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Surgical Outcome of Intraventricular Tumors; A Retrospective Single Center Study in Addis Ababa, Ethiopia

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Abstract

Background: Intraventricular tumors (IVT) are rare clinical entities; surgical resection remains challenging for neurosurgeons. Knowledge about the surgical outcome of these tumors in resource-limited settings is scarce. The study aims to do quality control of surgical management of IVT in a single neurosurgical center in Ethiopia.

Methods: This study employed a hospital-based retrospective review of 40 patients who underwent surgical treatment for intraventricular tumors (IVT) at Tikur Anbesa Specialized Hospital between January 2015 and December 2020. Descriptive statistics used to evaluate the clinical presentation, imaging, histology, surgical approach, complications, mortality, overall survival and risk factors for poor outcome.

Results: The median age was 19 years (range: 1-52 years). Headache was the most common presenting symptom (95%), followed by visual disturbance (65%). Supratentorial tumors accounted for 52.5% of cases, with medulloblastomas being the most frequent subtype (n=11). The overall complication rate was 52.5%, with hydrocephalus (40%) and infections (25%) being the most common postoperative complications. The 30-day operative mortality rate was 27.5%. Risk factors for complications and mortality included infratentorial tumor location, subtotal resection, EVD insertion, and longer ICU stay. Postoperative hydrocephalus independently predicted operative mortality.

Conclusion: This study reveals higher complication and mortality rates for Intraventricular tumor (IVT) surgeries, especially for infratentorial tumors. Limited resources and experience contribute to these concerning outcomes. Postoperative hydrocephalus is identified as an independent risk factor for 30-day mortality. The findings highlight the challenges of managing IVT surgically in resource-limited settings, emphasizing the need for serious consideration and proper management to achieve better outcomes.

***Keywords:** Intraventricular tumors; Hydrocephalus; Postoperative morbidity and mortality; Resource-limited setup; Surgical resection*

Introduction

Intraventricular Tumors (IVT) of the brain are rare clinical entities that account for 3% to 10% of all intracranial tumors. [1,2,3] These tumors illustrate a great heterogeneity in histopathological type, location, clinical presentation, and malignant potential. [3,4] Signs and symptoms commonly occur secondary to obstruction of the normal cerebrospinal fluid (CSF) flow and expansion of the intraventricular mass. [2,3,5,6,7]

According to published series and reviews, age and location emerge as pivotal factors in unraveling the mysteries surrounding the diagnosis of IVT. [1,3,8,9,10] In the pediatric population, common brain tumors include medulloblastomas, pilocytic astrocytomas, ependymomas, and choroid plexus papillomas.

Adults, on the other hand, frequently experience meningiomas, metastases, and high-grade gliomas. [2,8,11,12]

Surgical resection, alone or as the first step in the multidisciplinary treatment, remains the mainstay of treatment. [2,6,13] The choice of the surgical approach should prioritize achieving maximal tumor resection while minimizing retraction and damage to normal brain tissue. Typically, this decision relies primarily on factors such as tumor size, location within the ventricular system, the presence of hydrocephalus, as well as the experience and preference of the surgeon. Infratentorial tumors are commonly approached through suboccipital craniotomy with a telovelar route [14], while supratentorial (lateral and third ventricle) tumors are either through natural corridors such as sulci or interhemispheric sulcus or through the cortex. [2,12,14,15,16]

Neurosurgery is a high-risk specialty, and a well-functioning neurosurgical service is of great importance to deal with these tumors. In sub-Saharan Africa, the field of neurosurgery has been developing gradually. A collaborative effort between the Department of Neurosurgery at Haukeland University Hospital in Bergen, Norway, the Foundation for International Education in Neurological Surgery (FIENS), and the Department of Neurosurgery at Addis Ababa University resulted in the establishment of a neurosurgery training program in Ethiopia in 2006. This initiative has been highly successful, leading to the certification of numerous neurosurgeons in the country. The number of neurosurgeons has increased by more than 20 times between 2016 and 2020. [17]

Although intraventricular neoplasms show a relatively low incidence in the group of brain tumors treated in our settings, we experience that it is demanding to treat these patients. To the best of our knowledge, there is still no published data describing the neurosurgical treatment and outcome of intraventricular tumors in our country. Therefore, we aim to do a quality control study of surgical management and outcome of IVT and further identify significant risk factors for surgical mortality and morbidity in the Tikur Anbesa Specialized Hospital (TASH), Addis Ababa.

We believe that this study contributes to better knowledge and understanding regarding the quality of the current neurosurgical management of IVT. The challenges encountered in our specific setting provide valuable insights for enhancing surgical care and developing tailored treatment guidelines in the future.

Methods

Data collection

In this retrospective study, we identified patients who underwent primary intracranial IVT surgery at TASH between January 2015 and December 2020 using a prospectively maintained outcome-monitoring database. The study included individual participants who provided informed consent as per the guidelines set by the Institutional Review Board of Addis Ababa University.

We stratified the patients into two groups based on age: pediatrics (age < 18 years) and adults (age ≥ 18 years). Radiologists evaluated pre- and postoperative images to determine the precise location and size of tumors, presence of hydrocephalus, and the extent of resection. We defined tumor location as supratentorial when involving the lateral and third ventricles and infratentorial when localized in the fourth ventricle. Tumor volume calculated using the ellipsoid volume measurement formula (A*B*C/2) in cm^3.

Surgical interventions included primary cerebrospinal fluid (CSF) diversion procedures such as endoscopic third ventriculostomy (ETV) or ventriculoperitoneal shunt (VPS), as well as craniotomy approaches, as documented in the operation notes. All patients underwent postoperative brain imaging (CT) within 72 hours following surgery. Gross total resection (GTR) was defined as the resection of more than 95% of the tumor, as assessed on the postoperative scan.

We recorded postoperative complications, reoperations, length of hospital stay, and the patient's performance status before and after surgery by extracting information from the patient charts. The WHO performance scale was utilized to describe the patients' performance status. [18]

Statistical analysis

We utilized the statistical software package SPSS v.22 (SPSS Inc., Chicago, IL, USA) for all statistical analyses. We summarized the results by providing mean ± standard deviation for each parameter. We employed the chi-square test for categorical variables when appropriate. Statistical significance was determined by a p-value less than 0.05 ($p<0.05$).

The Research Reporting Guideline followed the principles of EQUATOR (Enhancing the Quality and Transparency Of Health Research) and implemented the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guideline.

Results

A total of 40 patients with IVT operated between January 2015 and December 2020 at TASH were enrolled in this study. The study population includes 17 children and 23 adults with a median age of 19 years (ranging from 1 to 52 years). The majority (85 %) of the patients were < 30 years. (Figure – 1).

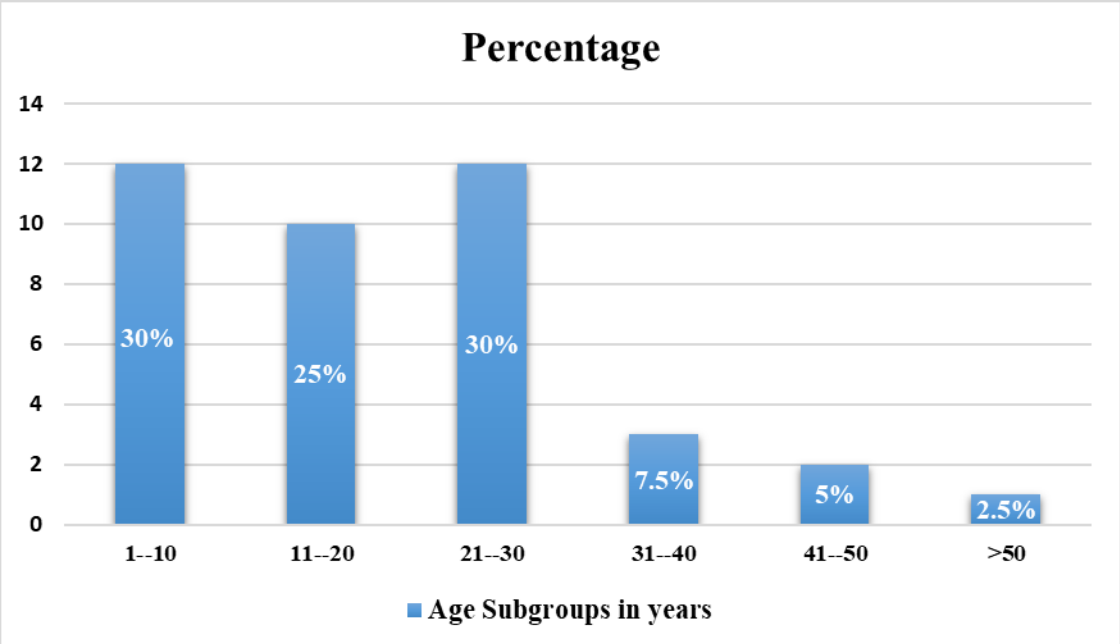

Figure - 1 *Age Distribution of Intraventricular tumors Operated Between January 2015 and December 2020 (N=40).*

Clinical presentations (Table – 1)

The average duration of illness, defined as the period from the onset of symptoms to hospital admission, was 11.9 months (±14.5), with a median of 6 months (ranging from 15 days to 6 years).

Among the patients, headache was the most common presenting symptom, reported by 38 patients (95%). Additionally, 26 patients (65%) had visual complaints at the time of presentation, and among them, ten individuals (38.5%) experienced partial or complete loss of vision in one or both eyes.

Table 1 – Clinical Features of Intraventricular Tumors Operated between January 2015 and December 2020 (N=40)

Variables	Total (N – 40)	Pediatrics (< 18 yrs) (N – 17)	Adults (≥ 18 yrs) (N – 23)
Duration of illness, mean ±SD in months	11.9 ±14.5	12.3 ± 17.3	11.7 ± 12.5
Presentation n (%)			
Headache	38 (95%)	15(88.2%)	23(100%)
Visual complaints	26(65%)	13(76.5%)	13(56.5%)
Nausea/vomiting	20(50%)	11(84.6%)	9(39.1%)
Seizures	4(10%)	1(5.9%)	3(13%)
Difficulty in maintaining balance	11(27.5%)	9(52.9%)	2(8.7%)
Motor weakness	3(7.5%)	-	3(13%)
Facial palsy	2(5%)	1(5.9%)	1(4.3%)
WHO performance status scores*			
1	27(67.5%)	9(52.9%)	18(78.3%)
2	13(32.5%)	8(47.1%)	5(21.7%)

Radiologic characteristics of tumors (Table – 2)

Preoperatively seventeen (42.5%) patients underwent both Computed Tomography (CT) and Magnetic resonance imaging (MRI) scans, while 15 (37.5%) patients had only MRI scans, and 8 (20%) had only CT scans.

The supratentorial region was the most common location in our study population, accounting for 21 cases (52.5%). Among these cases, 13 tumors (61.9%) were located at the lateral ventricles, with an equal distribution between the right and left sides. Additionally, eight tumors were found in the third ventricle. When analyzing the adult population, 69.5% of tumors were located in the supratentorial region, whereas 70.6% of pediatric tumors were located infratentorially. We observed a strong statistical association between age groups and tumor location (p=0.042).

The mean tumor volume for the entire cohort was 41.7 (± 34.8) cm^3. The mean volume of third ventricular tumors was significantly (P= 0.040) smaller (14.3 ± 7.9 cm^3) than tumors in both lateral (46.6 ± 38.6 cm^3) and fourth (49.9 ± 34.5 cm^3) ventricles.

Hydrocephalus was radiologically diagnosed in 36 (90%) patients and found to be equally distributed both in supra and infratentorial tumors. All pediatric patients and 19 (82.6%) of adults had a radiological diagnosis of hydrocephalus.

Table - 2 Radiologic characteristics of Intraventricular Tumors Operated Between January 2015 and December 2020 (N=40)

Variables		Supratentorial		Infratentorial	P-value
	Total	**Lateral V.**	**Third V.**	**Forth V.**	
Tumors, N (%)	40	13(32.5)	8(20)	19(47.5)	
Age, mean ±SD in years	20.6 ±12.7	22.6±12.8	28±15.2	16 ±10	0.059
Age category, N (%)					
Pediatrics (age < 18 years)	17(42.5)	3(17.6)	2(11.8)	12(70.6)	0.042
Adults (age ≥ 18 years)	23(57.5)	10(43.5)	6(26.1)	7(30.4)	
Gender, N (%)					
Male	24(60)	5(20.8)	6(25)	13(54.2)	0.156
Female	16(40)	8(50)	2(12.5)	6(37.5)	
Tumor volume, mean ±SD, cm^3	41.7±34.8	46.6±38.6	14.3±7.9	49.9±34.5	0.040
Hydrocephalus, N (%)	36(90)	10(27.8)	8(22.2)	18(50)	0.155

Pre-operative management and surgical intervention (Table – 3)

The average preoperative hospital stay was 10.5 (±7.26) days, median of 8 days (range 2 to 28 days). There was no correlation between the length of preoperative hospital stay with age or preoperative functional status.

All patients were treated with intravenous dexamethasone (4mg iv every 6 hours for adults and 1-1.5mg/kg/day divided every 4-6 hrs. for pediatrics) preoperatively and maintained until 3 to 5 postoperative days with gradual tapering. The majority of patients took prophylactic anticonvulsant medication (phenytoin 100 mg, orally three times a day for adults). Additionally, for four patients who had preoperative seizures, anticonvulsant continued after the operation. A pre-anesthetic evaluation was performed at least one day before the surgery.. Blood was cross-matched, and prophylactic antibiotic (ceftriaxone 2 gm IV for adults and 50-75mg/kg for pediatric patients) was administered 30 min before incision and continued every 4hrs throughout the operation and continued four times a day for about 2-3 days postoperatively.

All 40 patients underwent surgical interventions under general anesthesia. Thirteen Emergency CSF diversion procedures (12 ETV and 1 VPS) were done primarily for patients presented with acute hydrocephalus. Patients with acute hydrocephalus included one lateral, seven third, and five fourth ventricular tumors. Third ventricular tumors were strongly associated with symptomatic acute hydrocephalus needing emergency CSF diversion procedures (p=0.001) in our cohort.

Thirty-five patients went through tumor resection with the use of a microscope. The remaining five patients did not go through craniotomy but only CSF diversions procedures due to hydrocephalus. Nineteen fourth ventricular tumors were surgically addressed through suboccipital craniectomy using the telovelar route. Additionally, sixteen supratentorial tumors, consisting of 13 lateral ventricular tumors and three third ventricular tumors, were approached through craniotomy using either the transcortical or interhemispheric transcallosal route. We used the interhemispheric transcallosal route to access smaller supratentorial tumors, with a mean average volume of 17.2 cm^3 (± 12.4 cm^3). This subset comprised three third ventricular tumors and two lateral ventricular tumors. For the transcortical route, we employed it for eleven lateral ventricular tumors, which had a mean volume of 52.4 cm^3 (± 38.9 cm^3). Notably, we observed a significant association between tumor size and the choice of surgical approach for supratentorial tumors (p=0.048).

In 21 patients (60%), we achieved gross total resection (GTR). Additionally, we found that GTR more frequently achieved in supratentorial tumors (n=13) compared to infratentorial tumors (n=8) (p=0.019). Adults (75%) were more likely to get GTR (p=0.036) (Figure – 2)

External ventricular drainage catheters (EVD) were inserted at the end of operations in 26 patients to prevent hematomas and relieve hydrocephalus. A total of 92.3% of patients who underwent subtotal resections had EVD inserted (p=0.040). Moreover, the majority of EVD procedures (84.2%) were performed for infratentorial tumors. The median duration of postoperative EVD placement was five days, ranging from 3 to 20 days.

Table – 3 Surgical parameters of Intraventricular Tumors Operated Between January 2015 and December 2020 (N=35).

Variables	Supratentorial		Infratentorial	Total	P value
Approach	**Transcortical**	**Interhemispheric**	**Suboccipital**		
Total N(%)	11(31.4)	5(14.3)	19(54.3)	35	
Age category					
Pediatrics	2(13.3)	1(6.7)	12(80)	15	0.030
Adults	9(45)	4(20)	7(35)	20	
Location					
Lateral v.	11(84.6)	2(15.4)	-	13	
Third v.	-	3(100)	-	3	
Forth v.	-	-	19(100)	19	
Tumor volume mean ±SD, cm^3	52.4 ± 38.9	17.1 ± 12.4	49.9 ± 34.5	45.9± 35.2	0.048
Duration of operation ±SD, hrs	4:52 ± 1:02	5:12 ± 1:45	5:58 ± 1:27	5:31± 1:26	0.108
Extent of resection					
GTR	8(38.1)	5(23.8)	8(38.1)	21	0.019
Subtotal	3(21.4)	-	11(78.6)	14	
EVD	8(30.8)	2(7.7)	16(61.5)	26	0.131

Histopathology (Table – 4)

Histopathological diagnosis was obtained for 35 patients (87.5%), indicating that tissue samples were available for analysis. However, in the remaining five patients (12.5%) who did not undergo resection, a radiological diagnosis was made based on imaging findings alone.

According to 2016 WHO classification and grading, 24 (68.6%) of the tumors were low grades (grade I & II), and 11 (31.4%) were high-grade tumors (grade IV). All supratentorial tumors were benign/low grade, while 11 (57.9%) infratentorial (fourth ventricular) tumors were high grade (IV). Pediatric population had significantly (p=0.002) higher (81.8%) occurrence of high –grade tumors, and the commonest was medulloblastoma (11, 31.4%).

Postoperative complication (Table – 5) (Figure -2)

The median length of hospital stay for the patients was 18 days, ranging from 7 to 90 days. Overall, a complication rate of 52.5% was observed, with patients experiencing either one or a combination of multiple complications. Major postoperative complications, such as postoperative hydrocephalus (HCP) and central nervous system (CNS) infections, occurred in 47.5% of the patients. Among the complications, neurological deficits in the form of paresis were seen in 2 patients (5%). One patient experienced a seizure, while the other patient had complications related to cognitive impairment.

Postoperative HCP occurred in 16 (40%) of patients. In the univariate analysis, the development of postoperative hydrocephalus found to be significantly associated with several factors. These included infratentorial locations (p=0.028), suboccipital craniotomy (p=0.05), subtotal resection (STR) (p=0.036), postoperative external ventricular drainage (EVD) (p=0.004), and a longer stay in the intensive care unit (ICU). (p<0.001) Preoperative HCP seem to be associated with postoperative HCP but did not meet statistical significance (p= 0.085). In a multivariate analysis, the independent risk factor for postoperative HCP was prophylactic EVD insertion (p= 0.048, OR= 9.33, 95% CI 1.02-85.70).

Postoperative CNS infections occurred in 10 (25%) of patients. The median ICU stay was 4 (1-52) days. Patients with postoperative infections had significantly longer ICU stays exceeding four days (p=0.001). Univariate analysis showed risk factors for the occurrence of infection included pediatric patients (p= 0.042), infratentorial location (p= 0.002), suboccipital craniotomy (p= 0.007), STR (p= 0.022), postoperative EVD (p= 0.011), longer EVD stay (p= 0.05), longer ICU stay (p= 0.001) and longer postoperative stay (p= 0.032). However, multivariate analysis revealed infratentorial location/ suboccipital craniotomy (p= 0.045, OR= 12.45 95% CI 1.06-146.94) and longer ICU stay (p= 0.045, OR= 12.45 95% CI 1.06-146.94) as independent risk factors for postoperative infections.

Eighteen (45%) patients reoperated 16 for HCP, one for EDH, and one for residual tumor.

The median postoperative hospital stay was 10 (4-70) days. Eleven patients died before being discharged from the hospital. Among them, nine patients died within 30 days of their postoperative hospital stay, resulting in an operative mortality rate of 22.5%. Two (5%) patients died at the hospital after 30 days of hospital stay.

In the univariate analysis, several factors were identified as significant risk factors for inpatient mortality. These included infratentorial tumor location (p=0.039), prophylactic external ventricular drainage (EVD) placement (p=0.018), reoperations (p=0.003), longer ICU stay (p=0.034), the occurrence of major complications (p<0.001), postoperative hydrocephalus (HCP) (p<0.001), and postoperative infections (p=0.016).

In the multivariate analysis, when considering multiple factors simultaneously, the occurrence of postoperative hydrocephalus (HCP) was identified as an independent risk factor for inpatient mortality (p=0.002).

Table –5 Postoperative Outcome of Intraventricular Tumors Operated Between January 2015 and December 202 (N=40)

Variable	N or median	% or IQR
Length of stay, (days)	10	4 – 70
Overall complications	21	52.5%
Major complications	19	47.5%
Postoperative HCP	16	40%
Postoperative infection	10	25%
Reoperations	23	57.5%
Postoperative mortality		
30-day mortality	9	22.5%
In hospital mortality beyond 30 days	2	5%

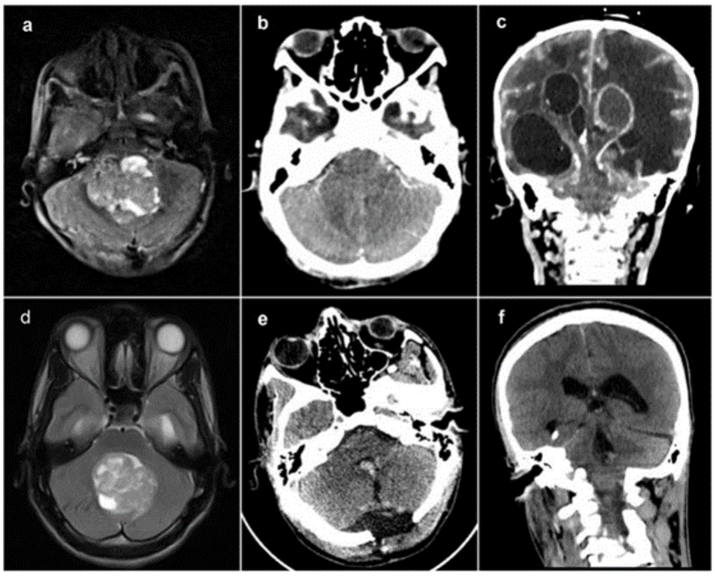

Figure-2 *Representative case examples.*

a-c: *Patient with poor outcome.* ***a:*** *preoperative T2W MRI Axial image showing a mass in the fourth ventricle,* ***b:*** *Postoperative image showing incomplete resection due to profuse intraoperative bleeding,* ***c:*** *postoperative CT images after 15days showing postoperative hydrocephalus and ventriculitis.* ***d-c:*** *Patient with a good outcome.* ***d:*** *Preoperative T2W MRI with fourth ventricular mass, Post-operative CT images took a day after* ***e:*** *showing GTR,* ***f:*** *Coronal image showing no hydrocephalus.*

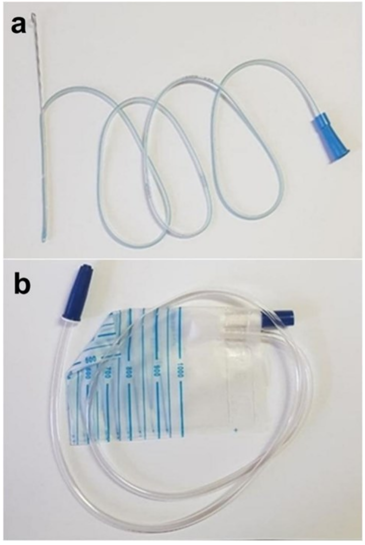

Figure-3 *External ventricular drain – system*

a. Sterile RYLE's tube (adult nasogastric feeding tube #8) with guide stylet inserted at tip used to enter the ventricular system.

b. Sterile urine bag – used to collect CSF by attaching to the RYLE's tube.

Functional outcome at discharge:

At the time of diagnosis 27 (67.5%) patients were restricted in physically strenuous activity (scored 1), and 13 (32.5%) were unable to carry out any work activities (score-2). At the time of discharge and on the first month of follow up, nine became fully functional (0), 12 scored 1, 3 scored 2, 3 scored 3, 2 scored 4 and 11 died scored 5.

Discussion

Surgical resection of IVT is demanding and may lead to significant complications and postoperative morbidity. [19] In the present study we report the outcomes of surgically treated patients with IVT in TSAH, Ethiopia.

In line with other studies, headache was the most common symptom in our population. [5,20, 21] However, visual deficit occurred in 65%, which is higher than that reported by other studies (17-32%), [2,7, 22], which together with the long duration of symptoms (median 11 months) may reveal that our patients seek medical help at an advanced stage of the disease, resulting from the evident shortcomings in diagnostic resource capacity and the patient's lack of economic resources. Hence, many patients will not undergo diagnostic workups at a rather late stage of the disease. Furthermore, the availability of neuroimaging is undoubtedly very limited in LICs, especially MRIs.

Reports have shown that tumors that arise within the lateral ventricles are often benign or low-grade, while pediatric infratentorial brain tumors are often malignant. [23,24] Half of all adult IVT occur in the lateral ventricles, while this is true for one-quarter of pediatric tumors. Infratentorial intraventricular brain tumors were found in 55% of pediatric cases. [3,11] In line with previous studies, our study shows that a significant proportion (69.5%) of tumors in adults were supratentorial, while 70.6% of pediatric tumors were infratentorial (p= 0.042). Furthermore, we found that high-grade infratentorial tumors were predominantly occurring (81.8%) in the pediatric population. Three-fourths (75%) of pediatric infratentorial tumors in our study were medulloblastomas, higher than that has been reported at 30% -56%. [3,25,26]

The timing of surgical intervention in our setting for IVT depended on the presence of acute HCP and the availability of ICU beds. All the patients presented with acute HCP managed acutely by CSF diversion procedures. Our patients stayed on average 10.5 days before surgery, which we assume too long.

At TSAH, there exists a solitary Intensive Care Unit (ICU) comprising 16 beds, which is shared among all medical specialties. As a result, patients experience extended waiting periods before undergoing surgery due to the scarcity of available ICU beds for postoperative care. Majority (90%) of patients were admitted to the ICU postoperatively, a higher proportion than in other studies. However, it is difficult to estimate how many patients actually needed treatment at an intensive care unit because all operated intraventricular tumor patients admitted at the intensive care unit for postoperative care due to lack of well-functioning postoperative high dependency care unit at TSAH.

We acknowledge that a combination of insufficient resources and limited expertise may contribute to unacceptably high rates of complications. Therefore, we need to establish a proper high dependency step-down unit and an intensive care unit dedicated to neurosurgical patients with trained and competent staff in the near future to increase the quality of postoperative care for the patients who undergo advanced neurosurgical procedures at TSAH.

In this series, the size significantly influenced the choice of approach for supratentorial tumors. Smaller tumors were approached using the interhemispheric transcallosal route, while larger ones were addressed through the transcortical route. Our strategy to access the tumors follows international standards, where the size and location of tumors in the ventricle determine the approach that should aim for the shortest and safest access to the tumor. [2,15,16]

The goal of the operation was to achieve maximal safe resection. Due to limited resources, we only performed postoperative CT scans instead of more informative postoperative MR scans, which provides a better evaluation on the extent of resections. Larger studies have reported gross total resection (GTR) rates ranging from 38.4% to 87% [7,12], whereas we achieved GTR in 60% of the cases.

Our findings indicate that, adults and tumors located in the supratentorial region are more likely to achieve gross total resection (GTR). Infratentorial tumors had significantly high STR, especially in children (figure – 2), and this was mainly due to premature termination of the surgery due to profuse bleeding and invasion of the vital structures (brain stem). In our setting, there is a frequent lack of hemostatic materials like Surgicel, Gelfoam, fibrin glue, or Flowseal, which are crucial for controlling intraoperative bleeding. However, developed countries routinely utilize these hemostatic materials to manage bleeding, thereby aiding in the progression of surgical procedures.

In children, due to low blood volume, surgery was terminated whenever we encountered profuse bleeding that we were hard to control by measures like irrigation and cotton patties.

In our cohort, the patients with subtotal resections end up with EVD insertions to prevent hematoma and hydrocephalus. Furthermore, we do not have intraoperative neurophysiological monitoring facilities in our settings, and such limitation contributed further to premature termination of surgery when there are signs of tumor invasion to vital structures such as the brainstem. However, as shown in Figure 2(d-e), we were able to do proper surgery and managed to do GTR when we did not encounter challenges such as bleeding and invasion to the adjacent critical structures.

The reported rates of postoperative complications for intraventricular tumors (IVT) exhibit significant variability across different series, ranging from 20% to 70% [2,11,26]. In our study, we observed a complication rate of 52.5%. The most frequently encountered complications were postoperative HCP and CNS infections.

According to various literature sources, the occurrence of postoperative hydrocephalus (HCP) requiring intervention has been reported in 10% to 50% of patients [10,19]. In our study, we observed a postoperative HCP rate of 40%. Notably, fourth ventricular lesions in our series were frequently associated with postoperative HCP. We hypothesize that factors such as residual tumor due to premature termination of surgery and hematoma resulting from intraoperative hemorrhage may contribute to the obstruction of CSF flow and subsequent development of HCP. (Figure -2a-c).

During intraventricular surgery with an EVD insertion necessitate careful consideration of the risk of ventriculitis. Previous studies reported 5%-13% risk of meningitis or ventriculitis. [2,27] We reported postoperative CNS infections (meningitis/ventriculitis) rate of 25%, that is certainly high, and we found significant association to EVD insertions and longer EVD stay. We used prophylactic antibiotics as recommended in other studies for patients with EVDs. Unfortunately due to limited resources, we lack a proper closed EVD drainage system. We use nasogastric (NG) tube as ventricle catheter attached to sterile urine bags as an EVD drainage system (figure-3). The utilization of an improperly closed and non-sterile system for the external ventricular drain (EVD) is presumed to be associated with elevated rates of postoperative CNS infections. Suboccipital craniotomy performed for fourth ventricular tumors was determined to be the primary independent risk factor for postoperative infections. This is particularly relevant as suboccipital craniotomies often involve the placement of an EVD, which may contribute to the elevated risk of infections associated with this procedure. While we identified a longer ICU stay as another independent risk factor for postoperative infection, it is challenging to establish its independence since severe CNS infections often result in an extended ICU stay.

Postoperative mortality rates reported in the literature varies between 0% and 36%. [2,11,15,22,28] In the present study, 30 days operative mortality was 27.5%. Postoperative HCP was identified as a risk factor for operative mortality. This study reveals that our postoperative HCP management needs to be revised meticulously and standardized to reduce the complication rates and mortality.

In our cohort, patients with infratentorial tumors seem to have poor surgical outcome. Our current practice involves selecting patients for surgery based on our belief that they are likely to have favorable outcomes. Unfortunately, we do not have access to outcomes data for patients who were deemed ineligible for surgery. However, in the future, we should put more effort into selecting appropriate candidates for operations given the risk factors for poor outcomes from this study.

We acknowledge that we have learned the necessary surgical skills to deal with these complicated tumors as we were able to do GTR in 60% of the patients. However, we should put effort to reduce perioperative complications, for example to get some necessary hemostatic materials to control bleedings that was the main cause for premature termination of surgery and further complications.

Furthermore, there is an immense need for a proper closed EVD drainage system to avoid infections and complications in our setting. Further good postoperative management with cautious monitoring of vital and neurological functions and timely, appropriate diagnosis and treatment of postoperative complications such as hydrocephalus and infections are important to improve the quality of surgical management and outcome.

Limitations

This study is retrospective, hospital-based and retrieving the data from patients' files may have caused bias.

Conclusion

This study highlights a significantly higher rate of postoperative complications and surgical mortality in patients with intraventricular tumors (IVT). Common complications observed were hydrocephalus and central nervous system (CNS) infections. In particular, surgical outcomes for infratentorial tumors, especially in children, were notably poor. The study strongly emphasizes the significance of patient selection for surgery based on the likelihood of achieving favorable outcomes. Additionally, postoperative hydrocephalus was identified as an independent risk factor for postoperative mortality. The study underscores the challenges faced in treating IVT within low-income countries (LICs), including limited resources and lack of experience, which contribute to unacceptably high complication rates. The study identifies significant challenges, including the scarcity of hemostatic materials, the lack of proper closed external ventricular drain (EVD) systems, and inadequate postoperative care. It emphasizes the importance of addressing these challenges seriously and implementing effective strategies to improve outcomes, particularly in resource-limited settings.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgments

We would like to acknowledge Dr. Yemiserach Bizuneh for helping us to collect data on our patients.

Appendix

WHO Performance status

Grade	Explanation of activity
0	Fully active, able to carry on all pre-disease performance without restriction
1	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, e.g., light house work, office work
2	Ambulatory and capable of all self-care but unable to carry out any work activities. Up and about more than 50% of waking hours
3	Capable of only limited self-care, confined to bed or chair more than 50% of waking hours
4	Completely disabled. Cannot carry on any self-care. Totally confined to bed or chair
5	Dead

Abbreviations

CI- Confidence Interval

CT scan - Computed axial tomographic scan

CNS- Central nervous system

CSF- Cerebrospinal fluid

ETV- Endoscopic Third Ventriculostomy

EVD- External Ventricular Drainage

FIENS - Foundation for International Education in Neurological Surgery

GOS- Glasgow outcome score

GTR -Gross Total Resection

HCP- Hydrocephalus

ICU- Intensive Care Unit

IV- Intravenous

IVT – Intraventricular Tumors

LIC- Low Income Country

MRI -Magnetic resonance imaging

NG - Nasogastric

OR – Odd ratio

OS – Overall survival

STR -Subtotal Resection

TASH - Tikur Anbesa Specialized Hospital

VPS -Ventricular-Peritoneal shunt

WHO – World Health Organization

References

1. Jelinek J, Smirniotopoulos JG, Parisi JE, Kanzer M. Lateral ventricular neoplasms of the brain: differential diagnosis based on clinical, CT, and MR findings. American Journal of Roentgenology. 1990;155(2):365-372. doi:10.2214/ajr.155.2.2115270

2. Elwatidy SM, Albakr AA, Al Towim AA, Malik SH. Tumors of the lateral and third ventricle: surgical management and outcome analysis in 42 cases. NSJ. 2017;22(4):274-281. doi:10.17712/nsj.2017.4.20170149

3. Filippidis A, Tsonidis CA. Intraventricular brain tumors in children. In: ; 2009. https://api.semanticscholar.org/CorpusID:11194552

4. Waldron JS, Tihan T. Epidemiology and pathology of intraventricular tumors. Neurosurgery Clinics of North America. 2003;14(4):469-482. doi:10.1016/S1042-3680(03)00060-3

5. Sayyahmelli S, Baran O, Uğurlar D, Kemerdere R, Antar V, Tanriverdi T. Intracranial intraventricular tumors: long-term surgical outcome of 25 patients. Turk J Med Sci. 2017;47:76-84. doi:10.3906/sag-1509-119

6. Ellenbogen RG. Transcortical surgery for lateral ventricular tumors. FOC. 2001;10(6):1-13. doi:10.3171/foc.2001.10.6.3

7. Milligan BD, Meyer FB. Morbidity of Transcallosal and Transcortical Approaches to Lesions in and Around the Lateral and Third Ventricles: A Single-Institution Experience. Neurosurgery. 2010;67(6):1483-1496. doi:10.1227/NEU.0b013e3181f7eb68

8. Suh DY, Mapstone T. Pediatric supratentorial intraventricular tumors. FOC. 2001;10(6):1-14. doi:10.3171/foc.2001.10.6.5

9. Centre, M. 'The British Journal of Radiology Review article : Computed tomography and magnetic',1994; 67(795), pp. 223–243.

10. Alam S, Uddin AN, Majumder MR, Hasan MM, Ahmed A. Intraventricular Tumor: An Analysis of 18 Cases. Nep J Neurosci. 2016;13(1):23-29. doi:10.3126/njn.v13i1.15908

11. Pendl G, Oturk E, Haselsberger K. Surgery of tumours of the lateral ventricle. Acta neurochir. 1992;116(2-4):128-136. doi:10.1007/BF01540865

12. Gökalp HZ, Yüceer N, Arasil E, et al. Tumours of the lateral ventricle. A retrospective review of 112 cases operated upon 1970–1997. Neurosurg Rev. 1998;21(2-3):126-137. doi:10.1007/BF02389318

13. Kasowski H, Piepmeier JM. Transcallosal approach for tumors of the lateral and third ventricles. FOC. 2001;10(6):1-5. doi:10.3171/foc.2001.10.6.4

14. Yaşargil MG, Abdulrauf SI. SURGERY OF INTRAVENTRICULAR TUMORS. Neurosurgery. 2008;62(6):SHC1029-SHC1041. doi:10.1227/01.NEU.0000316427.57165.01

15. Anderson RCE, Ghatan S, Feldstein NA. Surgical approaches to tumors of the lateral ventricle. Neurosurgery Clinics of North America. 2003;14(4):509-525. doi:10.1016/S1042-3680(03)00054-8

16. Apuzzo MLJ, Chikovani OK, Gott PS, et al. Transcallosal, Interfornicial Approaches for Lesions Affecting the Third Ventricle. Neurosurgery. 1982;10(5):547-554. doi:10.1227/00006123-198205000-00001

17. Asfaw ZK, Tirsit A, Barthélemy EJ, et al. Neurosurgery in Ethiopia: A New Chapter and Future Prospects. World Neurosurgery. 2021;152:e175-e183. doi:10.1016/j.wneu.2021.05.071

18. Young J, Badgery-Parker T, Dobbins T, et al. Comparison of ECOG/WHO Performance Status and ASA Score as a Measure of Functional Status. Journal of Pain and Symptom Management. 2015;49(2):258-264. doi:10.1016/j.jpainsymman.2014.06.006

19. Kriankumar C, Deshpande R, K. Chandrasekhar YbV, Rao Is, Panigrahi M, Babu P. Clinical management and prognostic outcome of intracranial ventricular tumors: A study of 134 cases. Cancer Res Stat Treat. 2019;2(1):10. doi:10.4103/CRST.CRST_19_19

20. For the French Society of Neurosurgery, Lubrano V, François P, Loundou A, Vasiljevic A, Roche PH. Outcomes after surgery for central neurocytoma: results of a French multicentre retrospective study. Acta Neurochir. 2013;155 (7):1261-1269. doi:10.1007/s00701-013-1732-y

21. Sw H, Choi H young, Koh EJ. Surgery of the Tumors in the Ventricular System. Journal of Korean Neurosurgical Society. 2006;39:26-31

22. Hassaneen W, Suki D, Salaskar AL, et al. Immediate morbidity and mortality associated with transcallosal resection of tumors of the third ventricle. Journal of Clinical Neuroscience. 2010;17(7):830-836. doi:10.1016/j.jocn.2009.12.007

23. Piepmeier JosephM. Tumors and approaches to the lateral ventricles: Introduction and overview. J Neuro-Oncol. 1996;30(3). doi:10.1007/BF00177278

24. Postalcı LŞ, Günaldı Ö, Demirgil B, et al. Intra-Ventricular Tumors: Assessment of 40 Cases. OJMN. 2014;04(02):53-58. doi:10.4236/ojmn.2014.42012

25. Elgamal EA, Mohamed RM. Pediatric Brain Tumors. In: Salih MAM, ed. Clinical Child Neurology. Springer International Publishing; 2020:1033-1068. doi:10.1007/978-3-319-43153-6_35

26. Toescu, S. M. et al. 'Influence of Surgical Approach', 27(January), 2021;pp. 52–61. doi: 10.3171/2020.6. PEDS2089.J.

27. Aftahy AK, Barz M, Krauss P, et al. Intraventricular neuroepithelial tumors: surgical outcome, technical considerations and review of literature. BMC Cancer. 2020;20(1):1060. doi:10.1186/s12885-020-07570-1

28. Zuccaro G, Sosa F, Cuccia V, Lubieniecky F, Monges J. Lateral ventricle tumors in children: a series of 54 cases. Child's Nervous System. 1999;15(11-12):774-785. doi:10.1007/s003810050470

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