ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 08 | August - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

THE DIVERSIFIED DIAPASON OF SPINAL TUMORS: AN OBSERVATIONAL STUDY

Histopathology

Dr. Riya Das	Assistant Professor, Department Of Pathology, JMN Medical College, Chakdaha (Formerly Worked At KPC Medical College & Hospital, Kolkata)
Prof. (Dr.) Sujata Mallick	Professor, Department Of Pathology, KPC Medical College & Hospital, Kolkata
Prof. (Dr.) Mahasweta Mallik	Professor, Department Of Pathology, JIMS, Budge Budge, Kolkata
Dr. Mouli Halder	Senior Resident, Department Of Pathology, KPC Medical College & Hospital, Kolkata

ABSTRACT

Background- Spinal tumors despite their rarity is a fascination and challenging area for neurologists and pathologists. Histopathology is crucial for diagnosis with routine stains and when in adjunct with immunohistochemistry helps immensely in exact categorisation of the lesions. **Aim-** This study aims to characterize the histological spectrum of spinal neoplasms by routine histopathological staining and when required by using immunohistochemistry. **Setting And Design-** Department of Pathology. Prospective observational study. **Material And Methods-** An institutional based prospective observational study was conducted in KPC Medical College and JIMS for a period of 2 years (July 2022 to July 2024) on histopathologically confirmed spinal tumors after ethics approval. Adhering to departmental protocols following processing of specimen histopathological diagnosis was made on routine H&E stain aided by immunohistochemistry. **Statistical Analysis-** Data was gathered and entered in Microsoft excel spreadsheet, tabulated, and calculated using SPSS Pack (SPSS Inc., Chicago, IL). **Results-** The most common age of presentation was in the 6th decade 27.5%) with a male preponderance (57.5%). Majority of the tumors were located in the thoracic spine (47.5%). Benign tumors (65%) were more frequently observed. Over all, the most prevalent tumor was schwannoma (25%) followed by meningioma (20%). **Conclusion-** Timely and accurate diagnosis is crucial as spinal disorders threaten significant morbidity. Routine histopathology is accurate enough for diagnosis. A few discrepancies require immuno-histopathological confirmation. The pathologist's role in diagnosing and evaluating the type of lesion hence is crucial, as the final prognosis is contingent upon the histological characteristics of the excised tissue.

KEYWORDS

Spinal neoplasms, Spinal cord tumors, Meningioma, Immunohistochemistry

INTRODUCTION

Neoplasms arising in the spinal cord or vertebral column are spinal tumors. Despite being uncommon, they are a fascinating research topic for neurologists and pathologists. Only 4–16% of all tumors affecting the central nervous system (CNS) are spinal cord tumors[1]. Spinal lesions typically affect the spinal tissues of the epidural space, including the spinal cord, spinal nerve roots, and spinal meninges. Myelography has been used historically to classify spine tumors into three primary groups: (1) extramedullary extradural, (2) intradural extramedullary, and (3) intradural intramedullary.[2] Most extradural tumors are metastatic and outside the dura mater lining[3]. Intradural-extramedullary are found inside the dura but outside the spinal cord parenchyma whereas those designated as intradural-intramedullary are found both inside and outside of the dura.[3] The majority—roughly 55–60%—are extradural, while 40–45% are intradural, of which 5% are intramedullary and 40% are extramedullary.[4]

The Intradural extramedullary spinal cord tumors include predominantly schwannomas (30%; incidence rate: 0.3–0.4 cases per 100,000 people), meningiomas (25%; incidence rate: 0.32 cases per 100,000 people), and metastatic tumors along with a small population of neurofibromas, teratomas, lipomas.[5-8] Meningiomas frequently recur but are usually benign. neurofibromas and Schwannomas originate from the nerve roots that project from the filum terminale or spinal cord. Neurofibromas can eventually turn cancerous. Gliomas account for the bulk of intramedullary spinal cord tumors. Astrocytomas (6-8%) and ependymomas (60-80%) are the two main forms of spinal glioma tumors.[9-13] Although about 3% of spinal tumors are intracranial ependymomas, their prognosis is significantly poorer than that of spinal ependymomas.[12,14-15] Out of 5% of primary bone cancers located in the spine, benign spinal tumors (80%) are more common than malignant spinal tumors (20%). [9,16] These tumors are often found incidentally and include hemangioma, osteoid osteoma & osteoblastoma. The extradural tumors are usually metastatic [9], commonly metastasizing to the breast, lungs, and prostate. Sarcomas, lymphomas, melanomas, multiple myeloma, and malignancies of the kidney, thyroid, and gastrointestinal system are among the other tumors that can metastasize to the spine.[17]

The clinical presentation, radiologic features, and tumor histology all play a role in diagnosing spinal tumors. This study aims to characterize the histological spectrum of these malignancies. This will provide insight into the prevalence of neuro-oncological disorders that are currently present in our community and address the challenges that we face in our pathology practice

MATERIALS & METHODS

Patients who visited the pathology department of KPC Medical College & Hospital and JIMS Hospital & Medical College between July 2022 and July 2024 were included in the study, and the data were subsequently analysed. The Institutional Review Board and the Ethics Committee authorized the study. Patient informed consent was obtained at the time of sample collection regarding the possibility of future use of the specimens for research purposes, and data confidentiality was upheld.

Relevant clinical data, such as the patient's age, gender, and clinical symptoms, were recorded. The protocol adhered to in our Department of Pathology for histopathological analysis of specimens was as follows: All surgically resected spinal tumor specimens were immersed in a 10% neutral buffered formalin solution for 24 hours. The bony elements were decalcified. Following a thorough evaluation, specific tissue samples were extracted from the surgical specimen and subjected to standard tissue processing and paraffin embedding. Thin sections measuring 5 μ in thickness were prepared. Haematoxylin and Eosin (H & E) staining, as well as immunohistochemistry (IHC) using markers such as Epithelial Membrane Antigen (EMA), Vimentin, S-100, Cytokeratin (Pan CK), MIB-1, Neurofilament, G-FAP, and R132H-IDH1, were performed based on the specific diagnostic requirements of each case. The resulting slides were seen using a light microscope to determine the diagnosis.

The statistical analysis of the data was carried out using the SPSS Pack (SPSS Inc., Chicago, IL).

RESULTS

This study included 40 subjects. The most prevalent age of presentation for spinal cord tumors was 61-70 years, accounting for 27.5% of the cases, followed by 51-60 years. 52.08 ± 18.87 years was the mean age determined.

Table No. 1: Age-wise Distribution

AGE GROUP (IN YEARS)	TOTAL CASES
0-10	01
11-20	02
21-30	01
31-40	07
41-50	04
51-60	07
61-70	11
71-80	06
>80	01

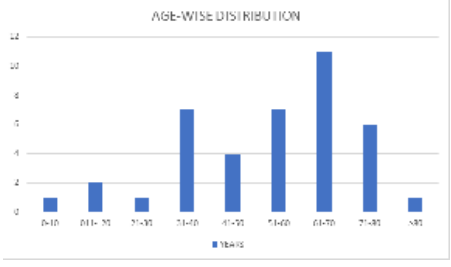


Figure No. 1: Age wise distribution of Spinal tumors

Male preponderance (57.5%) was observed in this study when compared to females(42.5%). Benign spinal tumors (65%) was more frequently observed than malignant spinal tumors (35%)

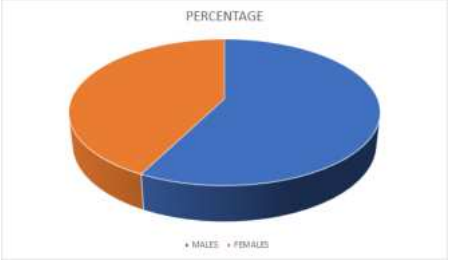


Figure No. 2: Gender- based distribution of Spinal tumors

Nineteen cases (47.5%) were localized in the thoracic spine, seven in the cervical spine (17.5%), five in the lumbar (12.5%), four in the cervico-dorsal(10%), three in the dorso-lumbar (7.5%), two in the lumbo-sacral (5%). In our study, no lesions were observed in the coccygeal region.

Table No. 2: Anatomy- based distribution of spinal tumors.

Localization of Tumor	Total cases
Thoracic spine	19
Cervical spine	7
Lumbar spine	5
Cervico-dorsal spine	4
Dorso-lumbar spine	3
Lumbo- sacral spine	2

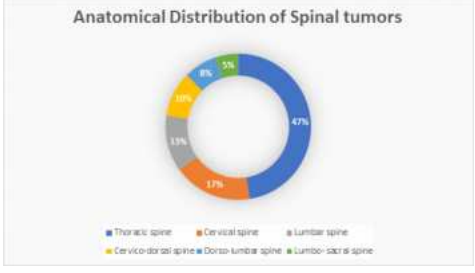


Figure no. 3: Anatomical distribution of Spinal tumors

The most prevalent spinal tumor was schwannoma, accounting for 25% of cases, followed by meningioma at 20%. In all cases, they were benign. All cases of Astrocytoma (2.5%), Chordoma (5%) and Metastatic tumours (20%) were malignant. The remaining cases consisted of 2 benign ependymomas, 1 low-grade oligodendroglioma, 4 benign neurofibromas, and 1 giant cell tumor. Additionally, a single case of malignant neuroendocrine neoplasms was recorded, accounting for 2.5% of the cases. The metastatic tumors comprised 3 from breast, 2 from colon and lung each and 1 from kidney.

Table No. 3: Histopathological Spectrum Of Spinal Tumors

TUMORS	BENIGN	MALIGNANT
Schwannoma	10	00
Meningioma	08	00
Metastatic tumors	00	08
Neurofibroma	04	00
Astrocytoma	00	01
Oligodendroglioma	01	00
Ependymoma	02	00
Glioblastoma	00	02
Giant cell tumors	01	00
Neuroendocrine neoplasms	00	01
Chordoma	00	02
Total	26	14

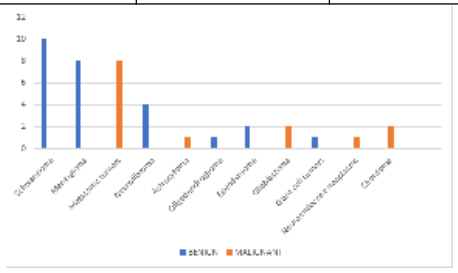


Figure No. 4: Histopathological spectrum of Spinal tumors

The spinal cord lesions had a compartmental distribution of 17/40 cases classified as intradural-extramedullary (42.5%), the same as that of extradural (17/40 cases – 42.5%), and 06/40 patients classified as intradural-intramedullary (15%).

Table No. 4. Compartmental Distribution Of Spinal Tumors.

TUMORS	EXTRA DURAL	INTRADURAL EXTRAMEDULLARY	INTRADURAL INTRAMEDULLARY	TOTAL CASES
Schwannoma	01	08	01	10
Meningioma	00	07	01	08
Metastatic tumors	08	00	00	08
Neurofibroma	04	00	00	04
Astrocytoma	00	00	01	01
Oligodendroglioma	00	00	01	01
Ependymoma	01	01	00	02
Glioblastoma	00	00	02	02
Giant cell tumors	01	00	00	01
Neuroendocrine neoplasms	00	01	00	01
Chordoma	02	00	00	02
Total	17	17	06	40

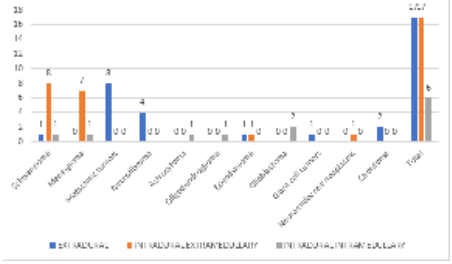
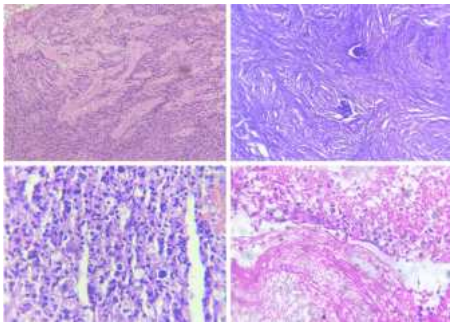


Figure no. 5: Compartmental distribution of Spinal tumors

Haematoxylin and Eosin (H&E) slides of cases with schwannoma revealed a highly cellular appearance, with spindle cells arranged in a palisading pattern and tumor cells separated by an extensive oedematous fluid with diffuse S100 and calretinin positivity and scattered focal CD 34 positivity. The microscopic examination of meningioma demonstrated meningothelial whorls and a psammoma body in many of the subvariants. EMA Positivity was found in meningioma. Neurofibromas were characterized by distinctively elongated nuclei with wavy, serpentine configurations and pointed ends. It demonstrated CD34, S100 positivity, and focal Calretinin positivity. Astrocytoma cases showed mild nuclear atypia in tumor

cells, a prominent fibrillary background, and a positive GFAP, IDH1 and Olig2 on IHC. There was a diagnostic dilemma between astrocytoma and oligodendroglioma. Both were positive for Olig2 and IDH1 on IHC. However, ATRX was retained in oligodendroglioma. Microscopic examination of glioblastoma patients revealed prominent cellularity, distinct pleomorphism, and areas of geographic necrosis. Olig2, p53, S100 and GFAP were immunopositive. Cases of myxopapillary ependymoma had epithelial tumor cells organized around fibrovascular centers and showed GFAP, S100, EMA and Vimentin positivity. NEN's was chromogranin A and synaptophysin immunopositive. IHC was done only in cases relevant. The cases of metastasis were from breast, colon, lung and kidney. Metastasis from breast were positive for ER and PR. Metastasis from colon were positive for CK 7 and 20. Metastasis from lung were positive for TTF1 and CK7. Ancillary tests for primary found out the exact origin.



Photomicrograph 1 : Upper left- Schwannoma, Upper right- Fibroblastic meningioma, Lower left-Anaplastic oligoastrocytoma Lower right-Glioblastoma

DISCUSSION

Due to the spinal region's anatomic diversity, the histopathological report is of utmost clinical significance [18]. We have assessed different spinal tumors based on age, gender, anatomical location, and pathological profile.

In this study, the highest incidence of spinal tumors, both benign and malignant, was seen in the sixth decade of life. Hirano et al. reported in their study that benign spinal tumours were more prevalent in those aged 50-59 years, whereas malignant spinal tumours were more common in those aged 40-49 years.[19] The majority of prior investigations indicated a male preponderance [19-24], which was congruous with our analysis.

In our evaluation, the thoracic area was the most commonly affected at the vertebral level, followed by the cervical and lumbar regions. our finding is consistent with previous research [25-28].

In the present investigation, schwannoma was the predominant spinal tumour, accounting for 40 % of cases. This finding is consistent with previous studies [19,20,25]. However, meningioma was more prevalent in certain studies [26–28].

The intradural extramedullary and extradural sites were involved in 42.5 % of cases; a similar pattern is observed in other research [19, 20 23,22,26-28]. In Santos J. et al., [25], the most prevalent site was the intradural intramedullary origin.

The prevalence of benign tumors was higher (65 %) than that of malignant tumours (35%) , consistent with findings of Hirano et al., Moein et al., 26. Prevedello et al. and many other researchers [19,20, 23,26-28].

Limitation

The study's small sample size posed a constraint on the generalizability of the findings.

CONCLUSION

The need of tissue diagnosis arises from the wide range of clinical lesions in this region, which have varying prognosis and treatment approaches. The precise site of the tumor was crucial for comprehending the characteristics and progression of the disease in various malignancies. The present analysis found that schwannomas and meningiomas were the most prevalent tumors. A comprehensive medical history, meticulous clinical examination, including pertinent tests, histopathology and immunohistochemistry, are essential for confirmatory diagnosis. Though histopathological evaluation predicts the morphology of the tumor accurately in most of the cases, immunohistochemical analysis is required in all diagnostic dilemmas. Timely and accurate diagnosis is crucial as spinal disorders threaten significant morbidity, a weakened condition of survival, a persistent neurological impairment, and/or lifelong reliance on walking. The pathologist's role in diagnosing and evaluating the type of lesion hence is crucial, as the final prognosis is contingent upon the histological characteristics of the excised tissue.

REFERENCES

1. Sisodia SM, Binayke RS, Joshi TC. The histopathological spectrum of spinal nerve root lesions. Int J Res Rev. 2018;5(5):18-21.
2. Mechtler LL, Nandigam K. Spinal cord tumors: new views and future directions. Neurol Clin. 2013 Feb;31(1):241-68. doi: 10.1016/j.ncl.2012.09.011. PMID: 23186903.
3. Gossman, William; Hoang, Stanley; Mesfin, Fassil B. (2019), "Cancer, Intramedullary Spinal Cord Tumors", StatPearls, StatPearls Publishing, PMID 28723060, retrieved 2019-12-03
4. Arnautovic, Kenan, and Aska Arnautovic. Extramedullary intradural spinal tumors: a review of modern diagnostic and treatment options and a report of a series. " Bosnian journal of basic medical sciences 9. Suppl 1 (2009): S40. [Crossref][PubMed][Google Scholar]
5. Parate DS. Histopathological spectrum of spinal space occupying lesions. J Med Sci Clin Res. 2019;7(1):1140-45.
6. Abul-Kasim K, Thurnher MM, McKeever P, Sundgren PC. Intradural spinal tumors: Current classification and MRI features. Neuroradiology. 2008;50(4):301-14.
7. Duong LM, McCarthy BJ, McLendon RE, Dolecek TA, Kruchko C, Douglas LL, et al. Descriptive epidemiology of malignant and nonmalignant primary spinal cord, spinal meninges, and cauda equina tumors, United States, 2004-2007. Cancer. 2012;118 (17):4220-27.
8. Seppala MT, Haltia MJJ, Sankila RJ, Jaaskelainen JE, Heiskanen O. Long-term outcome after removal of spinal schwannoma: A clinicopathological study of 187 cases. J Neurosurg. 1995;83(4):621-26.
9. Naresh Kumar, Wei Loong Barry Tan, Wei Wei, Balamurugan A Vellayappan, An overview of the tumors affecting the spine—inside to out, Neuro-Oncology Practice, Volume 7, Issue Supplement_1, November 2020, Pages i10–i17, https://doi.org/10.1093 /nop/npaa049
10. Parsa AT, Chi JH, Acosta FL, Ames CP, McCormick PC. Intramedullary spinal cord tumors: Molecular insights and surgical innovation. Clin Neurosurg. 2005;52:76-84.
11. Lonser RR, Weil RJ, Wanebo JE, DeVroom HL, Oldfield EH. Surgical management of spinal cord hemangioblastomas in patients with von Hippel-Lindau disease. J Neurosurg. 2003;98(1):106-16.
12. Shrivastava RK , Epstein FJ, Perin NI, Post KD, Jallo GI. Intramedullary spinal cord tumors in patients older than 50 years of age: management and outcome analysis. J Neurosurg Spine.2005;2(3):249–255.
13. Chang EL , Brown P, Lo SS, Sahgal A, Suh J, eds. Adult CNS Radiation Oncology: Principles and Practice. Cham, Switzerland: Springer International Publishing; 2018.
14. Teo, Charles, et al. Ependymoma. " Child's Nervous System 19. 5 (2003): 270-285. [Crossref][PubMed][Google Scholar]
15. Singh, Pratima K. , et al. Differential involvement of protein 4. 1 family members DAL-1 and NF2 in intracranial and intraspinal ependymomas. " Modern pathology 15.5 (2002): 526-531 [Crossref][PubMed][Google Scholar]
16. Inwards CY , Krishnan Unni K. Dahlin's Bone Tumors: General Aspects and Data on 10,165 Cases. 6th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2010.
17. Ecker RD, Endo T, Wetjen NM, Krauss WE. Diagnosis and treatment of vertebral column metastases. Mayo Clin Proc. 2005 Sep;80(9):1177-86. doi: 10.4065/80.9.1177 [Crossref][PubMed][Google Scholar]
18. Suh YL, Koo H, Kim TS, Chi JG, Park SH, Khang SK, et al. Tumors of the central nervous system in Korea: A multicenter study of 3221 cases. J Neurooncol. 2002;56(3):251-59.
19. Hirano K, Imagama S, Sato K, Kato F, Yukawa Y, Yoshihara H, et al. Primary spinal cord tumors: Review of 678 surgically treated patients in Japan. A multicenter study. Eur Spine J. 2012;21(10):2019-26
20. Moein P, Behnamfar O, Khalighinejad N, Farajzadegan Z, Fard SA, Razavi M, et al. A 12-year epidemiologic study on primary spinal cord tumors in Isfahan, Iran. J Res Med Sci. 2013;18(1):17-21.
21. Preston-Martin S. Descriptive epidemiology of primary tumors of the spinal cord and spinal meninges in Los Angeles County, 1972-1985. Neuroepidemiology. 1990;9(2): 106-11.
22. Govada N, Chowdary KR, Jeshtadi A, Gollapalli S, Dara K. Spinal nerve sheath tumors: Analysis of 20 cases with review of literature. Int J Res Heal Sci. 2014;2(1):140-45.
23. Jobunputra GP, Parikh UR, Goswami HM. Histopathological study of spinal tumors. Int J Cur Res Rev. 2016;8(14):01-08.
24. Singh PR, Pandey TK, Ahmad F, Chhabra DK. A prospective observational study of clinical outcome of operated patients of intradural extramedullary spinal cord tumor in our tertiary care center. Rom Neur. Published online. 2018;32(4):632-40.
25. Santos Júnior EC, Dantas F, Caries ACV, Cariri GA, Reis MTD, Botelho RV, et al. Evaluation of surgically treated primary spinal cord tumors in a single Brazilian institution: A case series study of 104 patients. Cureus. 2022;14(3):e23408
26. Prevedello DM, Koerbel A, Tatsui CE, Truite L, Grande CV, Ditzel LF, Araújo JC. Prognostic factors in the treatment of the intradural extramedullary tumors: a study of 44 cases. Arq Neuropsiquiatr. 2003;61:241–247. [PubMed] [Google Scholar] [Ref list]
27. Drashti P, Smita S, Hansa G. Histopathological study of primary spinal cord tumors. International Journal of Clinical and Doagnostic Pathology. 2021;4(2):35-38.
28. Murad A, Anas A, Erhan OS. Radiologic-Histopathologic correlation of adult spinal tumors: A retsospective study. Asian J Neurosurg. 2020;15(2):354-62.