



INTRASPINAL TUMORS: ANALYSIS OF 155 SURGICALLY TREATED CASES IN THREE HOSPITALS, ADDIS ABABA, ETHIOPIA.

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Acronyms

CT	Computed tomography
EDSCT	Epidural Spinal Cord Tumor
GTR	Gross Total Resection
IDEM	Intradural Extramedullary
IMSCT	Intramedullary Spinal Cord Tumor
MCM	Myung sung Christian Medical
MCS	Modified McCormick Scale
MRC	Medical research council
MRI	Magnetic Resonance Imaging
PSF	Pedicle Screw Fixation
SCT	Spinal Cord Tumor
TASH	Tikur Anbessa Specialized Hospital
ZMH	Zewditu Memorial Hospital

Abstract

Background: intraspinal tumors are one of the rare tumors of the CNS. The occurrence and distribution of intraspinal tumors by sex, age, and pathology are different among races and regions. There is a paucity of information on operated cases of spinal tumors in patients in sub-Saharan Africa

Objective: The objective of this study is to evaluate the demographics, histologic pattern, anatomic distribution, and extent and outcome of surgery of Ethiopian patients with spinal tumors.

Methodology: A retrospective study comprising a cohort of patients who underwent surgery for spinal tumors in three teaching institutions in Addis Ababa, Ethiopia, from January 1, 2015, to June 30th, 2020. Data obtained included patient demographics, duration of symptoms, anatomic location, imaging findings, McCormick scale before and after surgery, and type and outcome of the surgery. The data was collected from the patient's medical chart using a data collection checklist and was encoded into IBM/SPSS version 25. Descriptive statistics and Binary and multivariate Logistic Regression analysis was made to identify predictors of outcome. $P < 0.05$ was considered significant

Result: A total of 155 patients were included. The mean age was 39.5 years. The mean duration of illness was 13.9 months. 75.4% had lower limb weakness. Thoracic tumors predominate 46.9% followed by cervical tumors 20.6%. The majority of the tumors were IDEM 51.6%. GTR was achieved in 67%. The most common histological origin was meningioma 35.9%. An overall complication rate of 16.8% was observed, the commonest being new/worsening of neurologic deficit occurred in 12.3%, a significant association was found in cervical tumors ($p = 0.048$). The operative mortality was 5.8%, cervical tumors ($p = 0.05$), postoperative complications (neurologic deficit ($p = 0.023$), infection ($p < 0.001$) and bed sore ($P < 0.001$), and astrocytic tumors ($p < 0.001$) were found to be independent risk factors for mortality. Although neurological improvement was seen in 87%, patients with preoperative poor ambulatory status ($p < 0.001$) and sensory deficit ($p = 0.012$) and discharged with worsened status ($p < 0.001$) were found to be independent risk factors for poor neurologic outcome.

Conclusion: Most of the patients improved in their clinical outcome, cervical tumors are prone to postop complications and mortality. Patients who came with poor neurologic status and sensory deficits will develop a poor neurologic outcome.

Introduction

1.1 Background

Spinal cord tumors are one of the uncommon tumors of the central nervous system. Even though they are rare, they are potentially devastating lesions that threaten the patient's mobility or even life. Today, With the advancement of early detection and microsurgical techniques, they are considered one of the gratifying parts of neurosurgery (1).

The occurrence and distribution of intraspinal tumors by sex, age, and pathology are different among races and regions. The reported incidence ranges from 4-16% of CNS tumors. (1,2,3,4,5,6,7). Because of variation in population sizes studied and classification of tumors, the frequencies of different spinal cord tumors vary among these reports. Most primary CNS spinal tumors are benign (unlike the case with intracranial tumors). Most present by compression rather than invasion (8)

Primary spine tumors are composed of tumors arising from the spinal cord, spinal meninges, cauda equine, and the spinal column. Tumors can arise from the spinal cord or its surrounding structures or occur as a metastasis from other locations in the body. Based on their location in the spinal canal, spinal cord tumors are classified as Extradural, Intradural extramedullary (ID-EM), and Intramedullary spinal cord tumors (IMSCT)

Common presenting symptoms include Pain (back and/or neck pain, arm and/or leg pain), muscle weakness, numbness in the arms or legs, gait abnormality, sphincter dysfunctions (urine or/and bowel). The most common primary spinal cord tumor histology's are schwannoma, meningioma, and glioma (1,9)

Most spinal Mets are extradural. Intramedullary metastases are rare (10), accounting for 3.4% of symptomatic metastatic spinal cord lesions (11). Primaries include small-cell lung Ca, breast Ca, malignant melanoma, lymphoma, and colon Ca. (12). Spinal epidural metastases (SEM) occur in up to 10% of cancer patients at some time (13) The usual route of spread is hematogenous dissemination. Diagnosis relies on patients presenting signs & symptoms and confirmed by imaging studies, MRI being the diagnostic modality of choice. Surgery with tumor extirpation is 1st line of treatment for the majority of intraspinal tumors. radiotherapy, radiosurgery, and rarely chemotherapy are also employed in the treatment of these tumors.

For patients with a spinal cord tumor, the modified McCormick Scale is considered the standard outcome tool. It is completed by the treating physician and assesses global functional impairment in terms of neurological function and walking ability (9,14,15)

1.2 Statement of the problem

Significant strides have been made in neurosurgical services in Ethiopia in the last 10 years, with a shift in neurosurgical procedures done from trauma to non-traumatic pathologies. The ever-growing number and complexity of tumor cases operated, with a parallel improvement in outcome, can be taken as an excellent example, in neurosurgical success stories in sub-Saharan Africa.

Intraoperative neurophysiology, high magnification microscopes, ultrasonic aspirators, and intraoperative ultrasound are considered essential aid for the safe resection of spinal cord tumors especially the intramedullary tumors (IMSCTs). Almost all the aforementioned adjuncts of the surgery are non-existent and are considered luxuries, making management of these tumors challenging

There is a paucity of knowledge regarding intraspinal tumors in Ethiopia and Africa at large. In this study, we reviewed the cases of patients with spinal tumors treated surgically in 3 teaching hospitals in Addis Ababa. The patients' age at surgery, sex, the location of the tumor, and the pathological diagnosis and outcome of treatment are described. We hope this paper will fill the knowledge gap on the surgically treated spinal cord and spine tumors and can be used for reference in low- and middle-income countries....

The occurrence rate of spinal cord tumors in a population, frequency by sex or age, and frequency by pathology vary among races and regions. Comparing the relative incidence of various neoplastic entities within different nations and ethnic groups might provide relevant clues as to etiology and we hope this paper will add to this expanding knowledge by showcasing findings from sub-Saharan African population.

2. Literature review

2.1 Demography

In a population-based study done by Schillinger et al using the Central Brain Tumor Registry of the U.S. (CBTRUS), which is a population-based tumor registry, Overall incidence was 0.74 per 100,000 person-years. Incidence rates were lowest in children age 0–19 and highest in adults age 65–74. The overall median age at diagnosis was 51 years; however, the median age differed by histology type (16)

Engelhard and colleagues, in their study using hospital-based cancer registry, the National Cancer Database (NCDB), primary tumors of the spinal cord, spinal meninges, or cauda equina represented 4.5% of the patients having primary tumors of the CNS. Of these, 56.7% were female and 43.3% male. Their mean age was 49.3 years (median 50.0 years). Only 6.3% of the patients were under 15 years of age which is compatible with the one reported by Schillinger et al (3,16).

In a retrospective analysis of surgically treated patient in china, by Wu. YL et al, of the 184 patients, 97 (52.7%) were men and 87 (47.3%) were women. They noted male predominance in all tumors except meningiomas, for which the male/female ratio was 1:3 (17). The mean age of the patients at surgery was 56.3 years (range 7-83 years) (17).

In their analysis of racial distribution, Engelhard and colleagues reported 78.6% were classified as being white, 8.6% black, 8.6% Hispanic, 1.4% Asian, and 2.8% other or unknown (16). A similar observation was also made by Schillinger and et al (2). In a cohort of Nigerian patients who underwent surgery for spinal cord tumors, Adeolu et al reported a bimodal age distribution with the highest incidence seen in the 10-29 and 40-59 age groups. The mean age of patients was 43.49 years +/- 19.72 (18). In another retrospective study in sub-Saharan Africa from Kenya, (n=38), Twenty-one were males and seventeen were females giving a male/ female ratio of 1.3:1. Their ages ranged from six years to 70 years with an average age of 33.6 years for males and 40.2 years for females. The frequency peaked at 30 - 39 years for males and 40 - 49 years for females (19).

In a retrospective study assessing functional outcome after surgical treatment for primary spinal cord tumor in Ethiopia, Binyam G. reported similar finding where 60% were males and 40% were females with an M: F ratio of 1.5: 1. The mean age at admission was 36 +/- 16.5, (20) which

was relatively younger than most studies done Asia and the west (2,16,17,21). The tumor was evenly distributed across the age range with no age group with peak (20).

In most of the studies, the incidence of tumors of the meninges was significantly higher in females than males (1,2, 3,5,6,7,16,17,18,19,21,22). but males have significantly higher incidence rates for nerve sheath tumors and ependymomas (2)

Schiller et al classified all tumors reported with an age of diagnosis from 0 through 19 years (n = 327) as childhood spinal cord tumors. The most frequent site for childhood tumors was the spinal cord (91%) and just over half of these tumors were malignant (53%). The single most frequent histology type was ependymoma (24%). Nerve sheath and benign and malignant neuronal/glia histology, each accounted for 13%, and pilocytic astrocytoma accounted for 9% of total childhood spinal cord tumors. The overall incidence rate of childhood spinal cord tumors was 0.26 per 100,000 person-years. Incidence rates were not statistically significantly higher in males than in females. (2). Menezes AH, Sato Y, has similar observations in spinal cord tumors in children (4).

The patient age ranged from 50-60 years had the highest rate of metastatic tumor (4).

2.2 Presentation

Engelhard and colleagues, in their analysis of hospital-based cancer registry for primary spinal cord tumors, noted that the most common symptoms at presentation were pain (52.2%) and weakness (52.0%). Numbness and/or tingling occurred in 45.9%, followed by difficulty with coordination and/ or balance (26.5%), and urinary incontinence (13.0%) (16). The most frequently reported neurological signs included motor findings (weakness, fasciculations, and/or atrophy) in 30.9% of cases, decreased sensation (29.8%), and difficulty with gait (21.8%) (16)

Wu LY and colleagues also reported pain as the most common presenting symptom. But when they do analysis based on tumor pathology: Most of the patients with nerve sheath cell tumors (schwannomas and neurofibromas) had symptoms of sensory disturbance and pain; More than half of the patients with meningiomas had symptoms associated with cord compression (17), which is also the case in the report by Engelhard and colleagues (16). Schwannomas were found incidentally in eight patients. (17)

Mwang'ombe and Ouma in their retrospective analysis of surgically treated spinal cord tumors (n=38) in Kenyatta National Hospital (KNH), Kenya, noted the common presenting complaints

were sensory loss (89%), limb weakness (63%), paresthesia (42%), back pain (37%) and sphincteric disturbances(23%)(19).Two patients did not have any disability at the time of presentation at the hospital, five were able to walk with support (mild disability), twenty (52.6%) had some degree of limb movements present but were unable to walk even with support, and eleven (29%) had total paralysis. Eighty percent of the patients were therefore not able to walk at all (even with support) at the time of presentation to the hospital (19).

Similarly, in Adealu et al's paper, Data on clinical presentation were available for 39 patients. Among these, the motor deficit was present in 97.73% of patients at presentation; but only 1 patient (2.27%) presented with pain only (18).

Biniyam G. reported that 87%(n=70) of patients with spinal cord tumors reported motor weakness,77% radicular pain,55% loss of sensation. Fifty-seven Percent had bladder /bowel dysfunction (20).

In assessing the duration of symptoms before seeking medical care Mwang'ombe and Ouma noted that Six patients presented within three months from the time of onset of symptoms, sixteen patients came to the hospital between the fourth and the seventh month, five patients between the eighth and eleventh month and eleven patients after more than eleven months (19). A similar pattern of delayed presentation is seen in Adeolu's paper where more than half (58.06%) of the patients presented with symptoms of at least 6 months' duration with 35.48% presenting with symptoms lasting >1 year. Following the same pattern of late presentation, Binyam G., in his study in Ethiopia, reported mean duration of symptoms at presentation was 11 months (20).

The most common diagnostic tool used was MRI in most of the studies. Engelhard et al reported that for preoperative diagnostic testing, 87.9% of the patients were known to have had MR imaging of the spine, while 23.0% had undergone myelography, either with or without post myelogram CT scan of the spine. Overall, 36.0% of the patients had a CT scan of the spine done, 19.2% had a PET scan, and 19.5% had a SPECT scan (none of the SPECT scans showed any evidence of brain tumor). In 39.9% of cases, MR imaging of the brain was performed (16).

2.3 Location

In their series of 430 patients with tumors of the spinal cord meninges and the cauda equina,Engelhard and colleagues found that the primary site of the tumor was considered to be

the spinal cord in 70.5% of cases, the spinal meninges in 24.2%, and the cauda equina in 5.3%. In 5.4% of patients, multiple tumors were identified. Two tumors (one astrocytoma and one ependymoma) extended into the brainstem (16).

With regards to tumor location with respect to the spinal region, Mehta and colleagues reported that, Of the 96 ID-EM tumors, 60 (62.5%) were in the thoracic region. The remaining 36 tumors (37.5%) were located in the cervical spine; of these, the majority were located in the high cervical region. There were no lesions involving the lumbar spine (21). Similarly, Adeolu et al reported that 65% were in the thoracic region, and 16.36% were in the cervical region. Extradural location was the most common accounting for 58% of the cases; 22% were intradural-intramedullary, 18% were intradural-extramedullary, and the remaining 2% spanned extradural and intradural anatomic regions (5), which is more or less similar to the report elsewhere (2,16,20,21,22).

According to Wu LY et al, the thoracic spine was the most common location for intraspinal tumor 48%, followed by lumbosacral (32%) and cervical spine (19.2). the most common intraspinal tumor reported at the thoracic spine was metastasis followed by meningioma (17). Schwannomas were most common in the lumbosacral area (17), which is opposite to the findings by Mehta et al and Adeolu (19,21).

In their description of the location of ID-EM spinal cord tumors within the spinal canal, Mehta and colleagues found out that, of the 96 IDEM tumors, 12 (12.5%) were located anterior to the spinal cord, while 17 (17.70%) and 67 (69.79%) were located posterior and lateral to the spinal cord, respectively. No tumor had an extradural component (21)

Binyam G. Noted that almost half (52%) of the spinal cord tumors occurred at the thoracic level, followed by the lumbosacral region accounting for 14.3% (20)

2.4 Histopathology

Schellinger et al., using the Central Brain Tumor Registry of the United States (CBTRUS) database, which covers approximately 30% of the US population, identified 3226 cases, with the most common histological types being meningiomas (29%), nerve sheath tumors (24%), and ependymomas (23%). According to the biennial CBTRUS report, primary spinal cord tumors represent 4% of all primary CNS tumors (2)

Engelhard et al noted that the most common tumor types were meningioma (24.4%), ependymoma (23.7%), and schwannoma (21.2%). This breakdown differs significantly from the histological types found in brain tumor patients, where 35.5% of tumors were classified as glioblastoma, 19.8% meningioma, 5.0% schwannoma, and 1.0% ependymoma. The pathological behavior of the tumors (based on histological characteristics) was categorized as benign in 48.6% of cases, malignant in 38.6%, and uncertain in 12.8% (16).

Of children aged 0–14 years, 48.1% had an astrocytoma, and 14.8% ependymomas, while the following histological types were each represented in 7.4% of the cases involving children in this age: lymphoma, oligodendroglioma, PNET, schwannoma, and tumors of other specified types. 38.6%, and uncertain in 12.8% (16,17).

Wu LY, et al, in their analysis of 184 patients with intraspinal tumors, Primary spinal tumors accounted for 102 cases. Of this, schwannoma was the most common tumor (55/ 102 patients; 53.9%), followed by meningioma (16/102; 15.7%). Six (5.9%) patients had intramedullary tumors. Sixty-two (60.8%) patients had intradural extramedullary tumors, 14 (13.7%) patients had epidural tumors, and 20 (19.6%) patients had dumbbell tumors. Schwannomas occurred mainly at the lumbar spine (28/55 patients; 50.9%), whereas meningiomas occurred mainly at the thoracic spine (14/16 patients; 87.5%; Table 2). The peak age of patients with primary spinal tumors was 60-70 years (17).

In the same study, Of the 82 patients with metastatic tumors, the most common primary origin was the lung (22/82 patients; 26.8%), followed by the breast (11/82 patients; 13.4%), prostate (10/82 patients; 12.2%), liver (10/82 patients; 12.2%), gastrointestinal tract, lymphoma, ureter, pancreas, kidney, thyroid cancer, colon, larynx, multiple myeloma, and others. The thoracic spine was affected by 61% of metastatic tumors (17)

In the retrospective study from Nigeria by Adeolu. Histology was available for 56 patients; metastasis was the most common histologic tumor type accounting for 23.21%, followed by meningioma in 12.5% of cases, and ependymoma and astrocytoma each accounted for 7.14%. Astrocytoma was the most common tumor type in patients <30 years of age, accounting for 20%, whereas hemangioblastoma and lipoma accounted for 15% and 10% respectively, in this population. Prostate was the most common source of metastasis (38.46%) (18).

Of 61 patients for whom a histologic diagnosis was available in the study by Binyam G., on the cohort of patients with surgically treated spinal cord tumors, nerve sheath tumors accounted for 34.4%, followed by meningioma 29.5% and ependymoma 14.8% (20).

2.5 Extent of resection

In the study by Engelhard et al, of the surgically treated patients, 92.7% underwent laminectomy for tumor resection. Other surgical possibilities included laminectomy with or without opening the dura (for example, for biopsy, decompression, or both), radiosurgery, and endoscopic surgery (3), this is also reported in most of the studies reviewed (1,4,9,16,17,18,19,20,21,22). Gross-total resection of the tumor was accomplished in 63.7% of the 430 patients. Subtotal resection was recorded in 18.1%. Thirteen (6) patients had biopsy only. Examination of the ratio of gross-total to subtotal resection, stratified by tumor histological type, showed that patients with astrocytoma, other gliomas, and hemangioblastomas were more likely to have had a subtotal resection. Other tumors were totally resected more often, including ependymomas, schwannomas, and especially meningiomas (16).

Adeolu et al reported that gross total tumor excision was performed in 50.88% of the cases, and subtotal resection was performed in 24.56%. Spinal stabilization was performed in 10 patients; 8 of these had spinous process wiring and vertical strut; 1 patient each had pedicle screws with rod and spinous process wiring (Rogers' wiring technique) (18).

Binyam G. reported that virtually for all meningiomas GTR was achieved. 71.5 % of nerve sheath tumors and 33.3% of ependymoma, gross total resection was achieved. Conversely, the majority of astrocytoma and ependymoma were resected sub totally, 100% and 66.7% respectively (20).

2.6 Post-op complication and treatment outcome

The documented Postoperative neurological worsening by Engelhard et al was in 2.2% of patients. The reported complications also included infection (1.6%), hemorrhage at the operative site (0.8%), seizure (0.5%), deep venous thrombosis (0.5%), and anesthesia problems (0.3%). Interestingly, none of the patients with diabetes were reported to have had a wound infection. "Other" unspecified complications including CSF were reported to occur in 7.8% of patients (16) Mehta et al, in their analysis of 109 IDEM spinal cord tumors analyzed post-op complications extensively. There were 30 complications (31.25%). Seventy-seven patients (80.2%) had no

complications in the perioperative period. The mean length of hospital stay following surgery for the cohort of patients with no perioperative complication was 4.2 ± 1.2 days, compared with 8.7 ± 4.08 days for the cohort that had at least 1 perioperative complication ($p = 0.0004$). In the cohort of patients with complications, those with an anteriorly located tumor had a higher overall complication rate (33.4%) than those with a laterally or posteriorly located tumor (17.9% and 17.7%, respectively; $p = 0.002$). In a univariate analysis, they observed no correlation between the operating surgeon and the incidence of postoperative complication rates (21).

The surgery-related complication rates were higher (41.6%) in patients presenting with anterior tumors ($n = 12$) than in those presenting with lateral tumors ($n = 69$) or posterior tumors ($n = 17$) (4.4% and 0%, respectively) of. Postoperative neurological (motor/sensory) deficits were observed in 3 patients, all of whom had anteriorly located IDEM tumors. All major postoperative neurological deficits occurred in the thoracic spine between T-1 and T-8 (9.5% at T1–4 and 5% at T5–8) (21).

In the same paper by Mehta et al, overall major non–approach-related complications occurred in 7.1% of patients who underwent surgical resection for IDEM tumors. Major non–approach-related complications included pulmonary edema (3.1%), atrial fibrillation (1.0%), cecal volvulus requiring exploratory laparotomy (1.0%), and seizure activity (2.0%) (21).

The authors also did a univariate analysis in which, patient age, sagittal and ventral tumor location, ambulatory status, bowel dysfunction, bladder dysfunction, muscle weakness, pain, and sensory disturbance were all associated with an increased likelihood of a major postoperative complication. When included in a multivariate logistic regression model, a ventral tumor located in the upper thoracic region was independently associated with an increased likelihood of a major postoperative complication (21).

3.OBJECTIVE

3.1 GENERAL OBJECTIVE

To describe the epidemiology, presentation, pathology treatment, and outcome of intraspinal tumors

3.2 SPECIFIC OBJECTIVE

- To describe the demographics of intraspinal tumors
- To analyze presenting signs and symptoms of patients with intraspinal tumors
- To describe the occurrence of intraspinal tumors by location
- To determine the histopathology of intraspinal tumors
- To assess postoperative complications in intraspinal tumors
- To assess the neurologic status of the patient at admission, discharge, and during follow-up using a Modified McCormick Scale(MMS).

4. Study Methodology

4.1. Study Area

The study will be conducted in Tikur Anbessa Specialized Hospital (TASH), Myungsung Christian Medical Center (MCMC), Zewditu Memorial Hospital (ZMH), all providing Neurosurgical training & services in Addis Ababa, Ethiopia.

4.2 Study Period

The study was conducted from January 1, 2015, to June 30, 2020.

4.3 Study Design

An institution-based retrospective cohort study was conducted.

4.4. Source Population

All patients surgically treated for Intraspinal tumor from January 1, 2010, to June 30, 2020, in the three hospitals

4.5. Study Population

All surgically treated patients for intraspinal tumors and who had complete medical records were included

4.5.1. Inclusion Criteria

All surgically treated patients during the study period who had complete medical charts were included

4.5.2. Exclusion Criteria

- Patients with missing medical records.

4.6. Sample Size Determination and Sampling Technique

A convenience sampling technique was applied.

4.7. Data

4.7.1. Source of Data

Charts of the patients, surgical records, discharge summary follow-up records, imaging studies and histopathology reports, and Contact with phone calls were used.

4.7.2. Data Collection

A total of 207 patients with intraspinal tumors were offered operative treatment in the three institutions from January 2015 to June 2020. One hundred fifty-five patients who fulfilled the inclusion criteria were selected for the study.

After Receiving Ethical clearance, the cases were listed out from the operation logbooks of the study hospitals, and charts were retrieved from the archives of the hospitals using their medical record number. Data were collected by a structured questionnaire prepared by the principal investigator. Sociodemographic characteristics and preoperative patient conditions will be collected from patient history and physical examination documented by the Neurosurgery Resident or Neurosurgeon at that time. The patients' perioperative and post-operative conditions were recorded in the questionnaire. Modified McCormick scale was used as an assessment tool for pre-op as well as post-op ambulation status.

Operative procedures were collected from operation notes written by the operating Neurosurgeon. Post-operative complications and imaging findings will be collected from follow up notes documented by the Neurosurgery resident or neurosurgeon who has seen the patient & imaging archives in the hospital or from the patient on subsequent outpatient visits. By the contact address put on the chart, all the study participants will receive a phone call to complete the Questionnaire.

4.7.3. Data Analysis and Processing

Collected data was checked for completeness, clarity and was cleaned with due attention before it is subjected for encoding and analysis to IBM SPSS software version 25.

All data were analyzed by the principal investigator.

4.8. Study Variables

4.8.1. Independent Variables

- ✓ Sociodemographic data (age, sex, address, religion)
- ✓ Sign & symptom at presentation,
- ✓ duration of symptoms before surgery, location of the tumor.
- ✓ Neurologic status before surgery (Motor power using MRC scale and modified McCormick scale)).
- ✓ Tumor characteristics (spine segment, number of segments involved).
- ✓ Surgical approaches
- ✓ Extent of resection

4.8.2. Dependent Variables

- post-op neurologic status (Modified McCormick scale)
- Post-op complications
- Post-op death

4.9. Ethical Consideration

This study was conducted following the ethical principles stated in applicable guidelines on good clinical practice, whichever represents the greater protection of the individual. It was approved by the research and Ethics Committee of the Department of Surgery. The medical director of the respective hospital and concerned bodies were notified by an official letter. Informed consent was taken from the voluntary study participants by phone and they were informed that the confidentiality of the data provided will be kept.

4.11. Operational Definitions

Intraspinal tumors: any neoplastic lesion, either primary or metastatic that arises from the vertebral column, nerve roots, dura, or substance of the spinal cord.

Extradural spinal cord tumors are tumors that arise from vertebral bodies or epidural tissues

ID-EM: Tumors that are located within the dural sack but have an arachnoid plane between the tumor and spinal cord.

Dumbbell tumors: tumors that develop an “hourglass” shape as a result of an anatomic barrier encountered during growth with a contiguous intraspinal, foraminal, and/or extraforaminal components.

New Neurologic Deficit: Weakness or other neurologic deficit that did not exist before the operation.

Worsened Neurologic Deficit: Weakness or other neurologic deficit that existed preop and worsened after surgery.

Post-op infection: Infection of any focus confirmed by laboratory workup or confirmed by the treating physician

Recurrence: Gross total resection confirmed by post-operative CT scan or MRI and then found to have tumor growth in the same location on follow up.

Gross total resection- the operating surgeon’s assessment of all the visible tumors removed and/or postop control imaging showing no visual residual enhancing tumor.

Subtotal resection: operating surgeons’ assessment of visible tumor tissue is left during the surgery or/and residual tumor visible on post-op control imaging

Biopsy, when more than 50% of the mass is left

Operative mortality - any death, regardless of the cause, occurring within 30 days after surgery in or out of the hospital and after 30 days during the same hospitalization subsequent to the operation

5. Results

5.1 Demography

A total of 155 patients operated between January 2015- June 2020 with intraspinal tumors at TASH, ZMH, and MCM were enrolled in this study. Ninety -one (58.7%) cases were operated at TASH, 27.1% (n=42) at ZMH and 14.1%(n=22) at MCM. The study population includes 87 males and 68 females with an M:F ratio of 1.3:1. The median age of the patients at presentation was 38 (range 2-78) years. Adults (age ≥ 18 years) dominated the series 130(90.3%), and the majority were in a range of 19-49 years, making 61.9% of the cases. pediatrics (age < 18 years) constitutes 9.7% (fig 1 and 2).

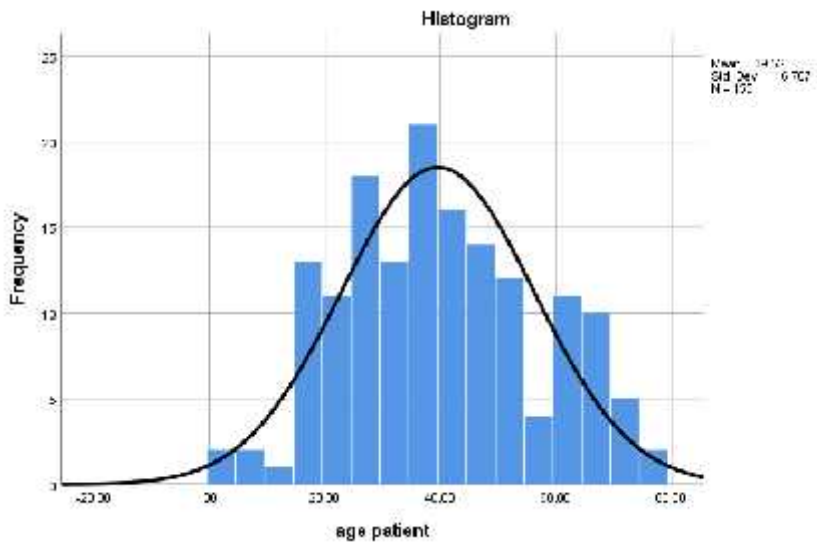


Figure 1: Histogram of the age distribution of the study population

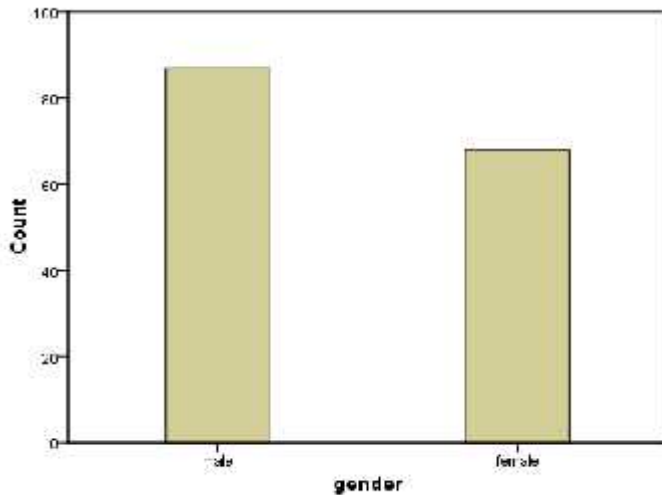


Figure1:bar graph showing the distribution of gender of 155 cases of intraspinal tumors

5.2 Clinical presentation

The mean duration of illness was 13.9 months. Pain (axial neck/back pain) was the most common symptom reported in 113(73.9%), followed by radicular pain in 95(62.1%). Paresthesia was seen in 81(52.3%). Fifty-one (33.3%) had sphincter dysfunction, of which 34(21.9%) had only bladder dysfunction and 17(11%) had both bladder and bowel incontinence

The most common sign at presentation was motor weakness, seen in 123(80.4%), the majority 117(75.4%) had lower limb weakness, and 33(21.3%) weakness involved the upper limb. Gait abnormality was seen in 60(39.2%) and Sensory dysfunctions with sensory levels were reported in 81 (52.3%).

Motor power assessment according to Medical Research Council (MRC) scale, 70(56.9%) of the patients were unable to move their limb against gravity (MRC = 2), of which 63 had lower limb weakness and in 7 of them the weakness involved the upper limb. Sixty-five (41.9%) patients had hyperactive DTR with sustained clonus (grade +4).

Comorbidities were found in 32(20.6%) patients. Fifteen cases (9.7%) reported having pre-existing hypertension and four (patients had both DM and hypertension. Three cases (1.9%) were on HAART for RVI with CD4 count >400cells/mm³. Six (3.9%) had a provisional diagnosis of NF-2 with multiple intracranial and spinal tumors (table 1)

Pre-operative ambulation status using the Modified McCormick scale (MMS) is presented in figure 3.

Among the 155 patients, 22(14.2%) graded 1, 41(26.5%) were grade 2, 31(20%) were grade 3, 36(22.6%) were grade 4 and 26(16.8%) were grade 5. Overall, 63(40.6%) were ambulatory without any assistance (MMS grade of 1&2) and 92(59.4%) required assistance for ambulation (MMS of 3-5). (figure3).

Table 1: Clinical presentation of among 155 cases of intraspinal tumors

<u>Clinical presentation</u>		<u>Count</u>	<u>%</u>
Motor deficit		123	79.3%
Local/axial pain		113	72.9%
Radiculopathy		95	62.3%
Paresthesia		81	52.2%
Compliant of gait abnormality		60	38.7%
Sphincter dysfunction	Urinary dysfunction	34	21.9%
	Both urine and bowl	17	10.9
		5	
Deep tendon reflex	0	4	2.5%
	+1	9	5.8%
	+2	30	19.3%
	+3	47	30.3%
	+4	65	41.9%
Medical comorbidities	Hypertension	15	9.7%
	DM	2	1.3%
	RVI	3	1.9%
	DM + Hypertension	4	2.6%
	Asthma	2	1.3%
Surgical comorbidity	NF2	6	3.9%

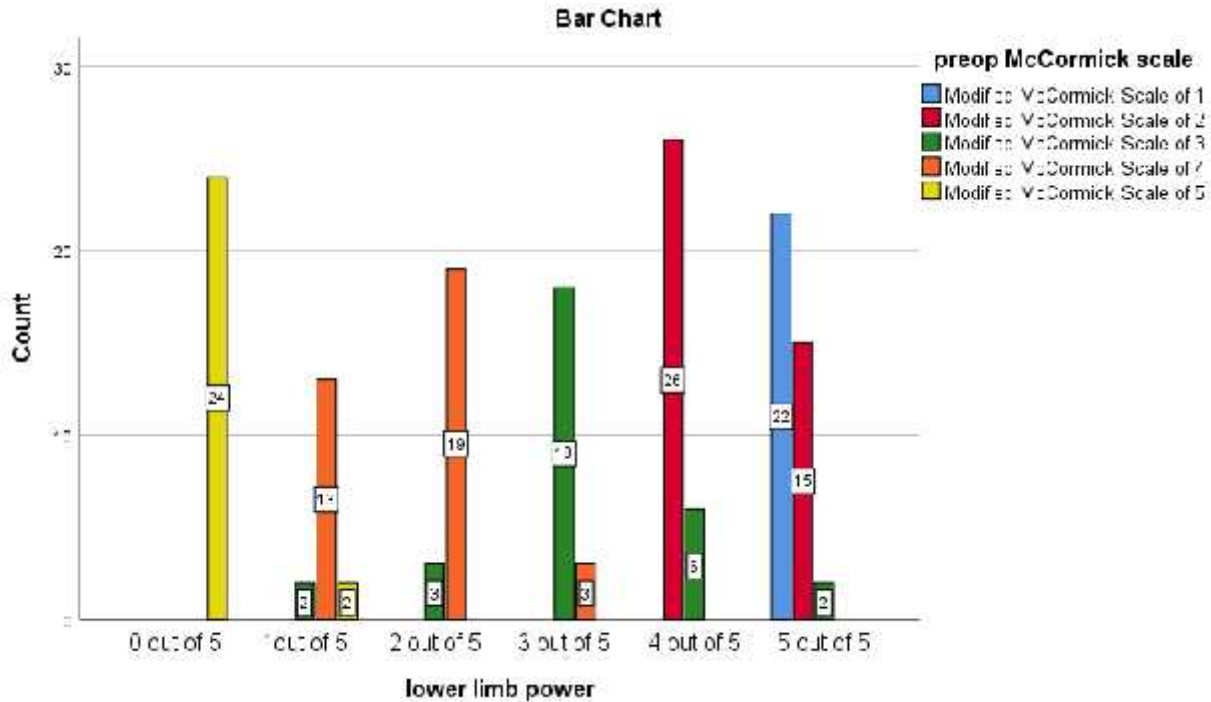


Figure 3: Showing lower limb power vs pre-op McCormick scale for 155 patients with intraspinal tumors

5.3 Radiologic characteristics of tumors

Preoperatively all 155 patients had MRI. Twenty-one (13.5%) cases had additional CT imaging. Tumors located at the thoracic level were the commonest making 46.5% (n=72) of the tumors followed by cervical 20.6% (n=32), lumbar 18.1% (n=28), thoracolumbar junction 8.4% (n=13), cervicothoracic junction 2.6% (n=4) and 1.9% (n=3) occupy lumbosacral and sacral levels. Four patients (2.5%) had multilevel lesions. (table 2).

The mean age of patients with tumors in each spine segment is listed in table 2.

Preoperatively all 155 patients had MRI. Twenty-one (13.5%) cases had additional CT imaging. Tumors located at the thoracic level were the commonest making 46.5% (n=72) of the tumors followed by cervical 20.6% (n=32), lumbar 18.1% (n=28), thoracolumbar junction 8.4% (n=13), cervicothoracic junction 2.6% (n=4) and 1.9% (n=3) occupy lumbosacral and sacral levels. Four patients (2.5%) had multilevel lesions

Patients had a mean age of 39.5(\pm 16.7) years. Statistical significance was found as patients with lower mean ages had lesions in the lumbar spine 32.5(\pm 13.7) years and older ones were located at the cervicothoracic junction 55.5(\pm 16.9) years, (p=0.001)

Half of the tumors (50.3%) involved 2 adjacent segments, single-segmented lesions were 33(21.3%), 27(17.4%) lesions involved 3 segments and 17(11%) spanned over four or more segments. Lesions involving 2 or fewer segments commonly seen at thoracic spine 56(50.5%) and long segmented (four or more) spine lesions predominantly occurred at cervical 7(41.2%) statistical significance was noticed (p=0.04). (table-2).

Table 2: distribution of tumors along the spinal column in 155 patients operated with intraspinal tumors

		Spine level						Total	p-value
		cervical	cervico-thoracic	thoracic	thoraco-lumbar	lumbar	lumbo-sacral		
Mean age		38.31	55.50	42.17	40.23	32.46	35.00	39.52	0.047
Gender	Male	19	3	37	7	17	4	87	0.895
	Female	13	1	35	6	11	2	68	
Number of affected segments	1	2	0	26	0	4	1	33	0.001
	2	15	4	30	10	16	3	78	
	3	8	0	10	2	7	0	27	
	4 or more segments	7	0	6	1	1	2	17	

5.4 Surgical intervention

All 155 patients underwent surgical interventions under general anesthesia. All patients received prophylactic antibiotics, ceftriaxone 1 gm iv, at the induction of anesthesia.

Laminectomy/hemilaminectomy was done in all cases. Facetectomy was done in 5(3.2%) patients with dumbbell tumors with statistical significance for these tumors involving facet removal ($p < 0.001$). PSF was done for 2(1.3%) patients at the thoracic and thoracolumbar location. One corpectomy with cage insertion and plating was done for C4 compression fracture with vertebral body mass.

The majority of the lesions were intradural 106(68.4%), 38(24.5%) were extradural (ED) and 11(7%) were dumbbell. Among the intradural tumors, 80(75.5%) were IDEM and 26(24.5%) were IMSCT. The thoracic spine was the commonest spine level for these lesions harboring 39(48.8%) of IDEM, 8(30.8%) of IMSCT, 20(52.6%) of ED, and 5(45.5%) of dumbbell tumors. No significant association was found b/n location and type of lesions.

Of the 155 surgically treated intraspinal tumors, 126(81.3%) underwent gross total resection (GTR), 17(11%) were resected sub- totally and for 7.7%(n=12) of cases, a biopsy was done. GTR was more achieved in thoracic lesions 55(43.6%). Among spine levels 90.6% of cervical, 75.5% of thoracic, and 85.7% of lumbar lesions achieved GTR. Subtotal resections involved 9.4% of cervical, 23.6% of thoracic, and 14.3% of lumbar spine lesions. A Significant statistical association was found among the extent of resection and spine level of lesions ($p = 0.013$) table-3

table-3 surgical interventions of 155 ISP lesions

		Spine level						P-value	
		Cervico - Cervical	Thorac o- thoracic	Thoracic	Lumbar	Lumbar	Lumbo- sacral		Total
Type of surgery performed	Laminectomy only	28	4	69	12	27	6	146	0.591
	Laminectomy+Facetectomy	2	0	2	0	1	0	5	
	Laminectomy+ PSF	0	0	1	1	0	0	2	
	Laminectomy+suboccipital craniotomy	1	0	0	0	0	0	1	
	Corpectomy+ cage+plating	1	0	0	0	0	0	1	
Tumor location	EDSCT	6	0	20	2	6	4	38	0.102
	IDEMSCT	15	4	39	6	16	0	80	
	IMSCT	7	0	8	4	5	2	26	
	Dumb-bell tumors	4	0	5	1	1	0	11	
Extent of resection	GTR	29	4	55	12	24	2	126	0.102
	Subtotal Resection	3	0	9	1	2	2	17	
	Biopsy	0	0	8	0	2	2	12	

The rate of GTR was significantly associated with the compartmentalized location of intraspinal lesions where 86% GTR was achieved in extramedullary spinal cord tumors [IDEM(97.5%), ED(63.2%), and dumbbell(81.8%)] and 57.7% of IMSCT. (p=0.002)

Among the 26 intramedullary tumors, only 57.7%(n=15) underwent GTR, lower than the 86% GTR rate for the Extramedullary located tumors, which is statistically significant ($\chi^2=9.65$, df=1, p=0.002).

5.5 Histopathology of tumors

Histopathological diagnosis is available for 149 lesions, in 6 patients the pathologies were different, two specimens were reported as Inflammatory tissues and three others were inconclusive and one was reported as disc material.

Age and gender distribution of the 149 histopathologically proven lesions are listed in table.

Among 149 lesions, 128(85.9%) were primary and 21(14.1%) were metastatic. The mean age in the primary tumor group was 38.5(\pm 15.96) years while in the metastatic tumors the mean age was 46.4(\pm 19.9) years which was statistically significant ($p=0.043$). Gender has shown no significance among all or major histopathologic groups ($p=0.92$).

The most frequently reported lesions were meningiomas in 46 patients, 30.9% among all, and 35.9% among primary tumors. Schwannomas were seen in 39 (30.5% among primary) followed by ependymomas 16(12.5%) cases, six (4.7%) of which were myxopapillary ependymomas. Astrocytomas were seen in 7(5.5%). Tuberculomas were found in 3(2.3%).

Among the primary histopathologies, meningiomas occurred in older ages with mean 43.2(\pm 15.4) years and myxopapillary ependymomas seen in younger ones, mean 26(\pm 6.95) years statistical significance was found ($p=0.025$). Gender distribution has no statistical difference among histopathology subgroups.

Metastatic lesions occurred in 21(14.1%). The commonest metastatic lesion was multiple myeloma/plasmacytoma seen in 6(28.6%) followed by high-grade sarcoma/osteosarcoma 5(23.8%). Poorly differentiated high-grade malignancy with no primary on metastatic workups occurred in 5(23.8%) and 3(14.3%) were Mets from thyroid. Age or gender had no statistical significance among metastatic lesions.

Table-4 Age and gender distribution of 155 histopathological proven lesions

	Age patient (SD)	Pediatrics vs Adult			Gender		p- value	Total	
		Children	Adult	p- value	Male	Female			
Histology of tumor	Meningioma	43.20(±	3	43	.555	21	25	0.088	46
	Schwannoma	39.13	2	37	.388	25	14	0.246	39
	Ependymoma	38.00	0	10	.624	6	4	0.283	10
	Astrocytoma	27.40	2	3	.074	3	2	0.859	5
	Myxopapillary ependymoma	26.50	1	5	.463	5	1	0.231	6
	Poorly differentiated malignancy	36.33	0	3	.522	1	2	0.861	3
	Osteosarcoma	39.60	2	3	.075	4	1	0.384	5
	Multiple myeloma/Plasmacytoma	58.67	0	6	.309	2	4	0.654	6
	NF	34.00	0	3	-	1	2	-	3
	Lipoma	22.33	1	2	-	3	0	-	3
	Arachnoid cyst	32.00	0	3	-	1	2	-	3
	Thyroid mets	64.33	0	3	-	3	0	-	3
	Inconclusive	50.67	0	3	-	1	2	-	3
	TB	48.67	0	3	-	0	3	-	3
	Ganglioglioma	23.50	0	2	-	1	1	-	2
	Others	31.67	4	11	-	10	5	-	15
	Total	39.52	15	140	-	87	68	-	155

Twenty-eight cases (71.8%) of the schwannomas were IDEM tumors, 25.6%(n=10) were dumbbell tumors ($\chi^2=48.349$, $df=3$, $p<0.001$). A single (2.5 %) tumor was reported as epidural. Ependymomas were evenly distributed among the cervical, thoracic, and lumbar spine. All myxopapillary ependymomas were found at or below the thoracolumbar junction. 66.7% of myxopapillary ependymomas were IMSCT

Table 5: the common histology of intraspinal tumors and their location in the spinal level.

	spine level							Total	p-value
	Cervico cervical	thoracic	thoraco- thoracic	lumbar	lumbar	lumbosacral	sacral		
Histology of tumor									
meningioma	19.6%	4.3%	69.6%	2.2%	4.3%	-	-	100.0%	0.001
schwannoma	30.8%	5.1%	25.6%	12.8%	25.6%	-	--	100.0%	0.01
ependymoma	30.0%	-	30.0%	-	30.0%	10.0%	-	100.0%	0.437
astrocytoma	80.0%	-	20.0%	-	-	-	-	100.0%	0.09
myxopapillary ependymoma	-	-	-	50.0%	33.3%	16.7%	-	100.0%	0.05
poorly differentiated	-	-	100.0%	-	-	-	-	100.0%	0.685
osteosarcoma	20.0%	-	20.0%	-	40.0%	-	20.0%	100.0%	0.426
multiple myeloma	16.7%	--	33.3%	16.7%	16.7%	-	16.7%	100.0%	0.943

Distribution of common histopathologic subtypes by location in the spine is listed in table-5

The majority of meningiomas 69.5% were located at the thoracic, followed by cervical 19.6% predilection of meningiomas for these levels was statistically significant ($p < 0.001$). Forty -two (91.3%) of meningiomas were located in the IDEM compartment while 8.7%(n=4) were epidural, statistically significance was seen ($\chi^2=42.259$, $df=3$, $p < 0.001$).

The commonest spine level for Schwannomas and astrocytoma was the cervical spine, where 80% of astrocytoma and 30.8% of schwannomas occurred. The level of the spine and occurrence of schwannoma was statistically significant as more than one-third of these tumors were located at the cervical with extension into the cervicothoracic junction ($p = 0.023$). 71.8% of schwannomas were IDEM, 25.6% were dumbbell and 2.5% were epidural, this

compartmentalized location of schwannomas along the spine was statistically significant ($p < 0.001$, $\chi^2 = 48.349$, $df = 3$).

Ependymomas were evenly distributed among the cervical, thoracic, and lumbar spine. All myxopapillary ependymomas were found at or below thoracolumbar junction ($p = 0.05$), and the majority 66.7% of these tumors were IMSCT

5.7 Postoperative outcome and follow up status

Postoperative outcomes are reported in table -7. The median length of hospital stay was 7.7 (range 3-100) days. An overall complication rate of 16.8% was observed. These included either one or a combination of multiple complications.

The most common postop complication was new/worsening of neurologic deficit in 19(12.3%). Fourteen (9%) of them had worsened in motor function, 4(2.6%) had new-onset urinary incontinence, and one patient developed new-onset sensory dysfunction. Postop infections occurred in 18(11.8%) patients, which was a combination of 7(4.5%) surgical site infections, 9(5.8%) bedsores, 6(3.9%) had respiratory tract infections and 4(2.6%) had meningitis. Postoperative CSF leak was seen in 13(8.4%), bedside or Intraop repair was done for all. Two (1.29%) patients developed post-surgical subdural hematoma which required borehole evacuation.

Nine patients died before being discharged from the hospital making the operative mortality of 5.8%. Among this, 66.7% (n=6) were females and 33.3% (n=3) were males ($P = 0.156$). The mean age was 40.67 (SD=19.8053)

Table-6: Summary postoperative outcome of 155 ISP lesions

Variable	N or median	% or IQR
Length of stay, (days)	7.7	3-100
Overall complications	26	16.8%
Neurologic deficit (new/worsening)	19	12.3%
Postop infection	18	11.8%
Wound infection	9	5.8%
Bed sore (grade 2/5)	9	5.8%
Postop CSF leak	14	9%
HAP	5	3.9%
Subdural hematoma	2	1.3%
Postoperative mortality	9	5.8%

5.8 Follow up status of study participants

146 patients were discharged and followed up, 21 patients with pathology result of high-grade tumors/ Mets were referred/linked to the oncology unit of TASH for chemo or radiotherapy. Patients were followed at neurosurgical referral clinic, with the earliest visit being at the 1-2 week, then one, three, six months, and yearly follow up.

Based on the neurologic status, at discharge, 74%(n=108) showed neurologic improvement, 22.6%(n=33) stayed the same, 3.4%(n=5) worsened from their preop neurologic status. At the 6th month of follow-up, 87.7%(n=128) showed an improvement, 9.6%(n=14) stayed the same and 2.7%(n=4) worsened from their preop status.

Patients ambulatory status using modified McCormick scale is presented in Table 7

Preoperatively 41.8%(n=61) were ambulatory without any assistance (MMS of 1&2) and 58.2% (n=85) required assistance for ambulation (MMS of 3-5). Postop at 6 month 76%(n=111) were MMS 1 &2 and 24% (n=35) were MMS 3-5(p< 0.001).

Table 7: Patients' ambulatory status, McCormick scale, in the pr-operative and at six months follow up

			6 th month McCormick scale					
			Modified McCormick Scale 1	Modified McCormick Scale 2	Modified McCormick Scale 3	Modified McCormick Scale 4	Modified McCormick Scale 5	Total
preop	McCormick	Modified McCormick Scale of 1	20*	1	1	0	0	22
scale		Modified McCormick Scale of 2	19	17	2	1	0	39
		Modified McCormick Scale of 3	5	17	4	1	2	29
		Modified McCormick Scale of 4	6	19	5	2	0	32
		Modified McCormick Scale of 5	5	5	3	3	8	24
Total			55	59	15	7	10	146

To investigate risk factors for postop complications, operative mortality, and postop worsening in ambulation status, independent variables were analyzed and subjected to univariate and multivariate logistic regression models.

Upon multivariate analysis, the cervical location was an independent risk factor for overall postop complications (p=0.048, AOR=2.47, 95%CI (1.01- 6.09)). Risk factors that were significantly associated with operative mortality on the multivariate analysis included, histopathologic diagnosis of astrocytomas (p<0.001,AOR=116 95%CI(10.89-1235.5), presence of postop infections (P<0.001, AOR=108,95%CI(12.3-958.4), bed sore (p<0.001,

AOR=7.18,95%CI(2.65-19.44), postop neurologic deficit(P=0.023, AOR=4.2, 95%CI(3.14-42.3) and cervical location(p=0.005, AOR=0.129, 95%CI(0.031-0.547).

Risk factors identified on multivariate analysis for the development of postop neurologic status needing assistance for ambulation (MMS 3-5) were, preop ambulatory status (MMS 3-5) (p< 0.001, AOR=5.66, 95%CI(2.20-14.54), preop sensory deficit (p= 0.012. AOR=2.87, 95%CI(1.26-6.53) and worsened neurologic status at discharge (p< 0.001, AOR=7.76, 95%CI(3.17-19.01) (table-8)

Table 8: summary of the result of logistic regression analysis Determining factors affecting postoperative complication, neurologic outcome (ambulation status), and death,

Dependent variable	Variable	P-value	AOR (CI 95%)	Chi-square, df, p
Post-op death	astrocytoma	P<0.001	116.(10.89,1235.5)	$\chi^2=19.85$, df=1, p<0.0001)
	post-op Infection	P<0.001	108(12.3,958.4)	$\chi^2=32.13$, df=1, P<.0001
	Post-op neurologic deficit	P=0.023	4.2(3.14, 42.3	
	Bedsore	P<0.001	7.187(2.65,19.44)	
	Cervical location of the tumor	P=0.005	0.129(0.031,0.547)	$\chi^2=8.25$, df=1, p=0.004)
Post-op ambulation needing assistance	Sensory dysfunction	P=0.012	2.87(1.262,6.533)	$\chi^2=6.15$, df=1, p=.013
	PRE-OP ambulation with support	<p0.001	5.66(2.208,14.541)	$\chi^2=16.51$, df=1, p<0.001
	Finding at discharge	P<0.00	7.76(3.171,19.012)	$\chi^2=20.83$, df=2, p<0.001)
Post-op complication	Cervical location of the tumor	0.048	2.47(1.007,6.087)	$\chi^2=4.067$, df=1, p=0.044)

*p-value<0.05 significant**

AOR-adjusted Odds Ratio

6. Discussion

Spinal cord tumors are one of the uncommon tumors of the central nervous system. In the current study, the median age at diagnosis was 39.5 years, younger than those from other reports from the western world and South East Asia (2,16,17,21). Even this is younger than the African report by Adeolu and Mwang'ombe (5,6). The incidence of these tumors was reported to be lower in children of age 0–19 and highest in adults (2) which is similar to our study, where 90.3% were adults (age > 18 years) and 9.7% were children. The majority of these tumors are seen in males with M:F ratio of 1.3:1 similar to most of the studies (16,17,18,21).

The most common clinical presentation was motor weakness 79.3% followed by pain 72.9% like most studies (2,16,17) but pain was the commonest presentation in studies from Africa (18). At presentation majority (60%) needed assistance for ambulation based on the MMS scale and sphincter dysfunction was seen in 33.3% which is higher than other reports (16) which might be due to late presentation, diagnosis, poor availability of neurosurgical service, and socio-economic factors impacting health-seeking behavior of our patients.

All patients had MRI and 13.5% of cases had additional CT mostly as a metastatic workup for suspected metastasis. The thoracic level was the commonest site (46.5%) in agreement with most of the studies (2,3,4,5,6,). The majority of the tumors were IDEM 51.6%. Hirano et.al reported similar figures (22).

GTR was achieved in 81.3%, higher than the reported figure by Engelhardt *et al* 63.7% (16), and by Adeolu 50.88% (18). This may be due to the higher proportion of tumors arising from the meninges and nerve sheaths and the lower number of IMSCT in the study population. A higher rate of GTR (86%) was achieved in extramedullary tumors and statistical significance was found in comparison to intramedullary tumors ($p= 0.002$, $\chi^2=9.65$, $df=1$). This difference could be due to our setup's lack of intraoperative neuromonitoring and other adjuncts used to help increase the safety and extent of resection in IMSCTs.

The majority of the tumors we found were primary SCT 85.9% and 14.1% were metastatic. A significant association was found as patients with primary lesions had lower mean ages (38.5(±15.96)) years and metastatic lesions occurred in older ones (46.4(±19.9)) years ($p= 0.043$). Most of the studies reported higher rates of metastatic lesions than ours (16,17).

The most commonly occurring tumors among primary SCT were, meningiomas 35.9%, schwannomas 30.5% and ependymomas 12.5%. Most series report similar figure also (1,2,3,4,6,7,8,9). Myxopapillary ependymomas occurred in 4.7% similar to most studies (16,17). Among the primaries, age was significant associated with meningioma and myxopapillary ependymoma ($p=0.025$). Meningiomas were seen in older patients (mean age 43.2 years) than patients with myxopapillary ependymomas (mean age 26 years). The frequently found primary tumor in children in our study was meningioma 20%, astrocytoma 13.3%, schwannoma 13.3% and ependymoma 6.7%). Osteosarcoma was the commonest among the malignant childhood tumor in our study (13.3%). This was in stark contrast to the report by Engelhardt *et al* and others, where astrocytoma and ependymoma were the most common tumors and tumors of the meninges and nerve sheath were rare (2,4,16).

Among the commonest primary histopathologic subtypes, 69.5% of meningiomas were located at the thoracic spine ($p < 0.001$) which is similar to other studies (1,2,3,5,16,17,18,19). 30.8% of schwannomas involved the cervical and cervicothoracic junction where predilection for this level was significant ($p=0.023$) contrasting other studies which showed lumbar spine was commonest (1,5,16,17,23).

The majority of the primary lesions (84%) achieved GTR compared to the metastatic tumors (67%) ($p=0.03$). Among the primary tumors, 97.8% of the meningiomas achieved GTR ($p < 0.0001$). Among the 26 intramedullary tumors, only 57.7% ($n=15$) underwent GTR, lower than the 86% GTR rate for the Extramedullary ($p=0.002$).

We observed an overall complication rate of 16.8%. This was almost similar to the 17.5% complication rate reported by Patel *et al* (33) but lower than the 13.7% reported by Engelhardt *et al*, (16). The most common complication was new/worsening of neurologic deficit seen in 12.3%, Mehta *et al* reported a much higher rate of neurologic worsening, 25%, for IDEM SCTs (7). Most reported a much lower rate of post-op neurologic complications (16,24,25,26,27). Post-op infections were the 2nd most common cause of post-op complications in our study affecting 11.8% of the cases, which was higher than most of the literature (3,25,26,27,28). CSF leak occurred in 9%, This was within the reported rate in the literature which ranges from 5% to 18% (32,33,37,38)

In our study, the cervical location of tumors was statistically associated with the occurrence of postoperative complications ($p= 0.048$, AOR 2.47). The majority of astrocytoma 80% and

schwannomas 30.8% and 36.4% of dumb-bell tumors reside in the cervical location. Seven (21.9%) out of the 32 tumors located in the cervical spines were IMSCTs. Safaei .M et al reported that the cervical location of the tumor to be associated with adverse outcomes (26). Abhiraj D. Bhimani et al reported a higher rate of pneumonia at the cervical level, but other complications were not significantly different from other levels (28).

The operative mortality was 5.8%, which was significantly higher than the report from other literature (25), which reported mortality of 0.55%-1%. (25,26,27,28,29).

Risk factors that were significantly associated with operative mortality on the multivariate analysis included, cervical location of tumors ($P=0.005$, AOR/.129, 95% CI 0.031-0.547), astrocytoma ($P<0.001$, AOR..), postop neurologic deficit ($p=0.023...$), postop infections ($p<0.001$) and presence of bedsore($p<0.001$). Patel C. et al found that the odds of an adverse outcome increased significantly with age greater than 64, multiple comorbidities, and postoperative complications (33), Which was similar to our finding.

Significant improvement was seen in patients' ambulatory status at their 6th months of follow up, compared to their prep status. Preoperatively 58.2% of patients were in need of assistance for ambulation (MMS 3-5), but at the 6th month follow up only 24% needed assistance ($p<0.001$). Overall, 87.7% improved in their neurologic status, 9.6% stayed the same, and worsening was seen in 2.7%.

We found out that, risk factors for worsening postop ambulatory status (MMS 3-5) at 6th month follow up on multivariate analysis were preop ambulatory status (MMS 3-5) ($p<0.001$, AOR..), preop sensory deficit ($p=0.012$. AOR..) and worsened neurologic status at discharge ($p<0.001$, AOR.)

7. Study Limitation

This study was a retrospective study with a small sample size, which may not accurately reflect the finding in the general population. Because of a lack of tumor registry, we fear most of the cases were not included because of lost patient records, this is especially true for those with surgical mortality. This study does not assess the effect of tumor size, location in respect to the cord for IDEM which may have an effect on surgical outcome.

8. Conclusion

Results from this study document the demographic characteristics, symptoms and signs, histological subgroups, treatment, and frequency of complications in a retrospective cohort of patients with intraspinal tumors in three hospitals in Addis Ababa, Ethiopia. Some of the results confirm or expand upon those in the literature, while others represent new information. Despite its shortcomings data presented here can be used to gain a better understanding of patients with these tumors, and to provide a baseline for future studies.

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11. Appendix

11.1 Questioner

1. Questioner to analyze demographics, clinical presentation, spine level, histopathology, and treatment and outcome of intraspinal tumors.

2. Name code(initials) _____ Chart No: _____

3. Socio-demographic data

3.1. Age _____ Sex: ___ Address. _____. Phone No. _____

3.2. Hospital operated: 1) TASH 2) ZMH 3) MCM

4. Clinical presentation

4.1. Radicular/local pain: yes___ no___

4.2. Numbness/paresthesia: yes___ no_____

4.3. Sensation dysfunction: yes___ no___

4.4. Motor deficit yes_____no_____

4.5. Motor function (MRC scale table 2) Grade _____

4.6. Bladder/bowel incontinence (sphincter dysfunction) yes___

4.7. If yes to 2.6 please specify_____

4.8. Gait abnormality

4.9. others(specify)

5. Preoperative McCormickscale (table 1) _____

6. Duration of illnesses (months)_____

7. Medical/surgical comorbidities _____

8. Diagnostic imaging

8.1. MRI: yes___ no___

8.2. CT: yes___ no___

8.3. Both----

8.4. Others(specify): _____

9. Spine tumor characteristics

9.1. Tumor location: cervical__ thoracic__ lumbar__ sacral__

9.2. location in relation to the cord: anterior-----lateral-----posterior

9.3. number of affected segments: _____

10. preop diagnosis
 - 10.1. meningioma
 - 10.2. schwannoma
 - 10.3. astrocytoma
 - 10.4. epyndymoma
 - 10.5. metastasis
 - 10.6. others(specify)
11. if the diagnosis on question no.5 is metastasis, is the primary known
 - 11.1. yes----- 9.2 .no----
12. if yes to question no.9, where is the primary? -----
13. treatment modality
 - 13.1. Surgery alone
 - 13.2. Surgery and radiation
 - 13.2.1. Radiation alone
14. type of surgery performed-----?
15. Extent of tumor resection
 - 15.1. gross total_____
 - 15.2. subtotal_____
 - 15.3. biopsy_____
 - 15.4. 13.4 unspecified_____
16. Was operating microscope utilized?
17. Post-operative clinical findings at discharge from the hospital
 - 17.1. Improved-----
 - 17.2. the same-----
 - 17.2.1. worsened-----
18. post-operative clinical findings, at last, follow up
 - 18.1. improved
 - 18.2. the same
 - 18.3. worsened
19. Did the patient develop new neurologic deficits? Yes----- no-----
20. if YES to question no.17, please specify-----

21. Post-operative MacCormick scale _____/_____

22. Histologic diagnosis _____

23. post-op complications

23.1. Neurologic worsening -----Infection-----DVT----hematoma -----CSF leak-----
other(specify)

24. Hospital stay in days _____

25. Duration of follow up (months) _____

Tables

Table 1: Modified McCormick scale

Grade	Description
I	Neurologically normal ambulates normally, may have minimal dysesthesia
II	Mild motor or sensory deficit; independent function and ambulation maintained
III	Moderate sensorimotor deficit, restriction of function, independent with external aid
IV	Severe motor or sensory deficit, restricted function, dependent
V	Paraplegia or quadriplegia (even if there is flickering movement)

Table 2: Muscle grading (Medical Research Council system)

Grade	Strength
0	No contraction
1	Flicker or trace contraction
2	Active movement with gravity eliminated
3	Active movement through full ROM against gravity
4	Active movement against resistance
5	Normal strength (full resistance)