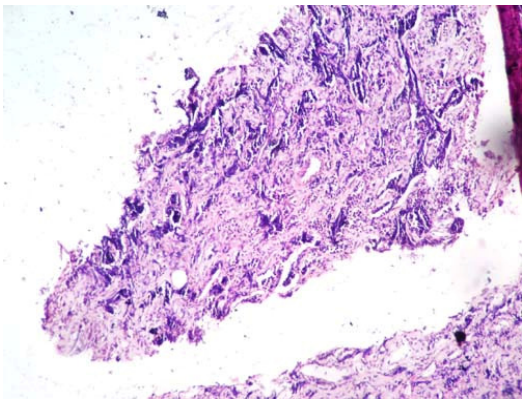


Fig 6 : Low power PNET

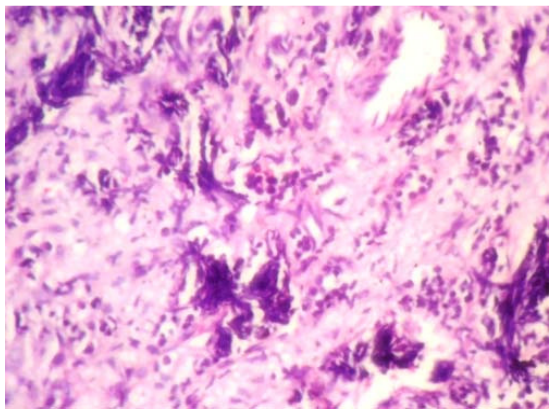


Fig 7 : High power PNET

Vascular pathologies present as intramedullary mass. They are

1) cavernous malformation,

2) venous ectasia associated with an arteriovenous malformation.

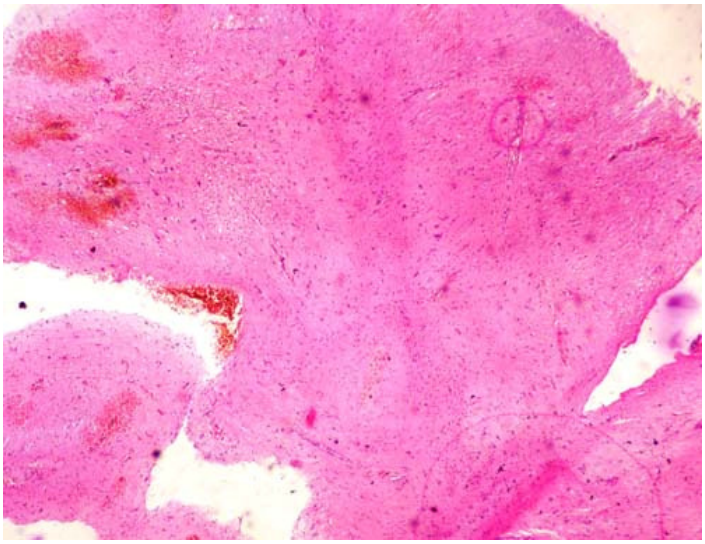


Fig 8 : Hemangioblastoma

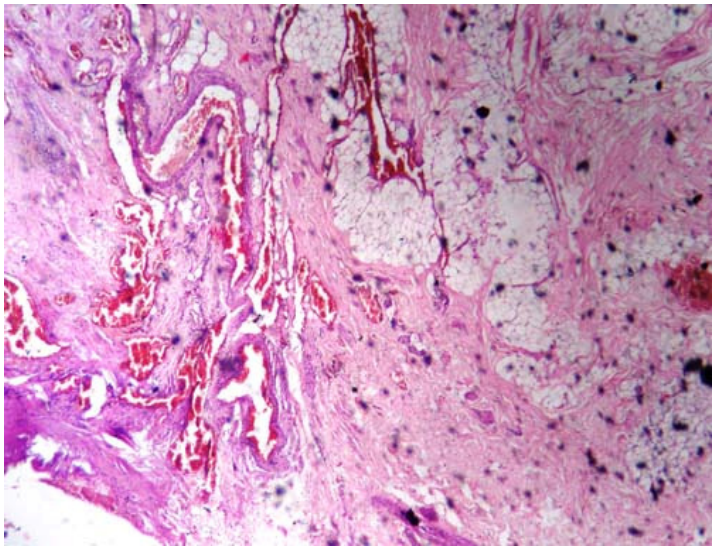


Fig 9 : Dermoid

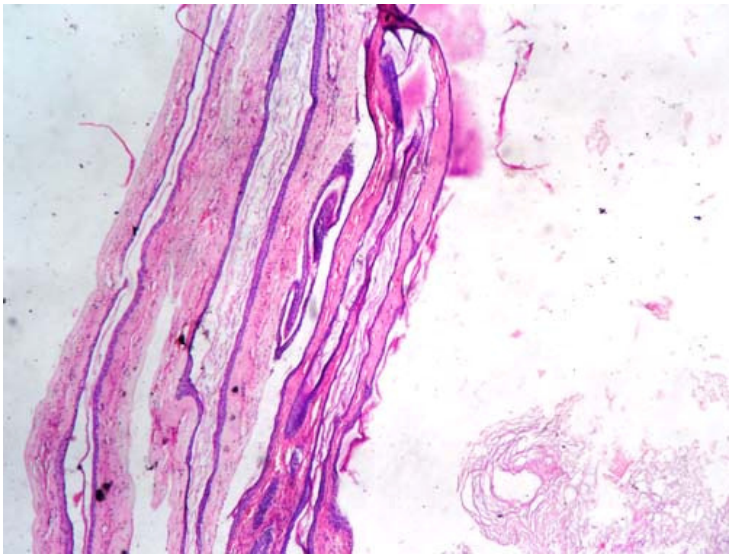


Fig 10 : Epidermoid

Secondary deposits are usually very vascular and mostly represent the pattern of primary.

The primary may be from breast, lung or prostate.

Secondary deposits may be osteolytic also.[18]

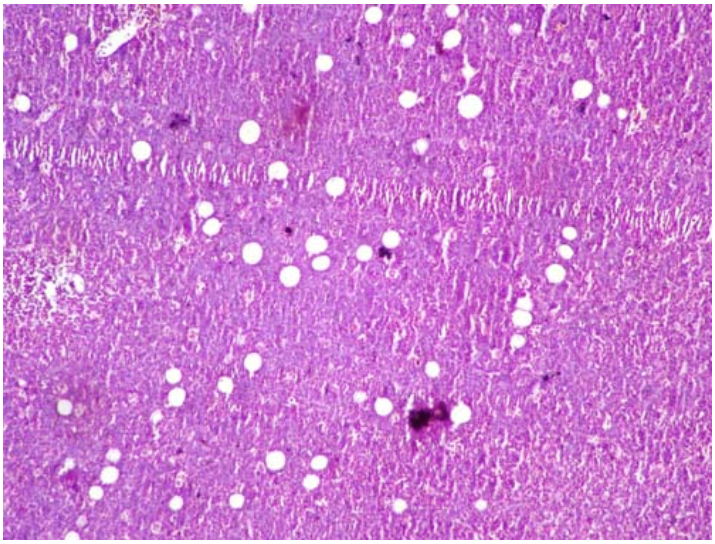


Fig 11 : Myeloid sarcoma

The study by John.R.Crawford and his collegues was fashioned to determine the relationship between clinical presentation, radiographic features, pathology of newly diagnosed pediatric primary spinal cord tumors. Twenty five pediatric patients were included in the study. Symptom duration was significantly shorter for high grade tumors. Homogenous gadolinium enhancement on MRI correlated with lower grade pathology. MRI homogenous gadolinium enhancement patterns may be helpful in distinguishing high grade spinal cord tumors.

The study by Koeller and his collegues concluded that intramedullary spinal neoplasms have limited distinguishing features on radiological images. In adults, ependymomas are the most common intramedullary spinal neoplasms. Astrocytomas are the second most common. In children this relationship is reversed.

There are no pathognomonic imaging findings that allow flawless differentiation of ependymoma from astrocytoma. The combination of MR imaging findings often permits one to arrive at a most likely diagnosis.

Features that favour an ependymoma include , 1) central location , 2) well circumscribed mass. 3) presence of hemorrhage , 4) location in the conus or filum. 5) focal, intense homogenous contrast enhancement. Astrocytoma is favoured when, 1) the mass is eccentric, 2) ill defined, 3) patchy enhancement with contrast in an irregular fashion .

Myxopapillary ependymoma is the most common tumor of conus medullaris or filum terminale. Gangliogliomas characteristically involve eight or more spinal segments. They have mixed signal intensity on T 1 weighted images. It is a finding unique among spinal cord tumors .

Hemangioblastomas and paragangliomas are both highly vascular lesions. They have prominent flow voids near the mass. They manifest with “Cap sign”. But cap sign is classically associated with ependymomas .

Less common spinal cord tumors include metastasis , lymlphoma and PNET .

A gentle , thorough and unhurried clinical examination elicits many informations. This will be supplemented by the factors got from a detailed history.

Subtle signs provide vital clues to the localisation of spinal cord tumors . But many times history alone is insufficient to arrive at a probable diagnosis in spinal cord tumors . However it will aid in the clinical examination which will increase the probability of an accurate diagnosis .

Detailed history and a thorough clinical examination many times saves considerable expense . This also reduces the delay in the diagnosis which helps in an early intervention and a better outcome.

Many fallacies have been associated with radiological diagnosis arrived without a proper history and clinical examination . Hence a closer association between the patient and the attending physician, and consultation with a radiologist will aid in proper early diagnosis .

Hence this study was conducted to analyse the clinical features, radiological features and histopathology of spinal cord tumors in a sample of 78 patients .

MATERIALS AND METHODS

78 patients with spinal cord tumors who were treated in Madras Institute of Neurology, Government General Hospital, Chennai ., during the period January 2012 to December 2013 have been studied.

Inclusion criteria for the study is :

1. All cases of spinal cord tumors
2. All spinal compressive myelopathy patients with suspected spinal malignancy

Exclusion criteria in this study are as :

1. Disc disease related spinal cord compressive lesions
2. Post traumatic spinal cord compressive lesions
3. Post inflammatory spinal cord compressive lesions

This is a prospective study and all eligible patients were enrolled in the study . All the clinical, radiological, and pathological details of 78 patients were entered into a proforma as given in Appendix I.

Criteria for detecting the level of lesion by clinical examination:

After thorough clinical examination including a detailed history the motor , sensory and reflex level were found. The highest level was taken into

account as the level of spinal cord tumor location and its corresponding vertebral level was also noted .

Criteria for assessing the plane of lesion clinically :

Intramedullary tumors :

1. Dissociated sensory loss
2. Suspended sensory loss with sacral sparing
3. Descending sensory loss/motor weakness
4. Early sphincter involvement .

Intradural extramedullary tumors :

1. Radicular pain
2. Ascending type of sensory loss /motor weakness
3. Late sphincter involvement

Extradural spinal cord tumors :

1. Radicular pain
2. Ascending type of sensory loss /motor weakness
3. Late sphincter involvement
4. Local spine tenderness .
5. Restriction of movements

Criteria for assessing the pathology of spinal cord tumors:

Schwannomas :

1. Predominant root symptoms
2. The plane of lesion being intradural extramedullary .

Meningiomas :

1. Presented most commonly in the dorsal cord
2. Females were affected predominantly.
3. The plane of lesion was intradural extramedullary .

Astrocytomas :

1. Clinically present like ependymoma in the pediatric group
2. Intramedullary tumors in dorsal cord were grouped under ependymomas.
3. Astrocytoma occurred in cervical and lumbar cord
4. the plane was intramedullary
5. Occur mostly in younger age group .

Extradural spinal cord tumors :

1. Present with spinal tenderness
2. Band like paresthesia, chest discomfort in case of dorsal tumors.

Metastasis and other primary extradural tumors :

These tumors taken into consideration based on

1. Age and clinical presentation such as duration of onset of illness
2. Evidence of primary elsewhere .

Criteria for assessing the plane of lesion radiologically :

Intramedullary spinal cord tumors :

1. Proportionate or disproportionate enlargement of the spinal cord and syrinx formation .,
2. MRI showing narrowing of CSF spaces at the level of tumor as seen in T 2 weighted and myelographic pictures .

Extradural spinal cord tumors :

1. MRI showing compression and displacement of the spinal cord
2. Widening of the adjacent spinal subarachnoid spaces and compete block showing brush border appearance were included in the extradural tumor group .

Intradural extramedullary spinal cord tumors : -

1. Widening of subarachnoid space on the side of tumor
2. Enhancement of adjacent dura .
3. Meniscus sign.
4. Dorsally placed lesions occurring commonly among females and

presenting with dural tail and broad based dural attachment were included in this group .

Criteria for the assessing pathology of the tumor- radiologically :

Ependymoma :

1. Intramedullary location.,
2. Symmetrical ,
3. Uniform contrast enhancement
4. Frequent association with polar cysts
5. 60 to 65 % association with syrinx .

Astrocytoma :

1. Intramedullary in location
2. Poorly marginated
3. Eccentric in position
4. Heterogenous contrast enhancement with intratumoral cysts .,
5. 20 % association with syrinx.

Hemangioblastoma :

1. Intramedullary location
2. Intense contrast enhancement
3. Disproportionate syrinx .

Schwannoma :

1. Intradural extramedullary tumor
2. Well circumscribed lesions iso intense on Tl , iso to hyperintense on T2 images
3. Enhance with contrast .

Neurofibroma :

1. Intradural extramedullary tumor
2. Associated with bone remodelling around the tumors
3. Sometimes have dumbbell appearance .

Meningioma :

1. Intradural extramedullary tumors
2. Iso to hypointense on T 1 images and hyperintense on T2
3. Intense contrast enhancement with calcification
4. Presence of dural tail

After detailed clinical examination , radiological investigation was done for all patients and all important details noted.

Patients were taken up for surgery and the specimen of the resected tumor was sent for histopathological examination.

The details of histopathological features were recorded .

After collecting all the above data, Statistical analysis of all data was done using SPSS 17.0 (Statistical package of social science) and by using Microsoft Excel 2010.

Base line statistics, correlation agreement (r^2) and Chi square test have been used for analysis.

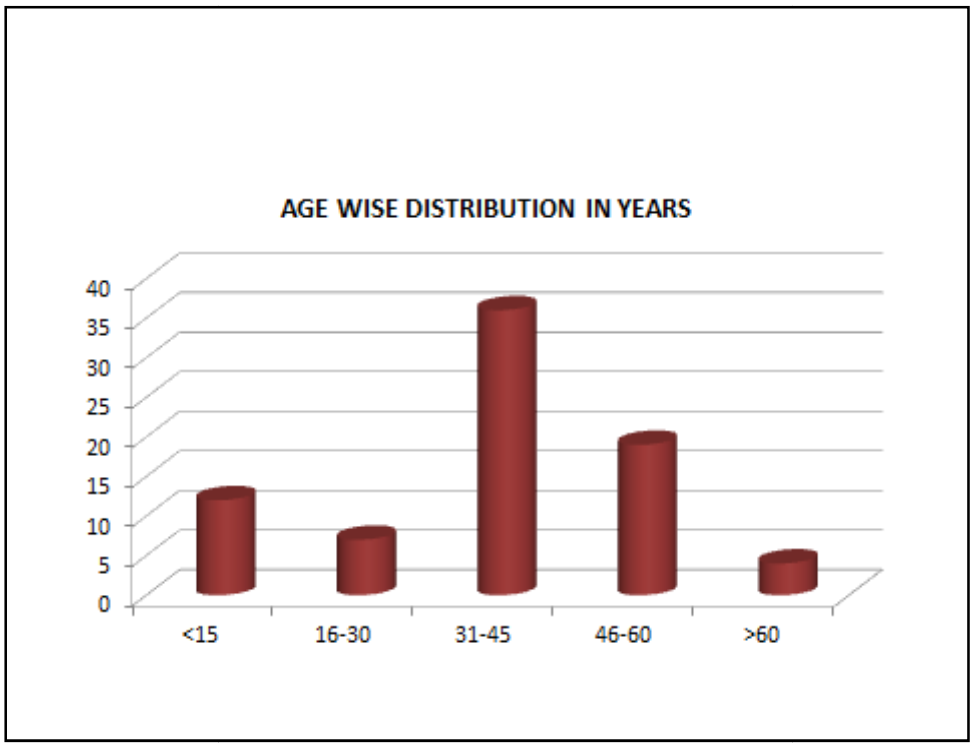
OBSERVATIONS AND RESULTS

78 cases of spinal cord tumors treated during the period , January 2012 to December 2013 at Madras Institute of Neurology , Government General Hospital , Chennai were studied.

Details of all cases are given in the Master Chart added in Appendix II.

The collected data are analysed as follows,

Fig 12 : AGE WISE DISTRIBUTION



Spinal cord tumors presented mostly in the age group 31 to 45 years and the least in the age group more than 60 years, in this study.

Fig 13 : SEX DISTRIBUTION

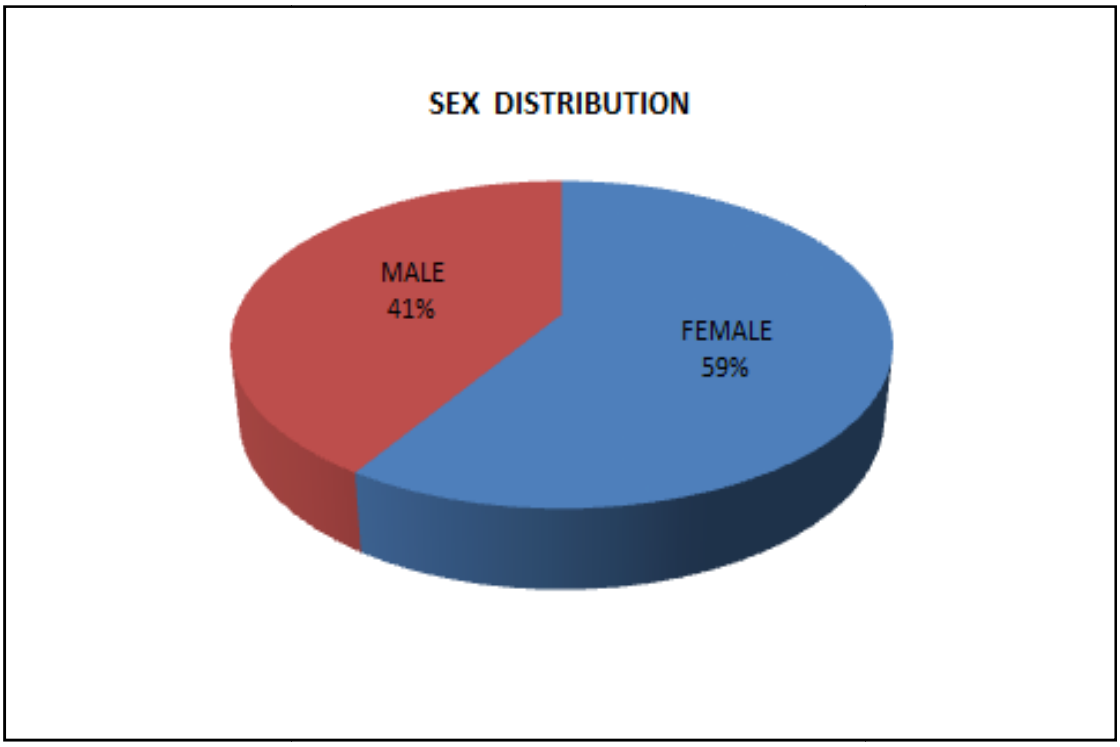


Table 1 : SEX DISTRIBUTION

MALE	FEMALE
32	46
TOTAL NUMBER OF CASES : 78	

Sex distribution showed a clear cut female preponderance in this study.

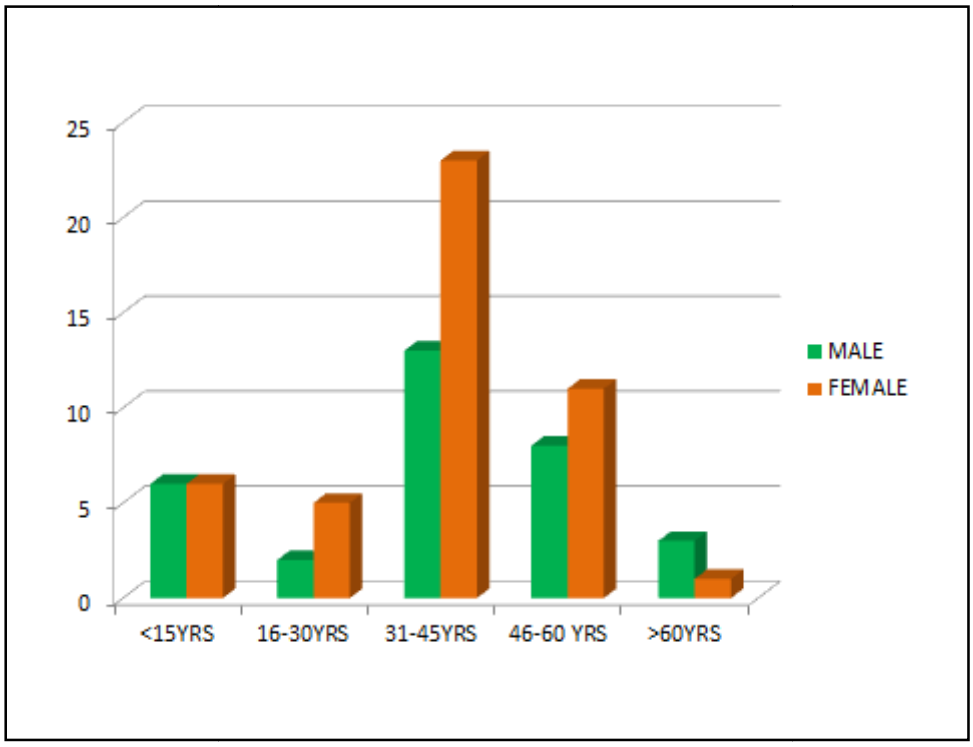
Table 2: CHI-SQUARE FOR AGE GROUP vs SEX DISTRIBUTION

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	3.896[a]	4	.420
Likelihood Ratio	3.915	4	.418
Linear-by-Linear Association	.427	1	.513
N of Valid Cases	78		

Table 3 : CHI-SQUARE FOR AGE GROUP vs CLINICAL TYPE

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.149[a]	8	.000
Likelihood Ratio	32.810	8	.000
Linear-by-Linear Association	3.156	1	.076
N of Valid Cases	78		

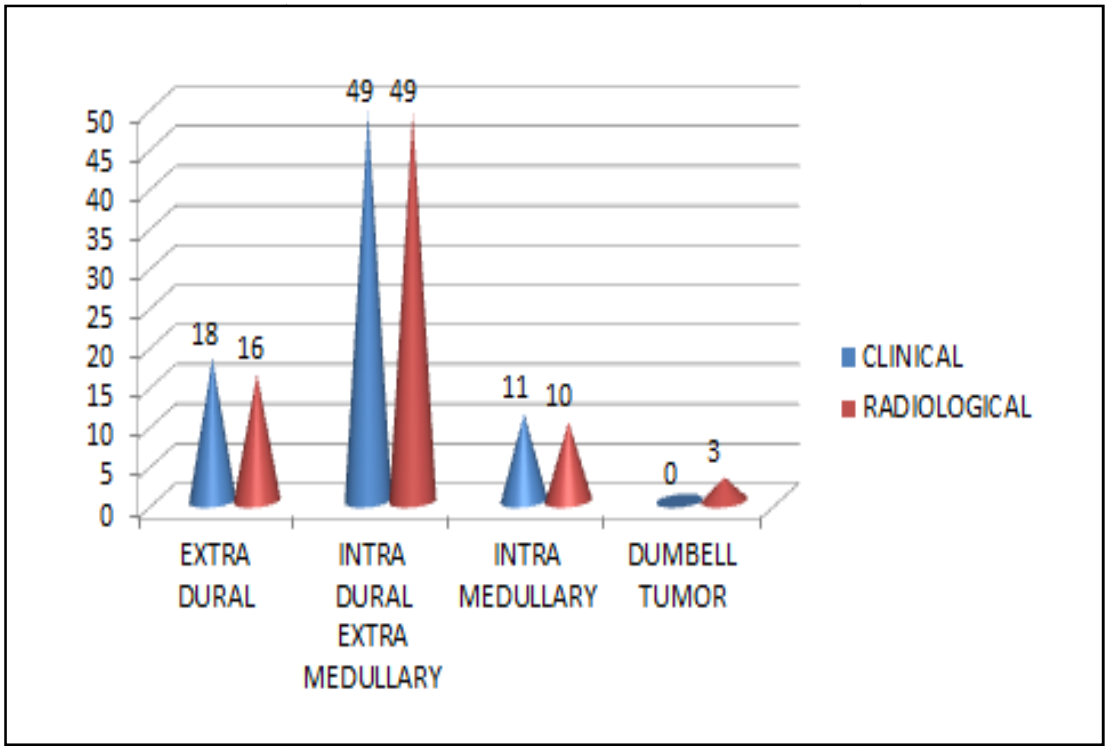
Fig 14 : AGE DISTRIBUTION Versus GENDER



Both male and female preponderance for spinal cord tumors was in the age group of 31 to 45 years .

In the age group <15 years the sex distribution was almost equal.

Fig 15 : CLINICAL AND RADIOLOGICAL CORRELATION PLANE OF TUMORS

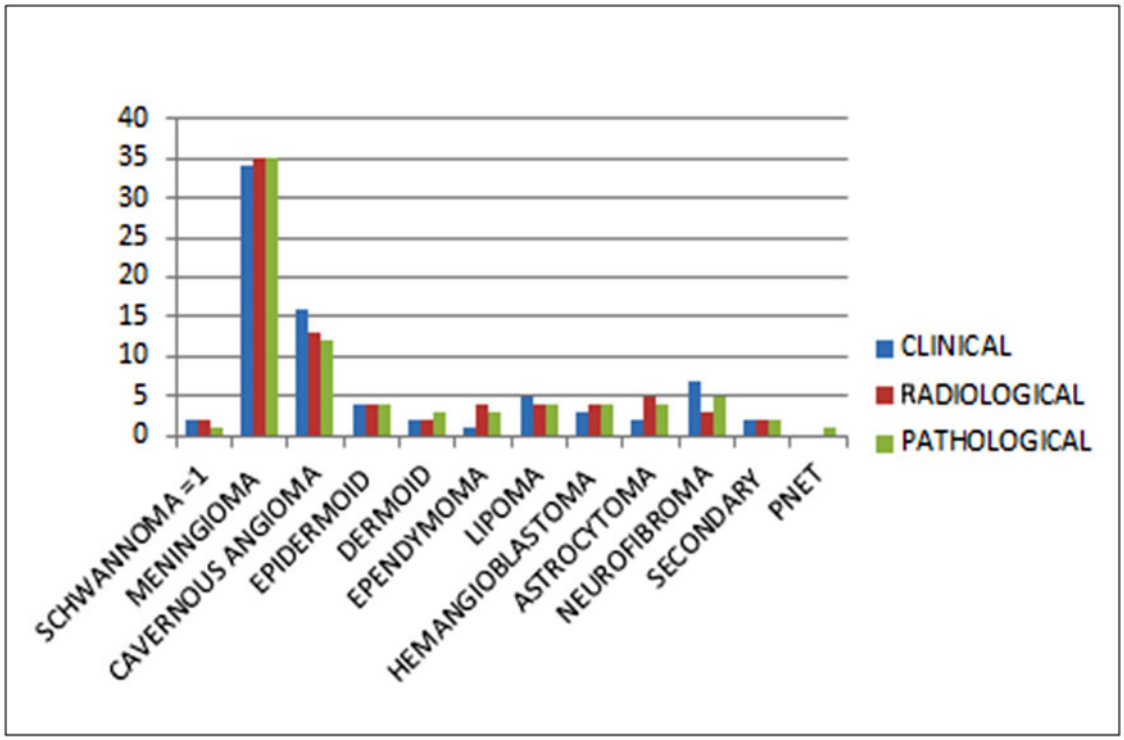


Clinical and radiological correlation was maximum with intradural extramedullary tumors .

Clinical and radiological correlation was minimum with intradural extramedullary tumors presenting as dumb bell tumors .

Clinical and radiological correlation was to acceptable limits in intramedullary tumors .

Fig 16 : CLINICAL, PATHOLOGICAL AND RADIOLOGICAL CORRELATION



Clinical correlation for schwannomas and meningiomas was having complete agreement which is statistically significant.

Clinically differentiation between schwannomas and meningiomas was difficult .

Clinical correlation for hemangioblastomas and lipomas was having less agreement.

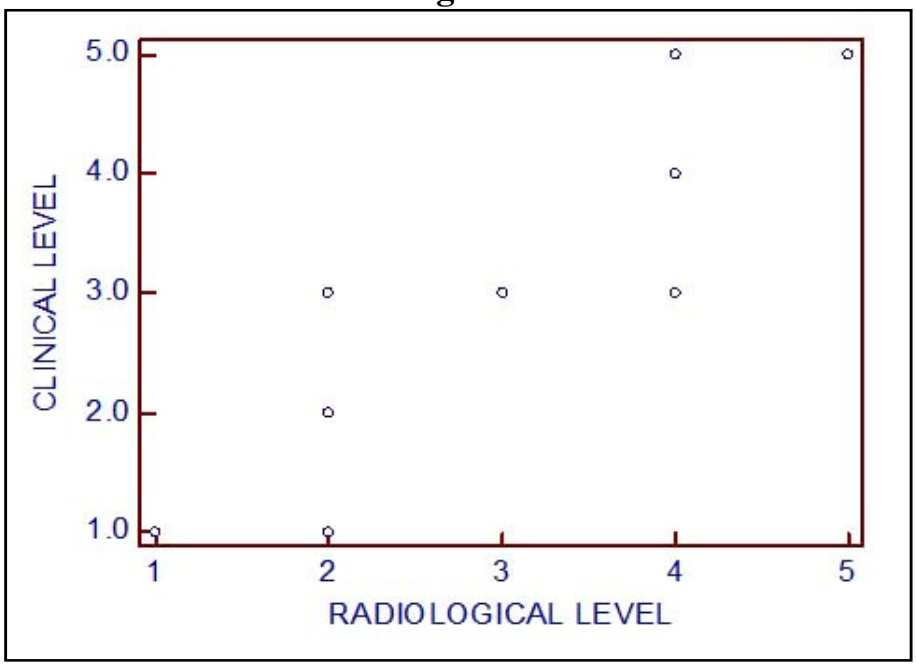
CORRELATION-MEASURE OF AGREEMENT BETWEEN RADIOLOGICAL LEVEL AND CLINICAL LEVEL.

Variable Y	CLINICAL LEVEL
Variable X	RADIOLOGICAL LEVEL

Table 4

Sample size	78
Correlation coefficient r	0.9655
Significance level	P<0.0001
95% Confidence interval for r	0.9462 to 0.9779

Fig. 17



Clinical / Radiological Level

1 = Cervical, 2 = Cervicodorsal, 3 = Dorsal, 4 = Dorsolumbar, 5 = Lumbar

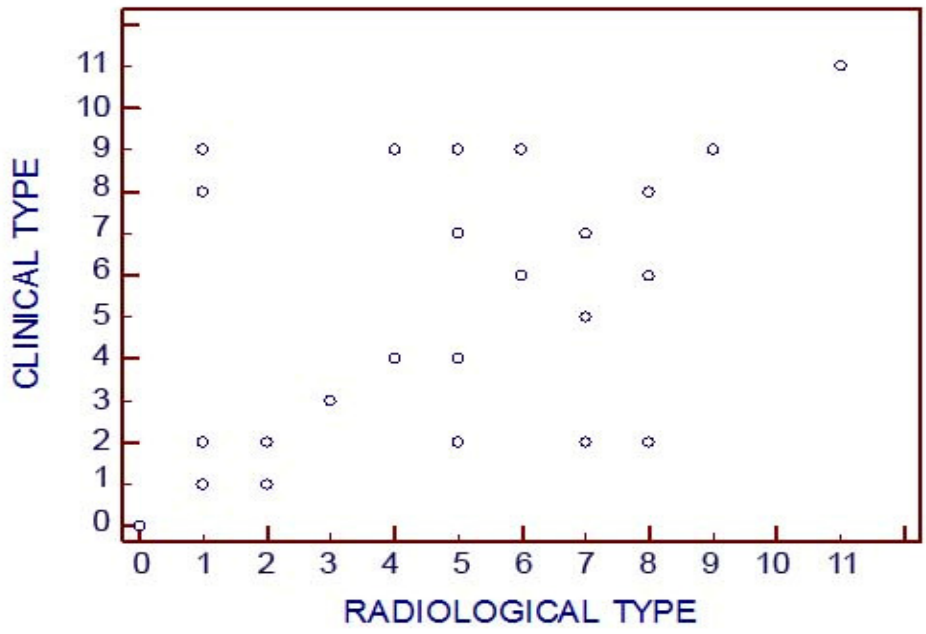
CORRELATION-MEASURE OF AGREEMENT BETWEEN RADIOLOGICAL TYPE AND CLINICAL TYPE - PATHOLOGY

Variable Y	CLINICAL PATHOLOGY TYPE
Variable X	RADIOLOGICAL PATHOLOGY TYPE

Table 5

Sample size	78
Correlation coefficient r	0.7830
Significance level	P<0.0001
95% Confidence interval for r	0.6788 to 0.8563

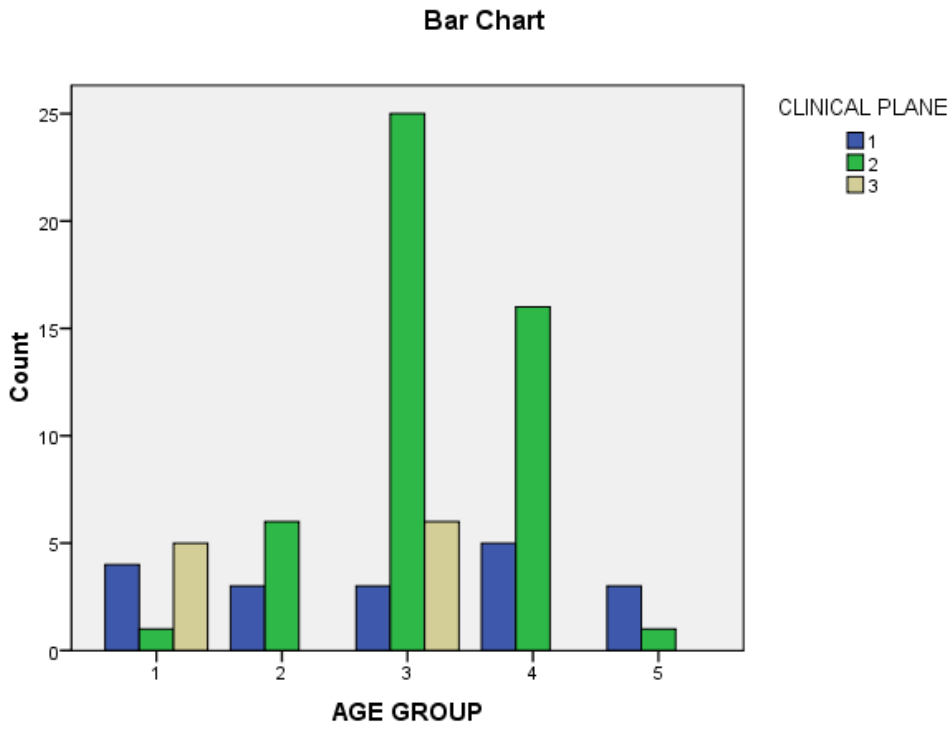
Fig. 18



Clinical Type:

0 = Neurofibroma, 1 = Schwannoma, 2 = Meningioma, 3 = Cavernous angioma, 4 = Epidermoid, 5 = Dermoid, 6 = Ependymoma, 7 = Lipoma, 8 = Hemangioblastoma, 9 = Astrocytoma, 11 = Secondaries.

Fig. 19 : AGE GROUP VERSUS CLINICAL PLANE



Clinical Plane:

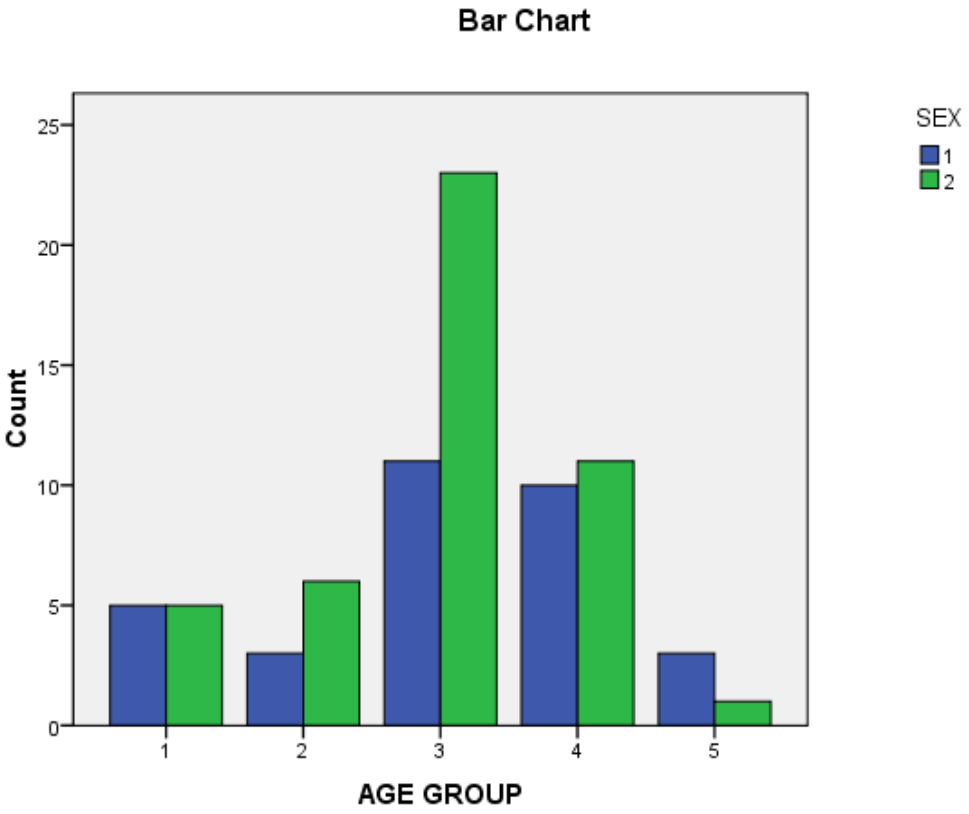
1 = Extra dural, 2 = Intra dural extra medullary, 3 = Intra medullary

Age Group :

1 = <15 years, 2 = 16 to 30 years, 3 = 31 to 45 years, 4 = 46 to 60 years,

5 = > 60 Years

Fig. 20 : AGE GROUP VERSUS CLINICAL LEVEL

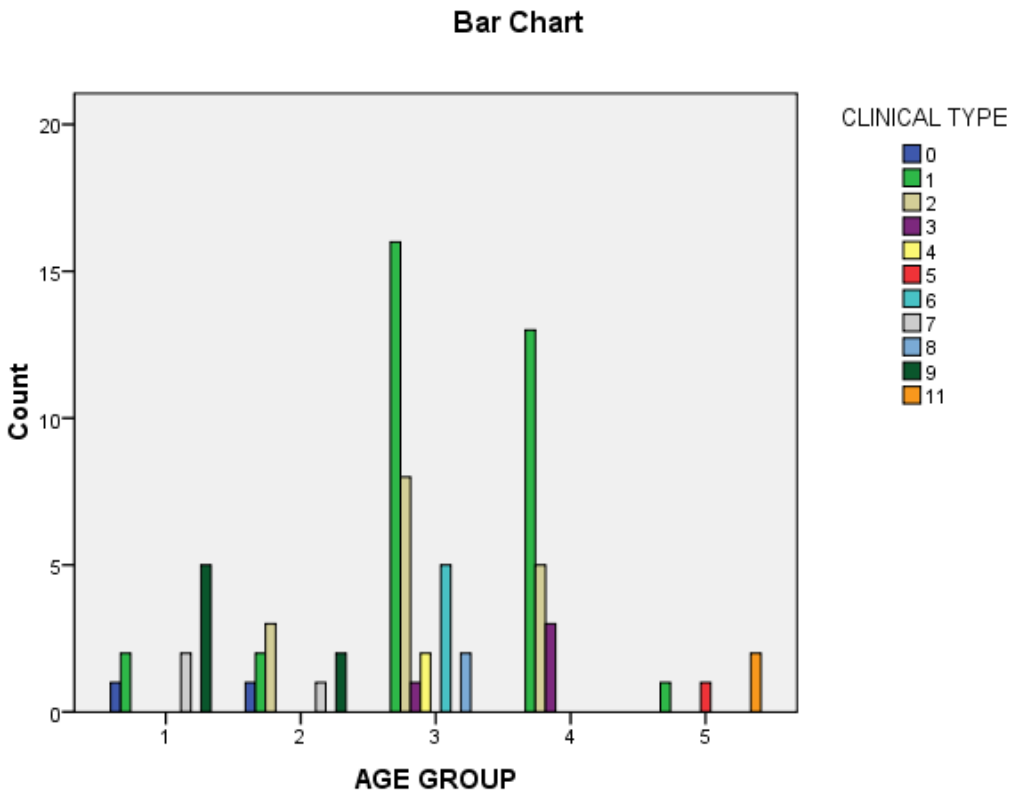


1 = Cervical, 2 = Cervicodorsal, 3 = Dorsal, 4 = Dorsolumbar, 5 = Lumbar

= Female

= Male

Fig. 21 : AGE GROUP VERSUS CLINICAL - PATHOLOGY TYPE



Clinical Type:

0 = Neurofibroma, 1 = Schwannoma, 2 = Meningioma, 3 = Cavernous angioma,

4 = Epidermoid, 5 = Dermoid, 6 = Ependymoma, 7 = Lipoma, 8 = Hemangioblastoma,

9 = Astrocytoma, 11 = Secondaries.

Age Group :

1 = <15 years, 2 = 16 to 30 years, 3 = 31 to 45 years, 4 = 46 to 60 years,

5 = > 60 Years

Table 6 : CHI-SQUARE FOR AGE GROUP vs CLINICAL LEVEL

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	37.565[a]	16	.002
Likelihood Ratio	39.220	16	.001
Linear-by-Linear Association	.706	1	.401
N of Valid Cases	78		

Table 7 : CHI-SQUARE FOR AGE GROUP vs RADIOLOGICAL PLANE

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	39.300[a]	12	.000
Likelihood Ratio	42.844	12	.000
Linear-by-Linear Association	2.356	1	.125
N of Valid Cases	78		

CORRELATION AMONG DIFFERENT AGE GROUPS

Age Group Less than 15 years :

In clinical and radiological correlation of level of lesion 92 % of them are completely in agreement, P value =0.0001 (P value< 0.05). It is statistically significant.[9,10]

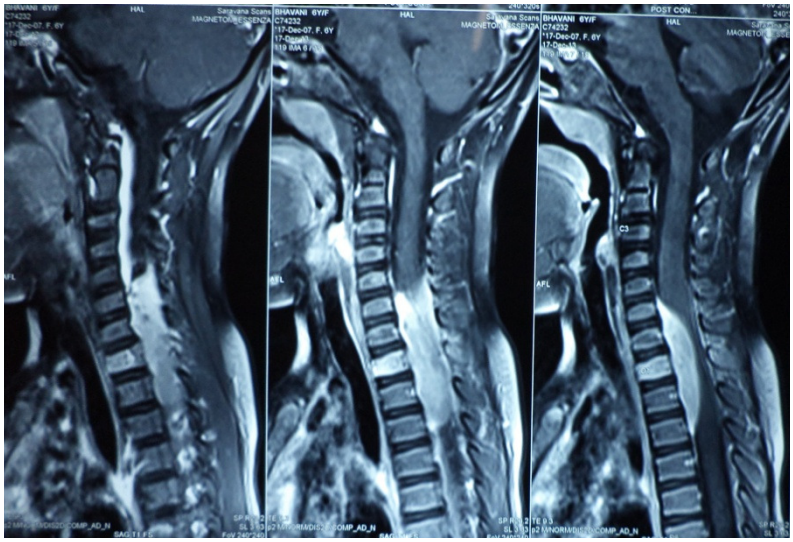


Fig. 22 : EXTRA DURAL TUMOR :
Primitive Neuroectodermal Tumour
6 year Female Child

In clinical and radiological of plane of lesion 98% of them are completely in agreement, P value = 0.002 (P value< 0.05). It is statistically significant.

In clinical and HPE correlation 60 % of them are completely in agreement.

In radiological and HPE correlation 75 % of them are completely in agreement, P value = 0.001 (P value< 0.05). It is statistically significant.[11,12]

Age group between 16 to 30 years :

In clinical and radiological correlation of level of lesion 86 % of them are completely in agreement, P value = 0.000 (P value< 0.05) , it is statistically significant.

In clinical and radiological correlation of plane of lesion 74 % of them are completely in agreement. [12,13]

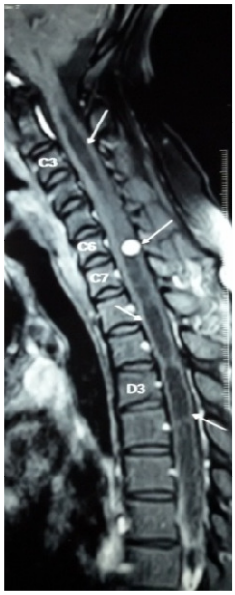


Fig 23 : INTRAMEDULLARY TUMOR

28 year female – Hemangioblastoma.

In this type of tumors ,

Clinical radiological correlation 96%

Clinical pathological correlation 96%

Radiological pathological correlation 98%

In clinical and HPE correlation 86 % of them are completely in agreement, P value = 0.005 (P value< 0.05) , it is statistically significant.

In radiological and HPE correlation 96 % of them are completely in agreement. [13,14]

Age group between 31 to 45 years :

In clinical and radiological correlation of level of lesion 91 % of them are completely in agreement, P value = 0.000 (P value< 0.05) , it is statistically significant.[16]

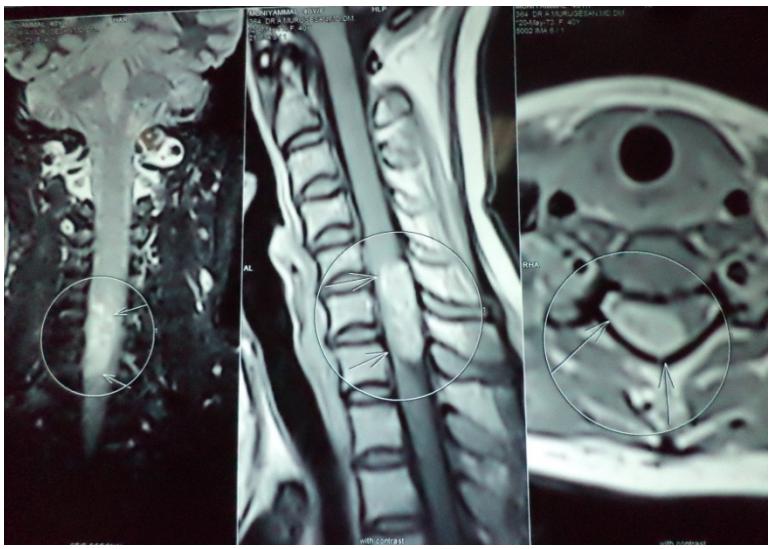


Fig 24 : INTRA DURAL EXTRAMEDULLARY TUMOR
40 year female
Schwannoma.

In this type of tumors,

- Clinical radiological correlation 95 %.
- Clinical Pathological correlation 93 %.
- Radiological Pathological correlation 95 %

In clinical and radiological correlation of plane of lesion 92 % of them are completely in agreement, P value = 0.002 (P value< 0.05) , it is statistically significant.[17,18]

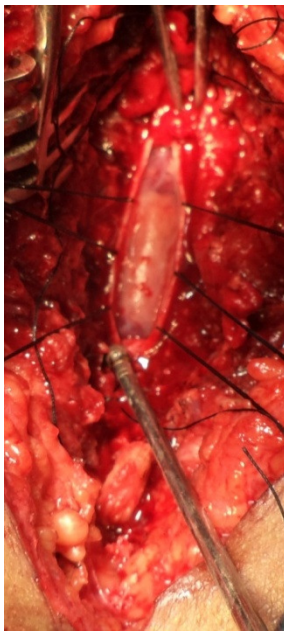
In clinical and HPE correlation 84 % of them are completely in agreement.

In radiological and HPE correlation 88 % of them are completely in agreement, P value = 0.000 (P value< 0.05) , it is statistically significant.

Age group between 46 to 60 years :

In clinical and radiological correlation of level of lesion 90 % of them are completely in agreement.

In clinical and radiological correlation of plane of lesion 92 % of them are completely in agreement.[19,20]

	**Fig 25 : INTRADURAL EXTRAMEDULLARY TUMOR** 38 year old female Meningioma

In clinical and HPE correlation 90% of them are completely in agreement, P value = 0.000 (P value< 0.05) , it is statistically significant.

In radiological and HPE correlation 94 % of them are completely in agreement .

Age group more than 60 years :

In clinical and radiological correlation of level of lesion 88% of them are completely in agreement.

In clinical and radiological correlation of plane 87 % of them are completely in agreement.

In radiological and HPE correlation 89 % of them are completely in agreement.[21]

Correlation of level in different pathology and different levels

- Correlation of level in Schwannoma was 92 %

  (P value = 0.000< 0.05).

- Correlation of level in Meningioma was 91 %

  (P value = 0.001< 0.05).

- Correlation of level in dorsal tumors was 96%

  (P value =0.000<0.05).

- Correlation of level in cervical tumors was 90 %

  (P value =0.003 <0.05).

- Correlation of level in lumbar tumors was 84 %

  (P value =0.000<0.05).

Dorsal - Level

In clinical and radiological correlation of plane 86 % of them are in complete agreement, P value = 0.000 (P value< 0.05) it is statistically significant.

In clinical and histopathological examination(HPE) correlation 88 % of them are in complete agreement.

In radiological and HPE correlation 87 % of them are in complete agreement.

Cervical-Level

In clinical and radiological correlation of plane 90 % of them are in complete agreement.

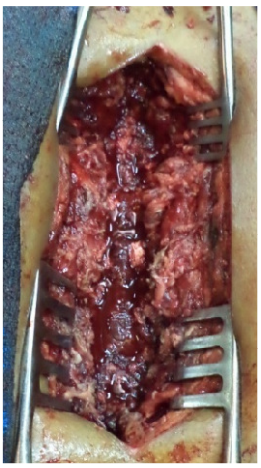
In clinical and HPE correlation 90% of them are in complete agreement, P value = 0.002 (P value< 0.05) , it is statistically significant.

In radiological and HPE correlation 92 % of them are in complete agreement, P value = 0.002 (P value< 0.05) , it is statistically significant.

Lumbar - Level

In clinical and HPE correlation 90% of them are in complete agreement.

In radiological and HPE correlation 91 % of them are in complete agreement.

	**Fig 26 : HIGHLY VASCULAR EXTRADURAL SECONDARIES C 6 TO D4** Patient presented with acute onset paraplegia

DISCUSSION

In spinal cord tumors even after a thorough clinical examination and radiological investigations the surgeon many a times finds surprises in the operative field . An attempt has been made in this study to find the correlation between clinical , radiological, and pathological diagnosis of spinal cord tumors.

95% of clinical diagnosis correlated with the radiological findings for all types of tumors. With regards to schwannomas the clinical and radiological correlation was more than 92 %. On analysing the correlation with regard to different levels, the correlation of level of lesion in the age group of 30 to 45 years was more than 90 %. This was possible due to predominantly the nerve root involvement in these tumors which helped to locate the correct level of these tumors .

Among the different age groups, the 45 to 60 age group showed the least correlation for the level of tumor , which was also true with the less than 15 years age group .

86 % of lesions correlated clinically with radiological findings in case of diagnosis of level of intradural extarmedullary tumors.

But in cases of intra medullary tumors , the clinical and radiological correlation was low. In this situation the advantage of MRI in locating the plane of lesion is well established .

With regard to the pathology of the tumors , the clinical and histopathological (HPE) correlation was around 90 % .

In this study the radiological and HPE correlation was , less than that obtained by clinical examination , which clearly brings out the superiority of clinical examination for diagnosis of spinal cord tumors .

Intramedullary tumors showed less than 90 % clinical and radiological correlation with regards to the level of the lesions . Surprisingly the clinical level of lesion fairly correlated with the pathology of lesion in intramedullary tumors. This study included only 10 cases of intramedullary tumors .

So a study with more number of patients will be able to conclude better in this group. Also literature reveals only few similar studies and further experience is needed in this group of tumors .

In this study osteoarthrosis, degenerative disc diseases, spondylolisthesis etc were not taken into consideration .The signs and symptoms pertaining to these diseases form the part of compounding factors in clinical assessment of the spinal cord tumors .

Younger age group patients could not co-operate to the fullest level during the clinical examination .

Secondary deposits in the spinal cord with primary elsewhere could have influenced the patients' clinical examination.

CONCLUSION

This study on various factors involved in the localisation and diagnosis of spinal cord tumors has given the following impressions

1. Clinical and radiological correlation in assessing the level , plane and pathology of lesions was better in adults than in children and old age people .

2. Clinical and radiological correlation for assessing the level and plane of lesions was better with cervical lesions followed by lumbar and thoracic cord lesions in this study.

3. For assessing the plane of lesion radiological examination had a better correlation than clinical evaluation .

4. In clinical and radiological correlation for assessing the level of lesion males had better correlation than females .

5. Clinical and radiological correlation for assessing the pathology of tumors has revealed the fact that clinical examination is superior in assessing the pathology of spinal cord tumors . This factor can be explained by the fact that the detailed clinical examination which is preceded by a detailed history has brought out the natural course of the

tumors which has greatly helped in predicting the pathology of the suspected tumor even before radiological investigations .

6. To conclude, clinical examination still holds a pivotal role in the diagnosis of spinal cord tumors even in this era of sophisticated investigations .

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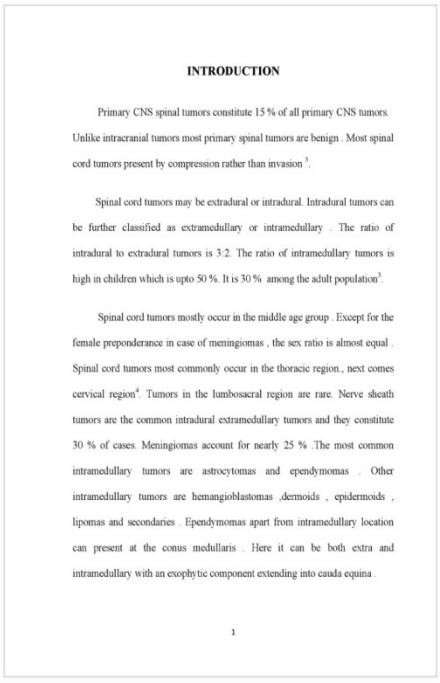

INTRODUCTION

Primary CNS spinal tumors constitute 15 % of all primary CNS tumors. Unlike intracranial tumors most primary spinal tumors are benign . Most spinal cord tumors present by compression rather than invasion [3].

Spinal cord tumors may be extradural or intradural. Intradural tumors can be further classified as extramedullary or intramedullary . The ratio of intradural to extradural tumors is 3:2. The ratio of intramedullary tumors is high in children which is upto 50 %. It is 30 % among the adult population[3].

Spinal cord tumors mostly occur in the middle age group . Except for the female preponderance in case of meningiomas , the sex ratio is almost equal . Spinal cord tumors most commonly occur in the thoracic region., next comes cervical region[4]. Tumors in the lumbosacral region are rare. Nerve sheath tumors are the common intradural extramedullary tumors and they constitute 30 % of cases. Meningiomas account for nearly 25 % .The most common intramedullary tumors are astrocytomas and ependymomas . Other intramedullary tumors are hemangioblastomas ,dermoids , epidermoids , lipomas and secondaries . Ependymomas apart from intramedullary location can present at the conus medullaris . Here it can be both extra and intramedullary with an exophytic component extending into cauda equina .

1

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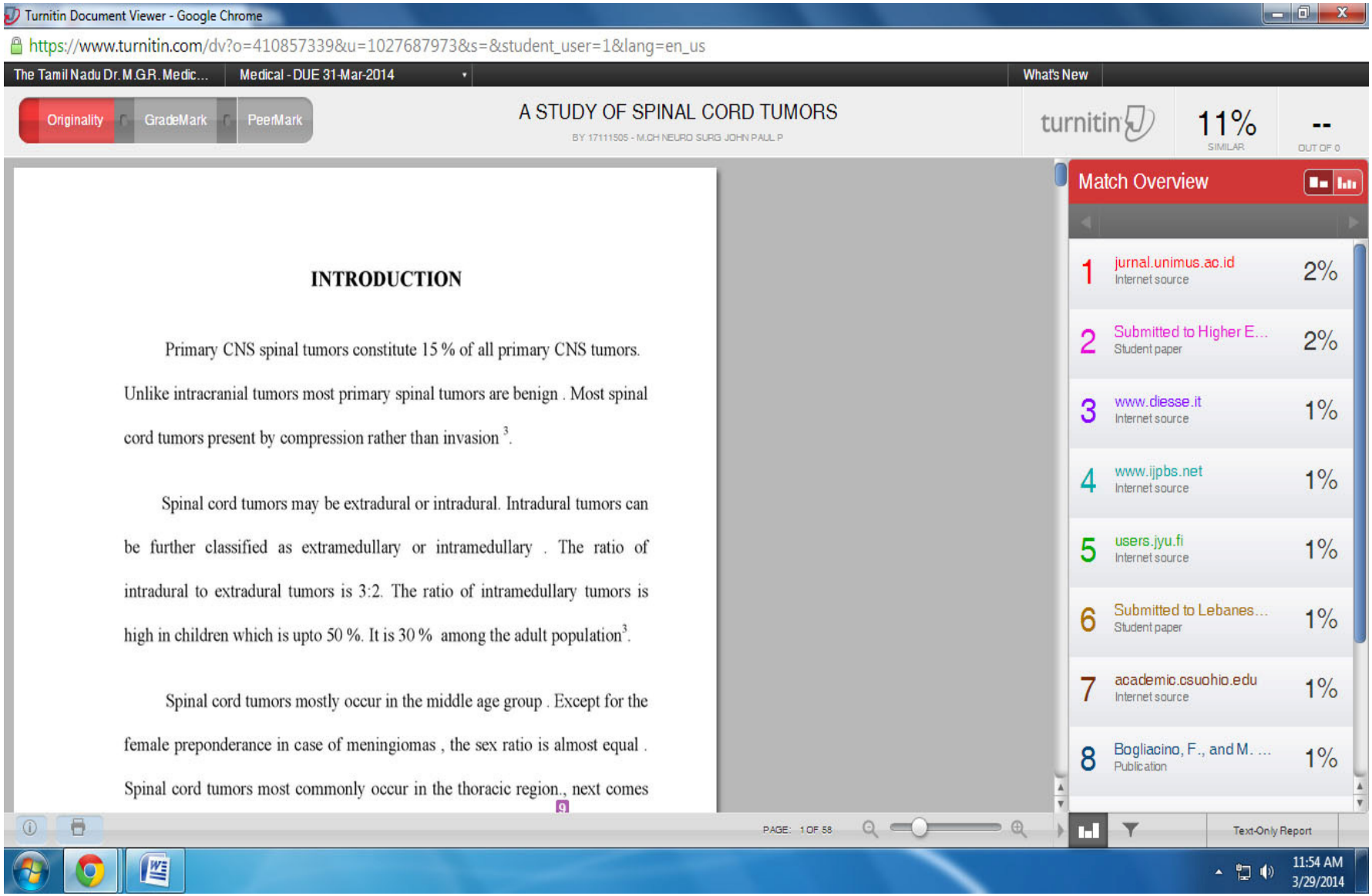
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INTRODUCTION
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PATIENT CONSENT FORM

Study Details : **"A Study of Spinal Cord Tumors"**

Study Centre : **Institute of Neurology,**
Madras Medical College and
Rajiv Gandhi Government General Hospital,
Chennai - 600 003.

Patient may check (✓) these boxes:

I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ☐

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ☐

I understand that the investigator of the clinical study, others working on his behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ☐

I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or wellbeing or any unexpected or unusual symptoms. ☐

I hereby give permission to undergo complete clinical examination and diagnostic tests including hematological, biochemical, radiological, EMG, EEG, NCS, Lumbar puncture and muscle biopsy, appropriate to the clinical diagnosis. ☐

I hereby consent to participate in this study. ☐

Signature / Thumb impression: Place : Date :

Patient Name and Address:

Signature of Investigator: Place : Date
Study Investigator's Name :

சுய ஒப்புதல் படிவம்

ஆய்வு செய்யப்படும் தலைப்பு : **தண்டுவட கட்டிகள் பற்றிய ஆய்வு**

ஆராய்ச்சி நிலையம் :நரம்பியல் மருத்துவத் துறை,
இராஜீவ் காந்தி அரசு பொது மருத்துவமன
மற்றும் சென்னை மருத்துவக் கல்லூரி
சென்னை- 6

பங்கு பெறுபவரின் பெயர் : உறவு முறை:

பங்கு பெறுபவரின் எண் :

பங்கு பெறுபவர் இதனை (√) குறிக்கவும்

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது. என்னுடைய என்னுடைய சந்தேகங்களைக் கேட்கவும், அதற்கான தகுந்த விளக்கங்களைப் பெறவும் வாய்ப்பளிக்கப்பட்டது. ☐

நான் இவ்வாய்வில் தன்னிச்சையாகத்தான் பங்கேற்கிறேன். எந்தக் காரணத்தினாலோ எந்தக் எந்தக் கட்டத்திலும் எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகிக் கொள்ளலாம் கொள்ளலாம் என்றும் அறிந்து கொண்டேன். ☐

இந்த ஆய்வு சம்மந்தமாகவும், மேலும் இது சார்ந்த ஆய்வு மேற்கொள்ளும்போதும், இந்த ஆய்வில் ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளைப் பார்ப்பதற்கு என் அனுமதி அனுமதி தேவையில்லை என அறிந்துகொள்கிறேன். நான் ஆய்வில் இருந்து விலகிக் கொண்டாலும் இது கொண்டாலும் இது பொருந்தும் என அறிகிறேன். ☐

இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையும், ஆராய்சோதனை முடிவுகளையும் மற்றும் மற்றும் சிகிச்சை தொடர்பான தகவல்களையும் மருத்துவர் மேற்கொள்ளும் ஆய்வில் பயன்படுத்திக் கொள்ளவும், அதைப் பிரசுரிக்கவும் என் முழு மனதுடன் சம்மதிக்கிறேன். ☐

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன். எனக்குக் கொடுக்கப்பட்ட அறிவுரைகளின் படி அறிவுரைகளின் படி நடந்துகொள்வதுடன், இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்றும் உறுதியளிக்கிறேன். என் உடல் நலம் பாதிக்கப்பட்டாலோ அல்லது அல்லது எதிர்பாராத வழக்கத்திற்கு மாறாக நோய்க்குறி தென்பட்டாலோ உடனே அதை மருத்துவ அணியிடம் அணியிடம் தெரிவிப்பேன் என உறுதி அளிக்கிறேன். ☐

இந்த ஆய்வில் எனக்கு மருத்துவப் பரிசோதனை, இரத்தப் பரிசோதனை மற்றும் நரம்பு மின் பரி ☐

மின் பரி
சோதனை செய்து கொள்ள நான் முழு மனதுடன் சம்மதிக்கிறேன்.

பங்கேற்பவரின் கையொப்பம். இடம் தேதி கட்டை விரல் ரேகை

கட்டை விரல் ரேகை
பங்கேற்பவரின் பெயர் மற்றும் விலாசம்

ஆய்வாளரின் கையொப்பம். இடம். தேதி

ஆய்வாளரின் பெயர்

APPENDIX-I

CASE STUDY PROFORMA

Name : **D.O.A :**

Age / Sex : **D.O.S :**

IP No. : **D.O.D :**

CLINICAL DATA :

Symptoms :

Pain	**Local**
	Radicular
	Ill localized
Motor	**Weakness UL/LL**
	Wasting, Fasciculations
	Stiffness
Sensory	**Pain , Temperature**
	Touch, Position, Vibration
Bladder	**Hesitancy, Frequency, Urgency, Incontinence, Incomplete Emptying, Bladder Fullness**

Progression : **Ascending**

Descending

Examination : **Bulk**

Tone

Power **Rt** **Lt**

UL

LL

Sensory : **Level**

Localisation

Dissociation / Suspended sensory loss

Reflexes Superficail Reflexes

Deep Tendon Reflexes

Bladder

Radiological Features :

MRI :

T1 T2, T1 Contrast, DWI, MRS, Others Sequences

Pathology Reports : Squash

HPE

APPENDIX II - MASTER CHART

S.NO.	IP NO	AGE	SEX	CLINICAL			RADIOLOGICAL			HPE
				LEVEL	PLANE	PATHOLOGY	LEVEL	PLANE	PATHOLOGY	
1	11234/12	7	F	C5	IM	ASTROCYTOMA	C5	IM	ASTROCYTOMA	ASTROCYTOMA
2	99350/13	7	F	D4	ED	NEUROFIBROMA	D4	ED	NEUROFIBROMA	PNET
3	11467/12	8	F	L2	IDEM	LIPOMA	L2	IDEM	LIPOMA	LIPOMA
4	11833/12	9	M	C2	ED	LIPOMA	C2	ED	DERMOID	LIPOMA
5	22823/12	11	F	C3	IM	ASTROCYTOMA	C3	IM	ASTROCYTOMA	ASTROCYTOMA
6	95368/13	12	M	C7	IM	ASTROCYTOMA	C7	IM	SCHWANNOMA	ASTROCYTOMA
7	101415/13	12	M	D7	ED	SCHWANOMMA	D7	ED	SCHWANNOMA	SCHWANOMMA
8	15063/12	13	F	D12-L1	IM	ASTROCYTOMA	D12-L1	IM	EPENDYMOMA	ASTROCYTOMA
9	123688/13	13	M	C5	ED	SCHWANOMMA	C5	ED	SCHWANNOMA	SCHWANOMMA
10	13949/12	14	M	L1	IM	ASTROCYTOMA	D12	IM	ASTROCYTOMA	ASTROCYTOMA
11	106614/13	15	F	D2	ED	MENINGIOMA	D2	ED	LIPOMA	LIPOMA
12	110094/13	15	M	C6	ED	ASTROCYTOMA	C6	ED	DERMOID	DERMOID
13	122662/13	17	M	L1	ED	LIPOMA	L1	ED	LIPOMA	LIPOMA
14	99018/12	21	F	D11-L1	IDEM	SCHWANOMMA	D11-L1	IDEM	SCHWANNOMA	SCHWANOMMA
15	99820/12	22	F	D1	IDEM	ASTROCYTOMA	D2	IDEM	EPIDERMOID	EPIDERMOID
16	108072/12	30	F	C6-D1	IDEM	NEUROFIBROMA	C6-D1	IDEM	NEUROFIBROMA	NEUROFIBROMA
17	7335/12	30	F	D12-L1	IDEM	MENINGIOMA	D12-L1	IDEM	MENINGIOMA	MENINGIOMA
18	9003/12	30	M	L2	IDEM	SCHWANOMMA	L2	IDEM	SCHWANNOMA	SCHWANOMMA
19	11749/12	30	F	D4	IDEM	MENINGIOMA	D4	IDEM	MENINGIOMA	MENINGIOMA
20	13626/12	32	F	D3-D4	IDEM	HEMANGIOBLASTOMA	D5	IDEM	HEMANGIOBLASTOMA	HEMANGIOBLASTOMA
21	15911/12	32	M	D4	IDEM	SCHWANOMMA	D4	IDEM	SCHWANNOMA	SCHWANOMMA
22	24816/12	33	F	D10-L1	ED	SCHWANOMMA	D10-L1	ED	SCHWANNOMA	SCHWANOMMA
23	27063/12	33	M	L2	IM	SCHWANOMMA	L2	IDEM	SCHWANNOMA	SCHWANOMMA
24	31861/12	33	M	D1	IDEM	EPIDERMOID	D1	IDEM	EPIDERMOID	EPIDERMOID
25	37170/12	35	F	C7-D2	ED	SCHWANOMMA	C7-D2	DT	SCHWANNOMA	SCHWANOMMA
26	54743/12	35	F	D12-L1	IDEM	SCHWANOMMA	D12-L1	IDEM	SCHWANNOMA	SCHWANOMMA

27	72610/12	35	F	D8	IDEM	MENINGIOMA	D9	IDEM	SCHWANNOMA	SCHWANOMMA
28	91211/12	35	F	D11-L1	IDEM	SCHWANOMMA	D11-L1	IDEM	SCHWANNOMA	SCHWANOMMA
29	115518/12	35	F	D10	IDEM	SCHWANOMMA	D10	IDEM	SCHWANNOMA	SCHWANOMMA
30	121939/12	35	F	L1	IDEM	EPIDERMOID	L1	IDEM	DERMOID	EPIDERMOID
31	376/13	35	F	D10-L1	IM	EPENDYMOMA	D10-L1	IM	HEMANGIOBLASTOMA	EPENDYMOMA
32	22310/12	36	F	C5	IM	EPENDYMOMA	C7	IM	EPENDYMOMA	EPENDYMOMA
33	29559/12	36	F	D6-D7	IM	EPENDYMOMA	D6-D7	IM	HEMANGIOBLASTOMA	HEMANGIOBLASTOMA
34	29831/12	36	F	C6	IDEM	MENINGIOMA	C6	IDEM	SCHWANNOMA	MENINGIOMA
35	37620/12	36	M	D12-L1	IDEM	HEMANGIOBLASTOMA	D12-L1	IDEM	HEMANGIOBLASTOMA	HEMANGIOBLASTOMA
36	52647/12	38	F	D6	IDEM	SCHWANOMMA	D6	IDEM	SCHWANNOMA	SCHWANOMMA
37	55245/12	38	M	L2	IDEM	MENINGIOMA	L2	IDEM	MENINGIOMA	MENINGIOMA
38	67674/12	38	m	D12-L1	IDEM	MENINGIOMA	D12-L1	IDEM	MENINGIOMA	MENINGIOMA
39	62835/12	39	F	C6-D1	IM	EPENDYMOMA	C6-D1	IM	EPENDYMOMA	EPENDYMOMA
40	69412/12	40	F	D12	IDEM	MENINGIOMA	D12	IDEM	HEMANGIOBLASTOMA	HEMANGIOBLASTOMA
41	70840/12	40	F	D11-L1	IDEM	SCHWANOMMA	D11-L1	IDEM	SCHWANNOMA	SCHWANOMMA
42	88979/12	40	F	L2	IDEM	SCHWANOMMA	L2	IDEM	SCHWANNOMA	SCHWANOMMA
43	76019/12	40	M	C6	IDEM	SCHWANNOMA	C6	DT	SCHWANNOMA	SCHWANNOMA
44	90046/12	40	M	D11	IDEM	SCHWANOMMA	D11	IDEM	MENINGIOMA	SCHWANOMMA
45	107362/12	40	F	C7-D1	IDEM	SCHWANOMMA	C7-D1	IDEM	SCHWANNOMA	SCHWANOMMA
46	107376/12	41	M	D10	IDEM	MENINGIOMA	D10	IDEM	MENINGIOMA	MENINGIOMA
47	107789/12	42	F	L1	IM	EPENDYMOMA	L1	IM	EPENDYMOMA	EPENDYMOMA
48	114183/12	42	F	D10-L1	IDEM	SCHWANOMMA	D10-L1	IDEM	SCHWANNOMA	SCHWANOMMA
49	35562/13	43	F	D4-D5	IDEM	MENINGIOMA	D4-D5	IDEM	MENINGIOMA	MENINGIOMA
50	35568/13	43	M	C7-D1	ED	SCHWANOMMA	C7-D1	DT	MENINGIOMA	SCHWANOMMA
51	87680/13	43	M	L2	IDEM	MENINGIOMA	L2	IDEM	MENINGIOMA	MENINGIOMA
52	11324/13	45	F	D11-L1	IDEM	CAVERNOUS ANGIOMA	D11-L1	IDEM	CAVERNOUS ANGIOMA	CAVERNOUS ANGIOMA
53	7623/13	45	F	C6-D2	IDEM	SCHWANOMMA	C6-D2	IDEM	SCHWANNOMA	SCHWANOMMA

54	100320/13	45	M	D6-D7	IDEM	SCHWANOMMA	D6-D7	IDEM	SCHWANNOMA	SCHWANOMMA
55	23145/12	45	M	C6-D2	IDEM	MENINGIOMA	C6-D2	IDEM	SCHWANNOMA	MENINGIOMA
56	45328/13	47	F	L1	IDEM	SCHWANOMMA	L1	IDEM	SCHWANNOMA	SCHWANOMMA
57	63542/12	47	F	D6-D7	IDEM	SCHWANOMMA	D6-D7	IDEM	SCHWANNOMA	SCHWANOMMA
58	67234/12	49	F	D6	IDEM	MENINGIOMA	D6	IDEM	DERMOID	DERMOID
59	98674/13	49	F	L2	IDEM	SCHWANOMMA	L1	IDEM	SCHWANNOMA	SCHWANOMMA
60	110032/13	49	M	D4	IDEM	MENINGIOMA	D4	IDEM	MENINGIOMA	MENINGIOMA
61	74389/12	49	M	D8	IDEM	SCHWANOMMA	D8	IDEM	MENINGIOMA	SCHWANOMMA
62	78659/13	51	F	D7	IDEM	SCHWANOMMA	D7	IDEM	SCHWANNOMA	SCHWANOMMA
63	11298/12	52	M	C7-D1	IDEM	MENINGIOMA	C7-D1	IDEM	MENINGIOMA	MENINGIOMA
64	2543/13	53	F	D6	IDEM	MENINGIOMA	D6	IDEM	MENINGIOMA	MENINGIOMA
65	89741/12	53	F	D4-D5	IDEM	CAVERNOUS ANGIOMA	D4-D5	IDEM	CAVERNOUS ANGIOMA	CAVERNOUS ANGIOMA
66	110342/13	55	F	D8	IDEM	SCHWANOMMA	D8	IDEM	SCHWANNOMA	SCHWANOMMA
67	97865/13	55	F	D8-D9	IDEM	CAVERNOUS ANGIOMA	D10	IDEM	CAVERNOUS ANGIOMA	CAVERNOUS ANGIOMA
68	2315/12	55	F	D10	IDEM	SCHWANOMMA	D10	IDEM	SCHWANNOMA	SCHWANOMMA
69	245319/12	55	M	D7	ED	SCHWANOMMA	D7	ED	SCHWANNOMA	SCHWANOMMA
70	110032/13	55	M	D7-D8	IDEM	SCHWANOMMA	D7-D8	IDEM	SCHWANNOMA	SCHWANOMMA
71	34218/12	55	M	D8	ED	CAVERNOUS ANGIOMA	D8	ED	CAVERNOUS ANGIOMA	CAVERNOUS ANGIOMA
72	56372/13	58	F	D2	ED	SCHWANOMMA	D2	ED	SCHWANNOMA	SCHWANOMMA
73	156234/12	60	M	D2-D3	ED	SCHWANOMMA	D2-D3	ED	SCHWANNOMA	SCHWANOMMA
74	23514/13	60	M	D3	ED	SCHWANNOMA	D3	ED	SCHWANNOMA	SCHWANNOMA
75	45328/12	63	M	D2-D3	ED	SCHWANOMMA	D2-D3	ED	SCHWANNOMA	SCHWANOMMA
76	34217/13	65	F	D4	ED	SECONDARY	D4	ED	SECONDARY	SECONDARY
77	6743/13	70	M	D10	IDEM	DERMOID	D10	IDEM	LIPOMA	DERMOID
78	34526/12	70	M	D9-D10	ED	SECONDARY	D9-D10	ED	SECONDARY	SECONDARY