ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCES

SCHOOL OF MEDICINE, DEPARTMENT OF SURGERY,

NEUROSURGERY DIVISION

ADDIS ABABA, ETHIOPIA.

RETROSPECTIVE STUDY ON SURGICAL OUTCOME OF MEDULLOBLASTOMA AMONG OPERATED PATIENTS IN TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA, BETWEEN MAY 1, 2018 AND SEPTEMBER 30, 2025.

A Thesis to be submitted to department of surgery, neurosurgery division for partial fulfillment of neurosurgery specialty certificate.

Addis Ababa University

December, 2025

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Retrospective Study on Surgical Outcome of Medulloblastoma Among Operated Patients in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, Between May 1,2018 and September 30, 2025.

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A thesis submitted to the Department of Surgery, Neurosurgery Division, College of Health Sciences, Addis Ababa University, in partial fulfillment of the requirements for the Neurosurgery Specialty Certificate.

ADDIS ABABA, ETHIOPIA

DECEMBER, 2025

Research proposal submission form

Table 1 proposal submission form

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Full Title of the research	RETROSPECTIVE STUDY ON SURGICAL OUTCOME OF MEDULLOBLASTOMA AMONG OPERATED PATIENTS IN TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA, BETWEEN MAY1, 2018 AND SEPTEMBER 30, 2025
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DECLARATION

I hereby declare that this thesis is my original work and has all sources of material used for this thesis have been duly acknowledged.

Name: Dr. Alemu Gemeda

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ADVISORS APPROVAL SHEET

This thesis has been submitted for examination with my approval.

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Abbreviations and Acronyms

BLH	Black Lion Hospital
GTR	Gross Total Resection
NTR	Near Total Resection
CSF	Cerebrospinal Fluid
CSI	Craniospinal Irradiation
STR	Subtotal Resection
DTI	Diffusion Tensor Imaging
MRI	Magnetic Resonance Imaging
OS	Overall Survival
PFS	Progression Free Survival
WHO	World Health Organization
CMS	Cerebral Mutism Syndrome
HCP	Hydrocephalus
TASH	Tikur Anbessa Specialized Hospital
KPS	Karnofsk Performance Scale
PCPC	Pediatric Cerebral Performance Category
BS	Brainstem
LMICs	Low- And Middle-Income Countries

Abstract

Background: Medulloblastoma is a highly malignant primary central nervous system tumor and the most common solid brain tumor in children, contributing substantially to childhood cancer mortality. Pediatric cases often show more aggressive features, while adult tumors tend to have better outcomes. Given these differences and the lack of adequate local evidence, assessing surgical outcomes at Tikur Anbessa Specialized Hospital and MCM hospital is important to guide clinical practice in Ethiopia.

Objective: To evaluate the surgical outcomes of patients with medulloblastoma who underwent operative management at TASH, and MCM hospital Addis Ababa, Ethiopia, between May 1, 2018 - September 30, 2025.

Methodology: A two-hospital based retrospective cohort study was conducted on 47 patients with medulloblastoma who underwent operative management from May 1, 2018 to September 30, 2025. Data were obtained from medical records, operative notes, pathology reports, and pre- and postoperative imaging using a structured data extraction checklist. Descriptive statistics were used to summarize patient characteristics, while Kaplan–Meier survival analysis and Cox proportional hazards models were applied to assess progression-free and overall survival and to identify factors associated with poor surgical and functional outcomes. Statistical significance was set at a p-value < 0.05.

Result: The survival declined markedly, being alive, 37 (78.7%), 95% CI (65.5–88.5) at 1 month, decreasing to 36 (76.6%), 95% CI (63.2–86.9) at 6 months, then 22 (46.8%), 95% CI (33.1–60.9) at 1 year, further to 11 (23.4%), 95% CI (13.1–36.8) at 2 years, and only 2 (4.3%), 95% CI (0.9–13.0) remaining alive at 3 years following surgery. No patient survived at 4 years follow up. The analysis indicates that more complete intraoperative resection is associated with better overall survival and longer progression-free survival. The patients with brainstem compression (AOR = 52.544; 95% CI: 1.754–1574.066) and immediate postoperative complications (AOR = 93.887; 95% CI: 1.985–4440.072), delayed initiation of radiotherapy and younger age were significantly associated with poor functional outcomes in medulloblastoma patients.

Conclusion: In conclusion, survival among medulloblastoma patients declined progressively after surgery, with better outcomes linked to complete tumor resection and older age groups. Brainstem compression and immediate postoperative complications and luck of timely initiation of oncologic intervention were associated with poor functional and survival outcomes, underscoring the need for careful surgical management and postoperative care to improve survival and recovery.

Keyword: medulloblastoma, functional outcomes, Factors, TASH, Addis Abeba, Ethiopia

CHAPTER I
Introduction

Background

Cerebellar medulloblastoma is one of the most common types of primary intracranial tumors in children. The treatment of this tumor, unfortunately, is considered as "one of the darkest chapters in pediatric neurosurgery". Cushing reported an average survival of five and six-tenths months in 14 patients with medulloblastoma who received no postoperative radiotherapy (1).

The risk stratification after surgery for patients with medulloblastoma has been based on three variables, i.e., age, metastasis, and residual tumor following surgery for a long time. In spite of several recent advances in the understanding of pathogenesis of medulloblastoma, management protocols have not been updated[2]. Recent research has focused on understanding the molecular mechanisms underlying the pathogenesis of medulloblastoma. On the basis of these findings, medulloblastoma has been categorized into four different molecular subtypes according to the World Health Organization (WHO) 2016 classification of brain tumors.[3]

Current clinical risk stratification for patients with medulloblastoma separates children into average-risk and high-risk strata. High-risk disease is defined by the presence of metastases at diagnosis, age less than 3 years, and residual disease of at least 1·5 cm^2. In the scientific literature, the prognostic benefit of gross total resection versus sub-total resection or biopsy is controversial. Many patients with 1·5 cm^2 or more of residual disease either have to undergo so-called second-look surgery to achieve a gross total resection or are treated with high-risk protocols including higher doses of craniospinal irradiation and more intensive chemotherapy.

Statement of the problem

Medulloblastoma is the most common malignant pediatric brain tumor and a leading cause of cancer-related death in children. It accounts for approximately 10% of childhood brain tumors but occurs rarely in adults, representing only 1% of primary central nervous system (CNS) tumors in that population. The annual incidence in children is estimated at 2 to 7 cases per 1 million, with a bimodal age distribution peaking between 1–4 years and 5–9 years. A male predominance is observed (male-to-female ratio of 1.5:1), though this ratio varies across molecular subgroups. Additionally, differences in incidence have been noted among ethnic and racial groups.[17]

Medulloblastoma is no longer considered a single entity, but rather consists of four distinct molecular subgroups (WNT, SHH, group 3, and group 4) with distinct demographics, clinical features including prognosis, transcriptomes, and genetics. Logistic regression analysis within the discovery cohort revealed tumor location and enhancement pattern to be significant predictors of medulloblastoma subgroups. Stereospecific computational analyses confirmed that group 3 and 4 tumors predominated within the midline fourth ventricle, wingless tumors were localized to the cerebellar peduncle/cerebellopontine angle cistern with a positive predictive value of 100% (95% CI, 30%–100%), and sonic hedgehog tumors arose in the cerebellar hemispheres with a positive predictive value of 100% (95% CI, 59%–100%). Midline group 4 tumors presented with minimal/no enhancement with a positive predictive value of 91% (95% CI, 59%–98%). When we used the MR imaging feature– based regression model, 66% of medulloblastomas were correctly predicted in the discovery cohort, and 65%, in the validation cohort.[4]

Aggressive resection of medulloblastoma might be associated with increased surgical complications. Post-surgical neurological morbidity for children with medulloblastoma, irrespective of the extent of residual tumors, is 24% and can increase to as high as 44% after gross total resection. Despite advances in neurosurgical techniques, achieving gross total resection (GTR) without causing neurological deficits remains a critical concern, as residual tumor often correlates with poorer survival and higher recurrence rates.[4]

One of the most troublesome postoperative complications of cerebellar and fourth ventricular tumor surgery is cerebellar mutism (CM) and its associated features. The condition has also been described in adult and pediatric patients who suffer from transient mutism after vascular incidents, infections, trauma, or metabolic disease, but children with cerebellar and fourth ventricular tumors represent by far the largest group.[5]

According to Study by Rosdali, which is a multinational cohort of MB in LMICs describes poor outcomes, which may be attributed to delays in care, high abandonment rate, surgical complications, treatment-related mortality and a low fraction of patients receiving radiotherapy. Interventions to build care capacity can be prioritized based on these data.[18]

This study on medulloblastoma surgical outcomes will directly improve patient care at our hospital by providing evidence-based guidance on the optimal extent of resection (GTR vs. NTR/STR), enabling us to balance maximal tumor removal with minimized postoperative complications like cerebellar mutism and functional deficits. By correlating resection extent with progression-free survival, overall survival, and neurological outcomes, the findings will help tailor individualized treatment plans, refine adjuvant therapy approaches, and establish standardized surgical protocols—ultimately enhancing survival rates, functional recovery, and quality of life for medulloblastoma patients in our institution. Furthermore, the study will identify the gaps in the management of this patients and will try to recommend treatment protocols which fits to our setup.

Significance of the study

This study provides important insight into the real-world surgical outcomes of medulloblastoma in a low- and middle-income country (LMIC) setting, where evidence is limited and often underrepresented in the literature. By documenting survival, postoperative complications, and early outcomes within the constraints of available resources, the study helps bridge the evidence gap between high-income countries and LMICs. The findings identify key challenges—such as delayed presentation, restricted access to adjuvant therapy, and follow-up limitations—that directly affect outcomes, thereby informing context-appropriate clinical decision-making and health policy planning. Importantly, the study establishes a local benchmark for outcomes, supports advocacy for improved neurosurgical and oncologic infrastructure, and serves as a foundation for future prospective, multicenter, and interventional studies aimed at improving pediatric brain tumor care in resource-limited settings.

CHAPTER II
Literature review

2.1. Overview of Cerebellar medulloblastoma

Medulloblastoma-primary malignant lesions of the central nervous system (CNS) account for approximately 20% of pediatric cancers and are the most common solid tumors in children. Cancer-related conditions are the second leading cause of death in children under 15 years of age. Among these, fatalities from CNS malignancies rank second only to leukemia. [4, 5]

Medulloblastoma represents the most prevalent malignant brain tumor in pediatric populations, comprising 30-40% of all posterior fossa lesions. [6, 7] The disease carries a historically poor prognosis, with a uniformly fatal outcome in the absence of postoperative radiation therapy. Early clinical experiences, such as Harvey Cushing's seminal series of 61 surgically managed cases, demonstrated devastating outcomes with merely 1.6% survival at three years. Subsequent analysis by McFarland and colleagues in 1969 revealed modest improvements, documenting median survival of 1.4 years and five-year survival rates of 30% when accounting for surgical mortality. [8, 9]

The therapeutic landscape underwent substantial transformation following the advent of megavoltage radiotherapy techniques. This technological advancement precipitated remarkable enhancements in survival outcomes, fundamentally altering the disease's natural history. Contemporary management strategies now integrate this modality as a cornerstone of treatment, building upon these historical foundations to achieve progressively better results. [10, 11]

Gross total resection (GTR), defined as the removal of ≥90% of tumor volume, is associated with improved progression-free survival (PFS) and overall survival (OS) in medulloblastoma patients. [3, 12, 13] Evidence suggests that GTR, when feasible, reduces residual tumor burden and potentiates the effects of adjuvant therapies, including radiation and chemotherapy (Thompson et al., 2016). However, aggressive resection near critical structures such as the brainstem or fourth ventricle elevates the risk of postoperative morbidity, including cerebellar mutism syndrome (CMS), cranial neuropathies, and motor dysfunction. [9, 14, 15] Recent molecular classifications (WNT, SHH, Group 3, and Group 4) have further refined prognostic

stratification, with WNT-activated tumors demonstrating the best outcomes even with near-total resection, while Group 3 tumors remain high-risk despite maximal resection.[13, 16, 17] These findings suggest that surgical goals should be tailored to molecular subtypes, balancing oncological benefits against functional risks.

Postoperative complications profoundly influence recovery trajectories and long-term quality of life in medulloblastoma patients. The most devastating of these, cerebellar mutism syndrome (CMS), occurs in up to 25% of cases and presents with a characteristic triad of transient speech arrest, emotional lability, and motor dysfunction. [1, 18]

Other frequent complications include hydrocephalus necessitating shunt placement (30-40% of cases), cerebrospinal fluid (CSF) leaks, and surgical site infections. [19] For many years, the risk stratification of medulloblastoma patients after surgery has been based on three well-established variables: patient age, presence of metastasis, and amount of residual tumor following resection. Despite significant advances in our understanding of the disease's molecular pathogenesis, these traditional factors continue to form the backbone of clinical management protocols. Recent research efforts have increasingly focused on deciphering the molecular mechanisms that drive medulloblastoma development and progression. [11, 20, 21]

The World Health Organization's 2016 classification of brain tumors reflects these scientific advances by categorizing medulloblastoma into four distinct molecular subtypes. This new classification system recognizes that these subtypes differ not only in their underlying biology but also in their clinical presentations, imaging characteristics, and patient outcomes. [16, 21] The molecular classification represents a major step forward from the previous binary risk stratification (low-risk vs high-risk groups), as it naturally incorporates two of the original risk factors - patient age and metastatic status - through their association with specific molecular subtypes. [12, 22, 23]

However, the third traditional risk factor, extent of surgical resection, has not been systematically reevaluated in the context of these molecular subtypes. This gap in knowledge persists even as some clinicians question the value of maximal resection, citing concerns about potential neurological damage and increased morbidity when operating near sensitive brain

structures. The ongoing uncertainty about the role of surgical resection in the era of molecular classification highlights the need for further research to optimize risk assessment and treatment strategies for medulloblastoma patients. [20, 24]

The current clinical risk stratification system for medulloblastoma categorizes pediatric patients into two distinct groups: average-risk and high-risk disease. High-risk status is defined by three key factors: (1) presence of metastatic disease at diagnosis, (2) age younger than 3 years, and (3) residual tumor burden exceeding 1.5 cm^2 following initial surgery. [21, 23, 25]

The role of surgical resection extent remains a subject of ongoing debate in the literature. While some studies suggest improved outcomes with gross total resection, others report comparable results with subtotal resection or even biopsy. This controversy has significant clinical implications, as patients with residual disease ≥1.5 cm^2 typically face two challenging options: undergoing additional "second-look" surgery to attempt complete resection, or proceeding with intensified high-risk treatment protocols. These aggressive regimens often involve higher doses of craniospinal irradiation and more intensive chemotherapy regimens, which may carry substantial toxicity burdens. [26, 27]

The pursuit of aggressive resection in medulloblastoma must be carefully weighed against the risk of postoperative complications. Current data indicate that approximately 24% of pediatric patients experience neurological morbidity following surgery, regardless of the extent of residual tumor. However, this risk escalates significantly to 44% in cases where gross total resection (GTR) is achieved. [28, 29]

A particularly concerning complication is posterior fossa syndrome (cerebellar mutism), which occurs more frequently after GTR compared to subtotal resections.[16, 30]The majority of affected patients develop persistent neurological deficits, including cognitive impairments ranging from mild to severe, speech and language dysfunction, and chronic ataxia. These long-term sequelae substantially impact quality of life and functional outcomes. [14, 31, 32]

Left-handed children treated for medulloblastoma may be the most at risk for CMS, and unilateral, localized damage within the cerebello-thalamo-cerebral pathway at the level of the right cerebellum is implicated in the presentation of CMS. This disruption in communication

between the right cerebellum and left frontal cortex may contribute to speech language problems observed in children with CMS.

The surgical challenge is further compounded by the anatomical characteristics of many medulloblastomas, which often exhibit firm attachments to the floor of the fourth ventricle. Even when dealing with relatively small tumors, attempts at complete resection may risk damage to critical neural structures in this delicate region. This anatomical reality underscores the need for meticulous surgical planning and technique to balance oncological goals with functional preservation. [30]

The degree of molecular and clinical similarity between adult and pediatric medulloblastoma is not entirely clear, yet. Some authors have certainly reported distinct molecular profiles and clinical behavior when comparing adults and children/infants. However, the distribution of cases across the subgroups is very different. In adults as compared to children. The most comprehensive study on adult MB published to date suggests that group 3 tumors are exceptionally rare in adults, whereas SHH tumors comprise about two-thirds of cases in this age group. [2, 23]

After 5 years, 10 of the 16 patients in study were still alive. Lateral localization of the tumor, desmoplastic histologic variant, and total excision were all good prognostic indicators. Total excision is difficult in patients with brainstem invasion, and even if total excision is performed, the prognosis is poor. [32]

Surgical resection remains a cornerstone of medulloblastoma treatment, with extent of resection significantly impacting prognosis. Gross total resection (GTR) is associated with improved 5-year survival rates (70-80%) compared to subtotal resection (STR), particularly in standard-risk patients.[12,13] However, postoperative complications such as cerebellar mutism syndrome (CMS) occur in 25-40% of cases, with clinical predictors including tumor midline location and disruption of the dentatothalamocortical pathway. [25, 32] Recent consensus guidelines emphasize the importance of maximal safe resection while preserving neurological function, as the balance between oncological control and quality of life remains crucial.[16] Molecular stratification

(WNT, SHH, Group 3, Group 4) further refines surgical decision-making, with WNT tumors demonstrating the most favorable outcomes following GTR. [18, 19]

According to a study by Julian L. Gendreau et al. (A Retrospective Analysis of the Demographics, Treatment, and Survival Outcomes of Patients with Desmoplastic/Nodular Medulloblastoma Using the Surveillance, Epidemiology, and End Results [SEER] Database), the overall five-year survival rate was 77.8%. Notably, age, sex, race, and geographical region of diagnosis showed no significant association with survival outcomes. [18, 25]

A study from Cape Town, South Africa quantifying medulloblastoma surgical outcomes in low- and middle-income countries (LMICs) reported 5-year and 10-year overall survival (OS) rates of 60.5% and 54.6%, respectively, for the entire cohort, while research by David Tandian in Indonesia demonstrated more extreme disparities: surgery alone resulted in 0% 5-year OS, though survival rates improved to 50% with radiotherapy and further increased to 70-80% when chemotherapy was incorporated into treatment regimens. [19]

In our set up Overall median and PFS of operated patients <15 years old is poor. Patients with negative outcome predictors have higher mortality& poor postoperative functional status. Standardization of treatment with surgery & CSI ± chemotherapy yields longer survival rates in both pediatric and adult patients.[10]

2.1. Conceptual framework

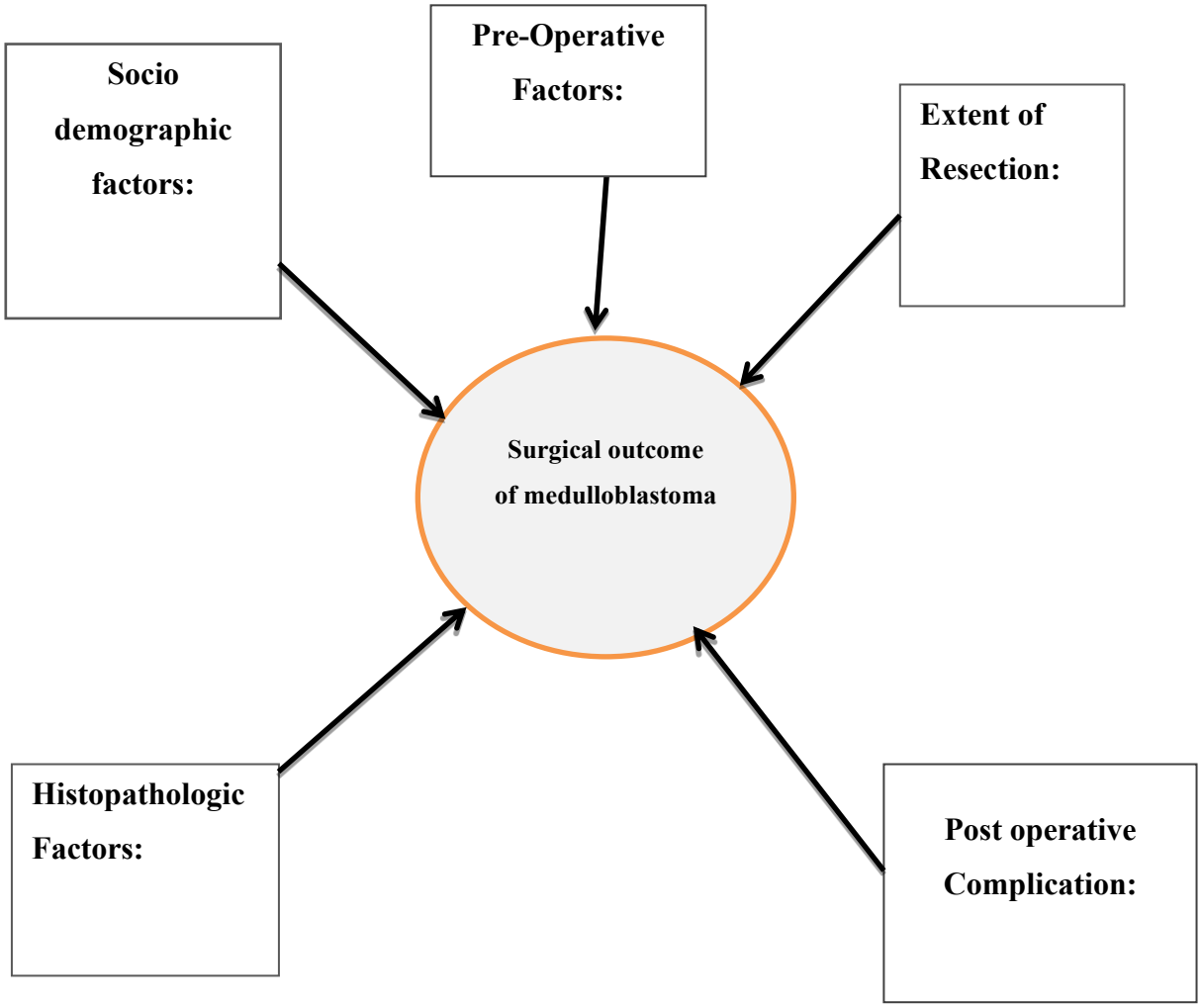

Figure 1 conceptual framework

CHAPTER III
OBJECTIVES OF THE STUDY

3.1. General objective

- To evaluate the surgical outcomes of patients with medulloblastoma who underwent operative management at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, between May 1, 2020 and september 30, 2025.

3.2. Specific objectives

- To assess the relationship between the extent of resection (gross total vs. subtotal resection) and progression-free survival (PFS) and overall survival (OS) in medulloblastoma patients.
- To analyze the frequency and severity of postoperative complications, including cerebellar mutism syndrome (CMS), hydrocephalus, cranial nerve deficits, and surgical site infections
- To identify risk factors associated with poor functional outcomes, including neurological deficits and quality of life post-surgery.

CHAPTER IV

METHODS AND MATERIALS

4.1. Study design and Period

A hospital based retrospective cohort study was conducted to find out medulloblastoma surgical outcomes at Black Lion Hospital, assessing factors such as extent of resection, complications, and survival rates.

4.2. Study Area

The study was conducted at TASH and MCM

4.3. Source Population

All patients undergoing surgery for medulloblastoma at Black Lion Hospital (BLH) and MCM

4.4. Study Population

All patients undergoing surgery for medulloblastoma at BLH and fulfilling the inclusion criteria with in the study period

4.5. Sampling method

Non-probabilistic convenient sampling technique was utilized

4.6. Sample Size

All patients who are going to be operated for medulloblastoma fulfilling inclusion criteria within the study period

4.7. Eligibility criteria

Inclusion criteria

- All patients operated for medulloblastoma in BLH hospital in the study time period and who are willing for study was included in the study

Exclusion criteria

- Patients with missing medical record
- Patients with extra-neural metastasis at initial presentation
- Patients lost from and never returned back to follow up
- Patients who were not fit for surgery at presentation
- Patients who didn't have consent for any surgical intervention
- Patients whose initial presentation was recurrence; either at tumor site or at remote site

4.8. Study variables

Dependent Variables

Surgical treatment outcome [Survival/Cured, Death, Referral, Recurrence]

Independent variables

- Age, Sex, Clinical presentation, Duration of illness, Preoperative performance status, Modified Chang's stage, Risk stratification, Radiologic characteristics, Presence of CSF & gross nodular seeding, Presence of HCP, Presence of BS compression & BS involvement, Preoperative CSF diversion, Extent of tumor resection, Histologic characteristics, Chemo/radio-therapeutic interventions, Interval duration between surgical and chemo/radio-therapeutic interventions, Presence of post intervention complications.

4.9. Sampling method and sample size determination

Convenience non-probabilistic sampling approach was used in this study.

All patients operated for medulloblastoma at the TASH and ,MCM in the specified period.

4.10. Operational definitions

- Extent of resection: The degree of resection extrapolated from operation notes OR immediate postoperative scans.
- GTR: No residual tumour on immediate postop MRI OR 100% resection.
- NTR: < 1.5 cm2 residual tumour on immediate postop MRI OR 91-99% resection OR rim enhancement of tumor resection cavity.
- STR: ≥ 1.5 cm2 residual tumor on immediate postop MRI or 51-90% resection OR nodular tumor enhancement.
- Biopsy/Partial resection: < 50% resection.
- Immediate postoperative period: ≤ 48 hours, post-surgery.
- High risk group/strata: Age < 3 years old, M+ or leptomeningeal seeding, STR.
- Average/Standard group/strata: Age ≥ 3 years old, GTR/NTR, M0 by cranio- spinal MRI & CSF.
- Lower cranial nerve palsy: Cranial nerve deficits involving 6^{th} to 12^{th} cranial nerves.
- Overall survival: Survival period (length of time) from the time of diagnosis & to a point in time at which time the patient is still alive [probability of surviving all causes of death].
- Progression free survival/ Event free survival/Disease free Survival: Survival period (length of time) after standard treatment; free of recurrence or any progression of the disease [without any symptoms & signs of the disease].
- Six months, One, Three- and Five-years' survival rates: The percentage of people in the study or treatment group who are alive at six months, one, three & five years respectively; after they were diagnosed & started treatment for medulloblastoma. There may or may not be recurrence.
- Tumor residual: The existence of tumor on immediate postoperative imaging.
- Tumor recurrence: The reappearance of tumor either on the original tumor site or on a remote site from the original tumor; that can manifest clinically or with positive cytology, and /or on radiographic scans; after having a negative radiologic finding on immediate postoperative scan.

- Radiation necrosis: radiotherapy induced death of normal cells; occurring during, months or years after, the treatment and mimics recurrent tumor both clinically and radiologically.
- Adult age group: Age > 15 years old.
- Paediatric age group: Age ≤ 15 years old.
- Standard treatment: Cranio-spinal irradiation (CSI) with or without chemotherapy following maximal safe tumor resection.
- Conventional radiotherapy for high-risk patients more than 3 years old & Recurrence: 30-36 Gy CSI and boosting the posterior fossa to 54-55.8 Gy in fractions of 1.8 Gy.
- Conventional radiotherapy for standard risk patients: 23.4 Gy CSI and boosting the posterior fossa to 54-55.8 Gy in fractions of 1.8 Gy.
- Functionality status/ Performance status: Standard non-parametric scale used to indirectly assess quality of life in patients with brain tumors; For this particular study, if a patient's condition is not scored at the time of evaluation; it can be extrapolated from the patient's clinical and social histories and scored according to the standard scales. Karnofsky Scale scoring; KPS is used for adult patients while Paediatrics Cerebral Performance Category
- Scale scoring; PCPCS is used for paediatric patients.
- Follow-up period: The total follow-up time, where in the patient is checked with the clinical and radiologic parameters after the patient is discharged following standard treatment and it is expressed in months.
- Recurrence time: The point in time when the patient developed recurrence after the first surgery and it is expressed in months.
- Time-to-death: The time span between surgery and death; expressed in days.
- Post treatment Performance status: The functional status documented at the last follow-up check.
- Significance on this study: The strength of association of two variables and the likelihood that a result is not by chance; Strong association was considered for p values of </=0.05 (significant at 5% level), <0.01 (significant at 1% level) and p value of <0.001(significant at 0.1% level, which is highly significant) while weak association was considered for p value </=0.1(significant at 10% level).

4.11. Data collection tools and procedures

The data was collected directly from patients or attendants, operation note registry, Biopsy result report, Inpatient and outpatient laboratory report, patient's electronic record, patient's pre op and post op images, card and phone call. The collection instrument was a structured questioner with a check list filled from data sources. The data was collected by Neurosurgical residents and principal investigator.

4.12. Data quality control

Training was given to the data collectors on how to conduct the data collection. Data quality was managed by training and appropriate supervision of principal investigator. Overall supervision was made by the supervisor and principal investigator. And the collected data was checked for its completeness, clarity and accuracy. This quality checking was done daily after data collection and correction was made. Data clean up, cross checking and double entry was done before analysis.

4.13. Data processing and analysis

The coded data, including demographic, preoperative, intraoperative, and postoperative factors, were exported to SPSS and Stata version 15 for cleaning, coding, and analysis. Descriptive statistics summarized participant characteristics using frequencies, proportions, and summary measures presented in text, tables, and graphs. Recovery time was calculated in days, and cumulative survival probabilities were estimated using life tables. Kaplan–Meier curves and log-rank tests described survival functions. Bi-variable Cox proportional hazards regression identified potential predictors ($p < 0.25$), followed by multivariable analysis using stepwise backward selection. The proportional hazards assumption was checked with Schoenfeld residuals. Adjusted hazard ratios with 95% confidence intervals were reported, and p-values < 0.05 were considered statistically significant.

4.14. Ethical considerations

Study participants was asked for their consent before asking for any information and informed consent was taken from every study participant. Confidentiality of the information was assured by omitting personal identifiers like names. The data was analysed anonymously and data sets was kept confidential. Ethical approval was obtained from the Ethical Review Committee of Addis Ababa University.

4.15. Dissemination of the Results

The finding of this research will be shared to the neurosurgery unit so that it can serve as a baseline data to the attending neurosurgeons and fellow residents. This research finding will be submitted to journals for publication.

CHAPTER V
Results

5.1. Socio-demographic characteristics and Clinical Presentation

Socio-demographic characteristics: A total of 47 of Medulloblastoma Patients Operated at TASH and MCM records were reviewed. The mean age was 10.7 years and the median was 8 years and the range was 36.4 years. (minimum 1.6, maximum 36 years). Most patients were male, 30 (63.8%) and 17 (36.2%) were female. Most participants were pediatric patients (≤15 years), accounting for 38 cases (80.9%), while 8 patients (19.1%) were adults (>15 years). Most patients were from TASH (39 patients, 83%), while MCM contributed 8 patients (17%).

Clinical Presentation: Most patients (70.2%) experienced a rapid symptom onset, seeking care within just three months. While 19.1% presented between three and six months, only a small minority (10.6%) had symptoms lasting up to a year. Nausea and vomiting were present in 47 (100.0%) patients, and cerebellar ataxia was also universal, 47 (100.0%). Headache was reported in 43 (91.5%) patients. Among those with ataxia, 22 (46.8%) had both truncal and appendicular involvement, 17 (36.2%) had truncal ataxia, and 8 (17.0%) had appendicular ataxia. Visual symptoms were present in 34 (72.3%) patients, with blurring of vision reported in 19 (55.9%), bilateral visual loss in 9 (26.5%), decreased vision in 5 (14.7%). Cranial nerve palsy was noted in 19 (40.4%) patients, predominantly affecting cranial nerves IX and X, 14 (73.7% of those with palsy), and IX, X, and VII in 5 (26.3%). Most patients, 33 (70.2%), presented within 3 months of symptom onset. All patients were conscious at presentation, 47 (100.0%), while seizures occurred in 4 (8.5%) The Socio-demographic characteristics and Clinical Presentations are listed in (Table 2 and 3).

5.2 Preoperative Functional status of the study groups

When we see the preoperative functional status of the pediatric patients, over 64% of the children faced severe disability (PCPCS 4) and the remaining 35.9% presented with moderate disability (PCPCS 3) due to the disease. There are 8 adult patients in this study who presented with preoperative functional scores ranging

from 60 to 80. The majority of these individuals maintained a high level of independence prior to surgery, with 87.5% of the group showing a score of 70 or higher. Overall, the cohort demonstrated a median preoperative baseline of 75, indicating that most patients were capable of self-care before undergoing medical intervention.

Variable	Category	N	%
Hospital	TASH	39	83.0
	MCM	8	17.0
	Total	47	100.0
Sex	Male	30	63.8
	Female	17	36.2
	Total	47	100.0
Age category	Pediatric (≤15 yrs)	38	80.9
	Adult (>15 yrs)	9	19.1
	Total	47	100.0

Table 2 : Socio-demographic characteristics of operated patients at TASH, and MCM, Addis Ababa, Ethiopia, from may1, 2018 to september 1, 2025.

Variables	Category	n	%
Headache	Present	43	91.5
	Absent	4	8.5
Ataxia	Both Truncal & Appendicular	22	46.8
	Truncal only	17	36.2
	Appendicular only	8	17
Visual Symptoms	Present	34	72.3
	Absent	13	27.7
Cranial Nerve (CN) Palsy	Present	19	40.4
	Absent	28	59.6
Neurological Signs	Body Weakness	6	12.8
	Seizure	4	8.5
	Nystagmus	3	6.4

Table 3**:** Clinical Presentation of Medulloblastoma Patients Operated at TASH, and MCM, Addis Ababa, Ethiopia, from may1, 2018 to september 1, 2025.

5.3. The Radiologic features

A total of 47 medulloblastoma patients operated at TASH and MCM had radiologic data reviewed. The mode of diagnosis was MRI alone in 25 (53.2%) patients and combined CT and MRI in 22 (46.8%). On CT, tumors were hyperdense in 21 (99%) and isodense in 1 (1%), with contrast enhancement present in 21 (91.3%) of those scanned. Calcification was noted in 9 (34.6%) patients, and cystic components in 7 (28.0%). On MRI, T1 signal was hypointense in 41 (87.2%) and isointense in 6 (12.8%), while T2 signal was hyperintense in 44 (93.6%). All tumors (47, 100.0%) showed contrast enhancement on post-contrast T1 sequences. Most tumors measured 3–5 cm, 38 (80.9%), with 6 (12.8%) exceeding 5 cm. Brainstem infiltration was present in 11 (23.4%), and brainstem compression in 37 (78.7%). Hydrocephalus was noted in 46 (97.9%) patients. Gross nodular seeding was observed in 4 (8.5%). Tumor location was predominantly vermian, 45 (95.7%). Whole spine MRI was performed in 27 (57.4%) patients, with spinal metastases identified in 11 (23.4%) of those. Extra-neural metastasis was not documented, while staging according to Modified Chang's classification showed T2 in 36 (76.6%) as the most common stage.

Imaging Modality	Frequency	Percentage
CT		
Isodense	1	4.5%
Hypodense	0	0%
Hyperdense	21	95.5%
Calcifications	9	40.9%
MRI		
T1 isointense	6	12.8%
T1 hypointense	41	87.2%
T1 post contrast	47	100%
T2 hypointense	3	6.4
T2 hyperintense	44	93.6%

Table 4: The Radiologic features of Medulloblastoma Patients Operated at TASH and MCM Addis Ababa, Ethiopia, from may1, 2018 to september 1, 2025.

5.4. Patterns of surgical intervention

The mean duration of preoperative hospital stay was 15.27 days, with a median of 14.5 days, indicating a slightly right-skewed distribution. The duration varied widely, with a range of 76 days. Minimum 1 and maximum 77 days.

The average duration of surgery was 263.6 minutes (approximately 4.4 hours), with a median of 240 minutes (4 hours). After the procedure, patients spent an average of 6.85 days in the Surgical Intensive Care Unit, with a median stay of 5 days and a range of 2 to 22 days. The subsequent postoperative stay in the general wards averaged 15.4 days, with a median of 8 days and a range of 67 days. minimum 7 and maximum 60 days, reflecting a right-skewed distribution due to a few patients with prolonged hospitalizations

5.5. Postoperative Complications and Related Factors

Among 47 patients, Gross total resection was achieved in 33 patients (70.2%). Near total resection was performed in 8 patients (17.0%), subtotal resection in 5 patients (10.6%), and partial resection in 1 patient (2.1%). The average duration of surgery was 263.6 minutes (approximately 4.4 hours), with a median of 240 minutes (4 hours). After the procedure, all patients were admitted to SICU and patients spent an average of 6.85 days in the Surgical Intensive Care Unit, with a median stay of 5 days and a range of 2 to 32 days.

EVD was used in 6 (12.8%). Immediate postoperative complications occurred in 8 (17.0%), mainly ventriculitis (4, 8.5%), CSF leak (2, 4.3%), and hospital-acquired infections (2, 4.3%). Postoperative scans confirmed resection status: GTR 33 (70.2%), NTR 8 (16.6%), STR 5 (10.6%). Histopathology showed classic medulloblastoma in 30 (63.8%), desmoplastic in 13 (27.7%), and extensive nodularity in 4 (8.5%). At discharge, KPS scores were 60 in 3 (37.5%) and 70 in 5 (62.5%), with most patients classified as standard-risk (34, 72.3%). Oncology interventions were provided in 21 (44.7%) patients, with radiotherapy (17, 94.4%) and chemotherapy (19, 90.5%) as the most common. Post-treatment complications occurred in 13 (61.9%) patients, predominantly neutropenic fever or mucositis

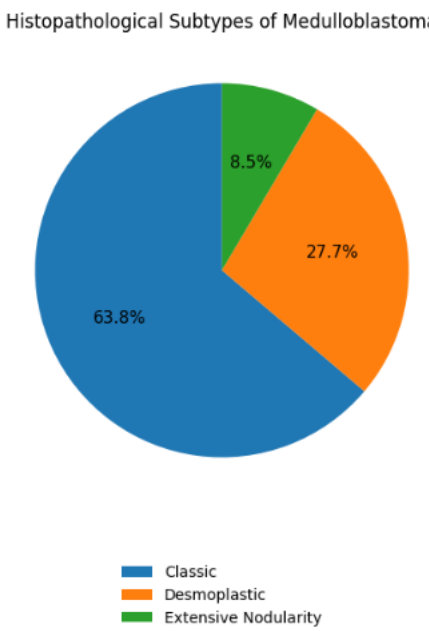

Figure 2. Histopathological subtypes among 47 operated medulloblastoma patients at TASH and MCM, Addis Ababa, Ethiopia, from may1, 2018 to september 1, 2025.

Types complications	**Frequency**	**Percentage**
Ventriculitis	9	18.8%
CSF Leak	7	14.6%
HAI	10	20.8%
Pseudo meningoceles	2	4.2%
Meningitis	2	4.2%
Cerebellar mutism	6	12.5%
Lower cranial nerve palsy	3	6.3%
Brainstem dysfunction	3	6.3%

Table 5: Postoperative complications of Medulloblastoma Patients Operated at TASH, Addis Ababa, Ethiopia, from may1, 2018 to september 1, 2025.

5.7. The relationship between the extent of resection and OS and PFS

The association between extent of resection and survival outcomes was primarily assessed using Cox proportional hazards regression. On univariate Cox analysis, less complete intraoperative resection was significantly associated with worse overall survival, with a threefold increased hazard of death compared with more complete resections (HR = 3.0, 95% CI: 1.2–7.5, $p < 0.05$). In contrast, extent of resection was not significantly associated with progression-free survival (PFS) on Cox analysis ($p > 0.05$)

Extent of resection	Number of patients (n)	Percentage (%)
Gross total resection	33	70.2
Near total resection	8	17.0
Subtotal resection	5	10.6
Partial resection	1	2.1
Total	47	100

Table 6: Extent of resection of Medulloblastoma Patients Operated at TASH and MCM Addis Ababa, Ethiopia, from may1, 2018 to september 1, 2025.

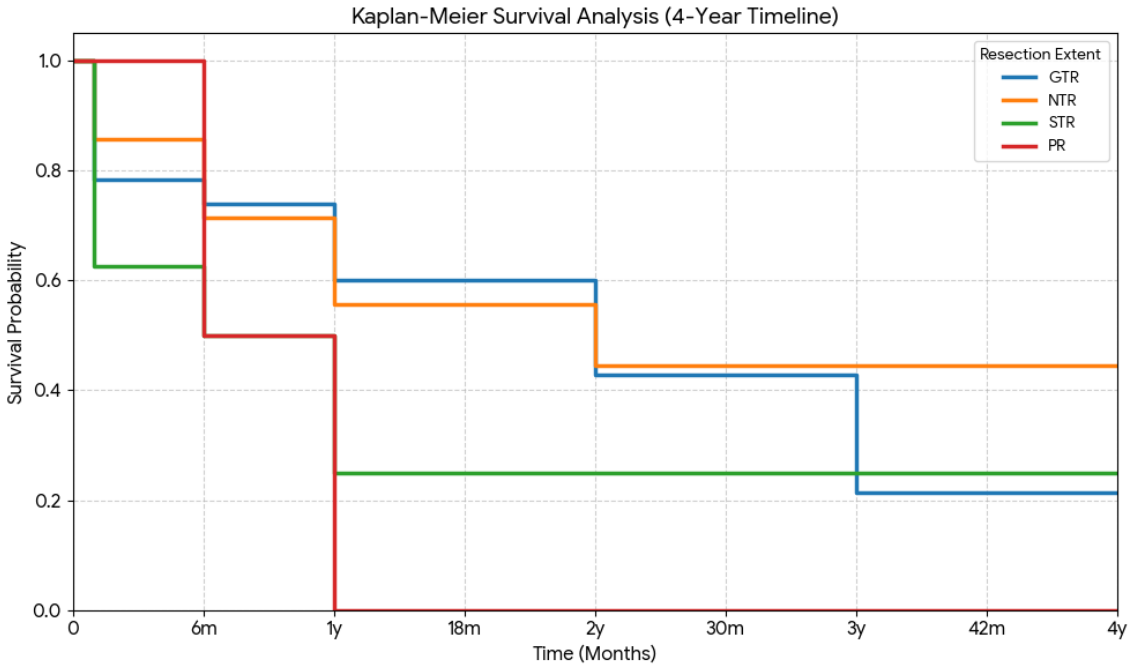

Figure 3. Kaplan–Meier Survival analysis for 47 operated medulloblastoma patients at TASH and MCM, Addis Ababa, Ethiopia, from may1, 2018 to September 1, 2025.

5.8. The relationship between Histopathology and outcome

Histopathological evaluation revealed classic medulloblastoma in 30 patients (63.8%), desmoplastic medulloblastoma in 13 (27.7%), and extensively nodular medulloblastoma in 4 (8.5%), with classic histology being the predominant subtype. Survival outcomes did not differ significantly among histopathological subtypes at 6 months (χ^2 test, $p = 0.755$), 1 year (χ^2 test, $p = 0.723$), or 2 years (χ^2 test, $p = 0.301$). Although a higher absolute number of survivors was observed in the classic subgroup during early follow-up, this reflects the larger size of this group rather than a true survival advantage. Survival proportions were comparable across histological categories, with overlapping 95% confidence intervals, indicating no statistically meaningful differences. Time-to-event analysis using Kaplan–Meier curves with log-rank testing also demonstrated no significant differences in survival between histopathological subtypes. Overall, histopathological subtype was not an independent predictor of short- or intermediate-term survival in this cohort; however, interpretation is limited by small subgroup sizes and incomplete long-term follow-up

5.9. The relationship between oncologic intervention and survival

Chemoradiotherapy was initiated in the majority of patients following surgical management, typically after an initial postoperative recovery period. The interval between surgery and initiation of adjuvant chemoradiotherapy varied, with most patients commencing treatment within several weeks postoperatively, reflecting differences in clinical status, wound healing, and logistical factors. Among patients with available data, the mean duration between surgery and initiation of chemoradiotherapy was 52.5 days. A small proportion of patients did not receive chemoradiotherapy, most commonly due to early mortality, poor performance status, or loss to follow-up. In this study of 47 patients with medulloblastoma, 18 (38.3%) were initiated on a combined regimen of chemotherapy and radiotherapy, while the remaining 29 (61.7%) received single-agent chemotherapy or no oncological intervention. Survival analysis demonstrated a profound clinical benefit associated with the initiation of multimodal therapy; the 12-month survival rate was 100% (95% CI: 100%–100%) in the combined therapy group compared to only 16.1% (95% CI: 1.9%–30.3%) in the cohort that did not receive the combined regimen. This survival advantage was sustained at 24 months, with survival rates of 90.0% (95% CI: 71.4%–100%) and 8.0% (95% CI: 0.0%–18.7%), respectively. Log-rank testing confirmed that the difference in survival between these groups was highly significant ($p < 0.001$)

Time Point	Alive (n)	Dead (n)	Survival (%)
1 month	37	10	78. 7%
6 months	31	6	66. 0%
1 year	22	8	46. 8%
2 years	11	3	23. 4%
3 years	2	1	4.3%
4 years	0	All	0%

Table 7: Overall survival of Medulloblastoma Patients Operated at TASH and MCM Addis Ababa, Ethiopia, from may1, 2018 to September 1, 2025.

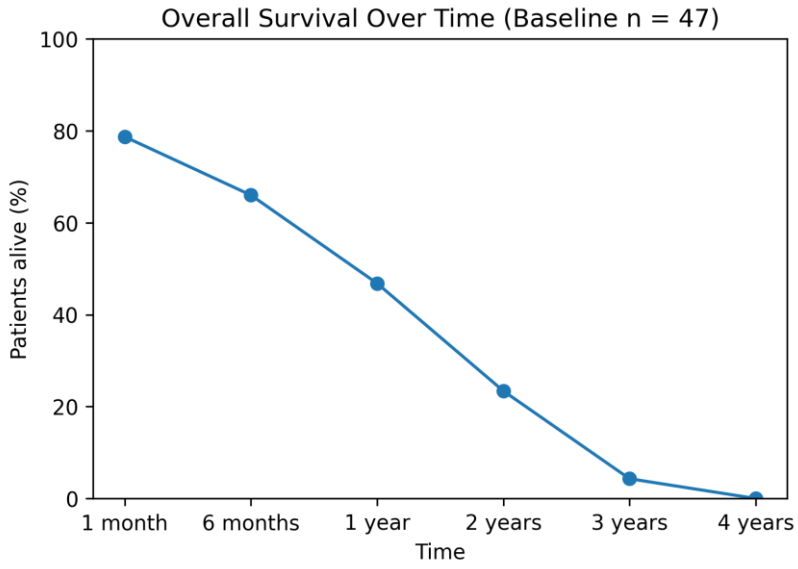

Figure 4: Overall survival of Medulloblastoma Patients Operated at TASH and MCM Addis Ababa, Ethiopia, from may1, 2018 to September 1, 2025.

6.0. Surgical treatment outcome of Medulloblastoma

The trend of surgical treatment outcomes among medulloblastoma patients operated at TASH shows a progressive decline in survival over time. In the early postoperative period, outcomes were relatively favorable, with 37 patients alive (78.7%), 95% CI (65.5–88.5) and 10 deaths (21.3%), 95% CI (11.5–34.5) at 1 month, and 36 patients alive (76.6%), 95% CI (63.2–86.9) with 11 deaths (23.4%), 95% CI (13.1–36.8) at 6 months. By 1-year post-surgery, survival declined further, with 22 patients alive (46.8%), 95% CI (33.1–60.9) and 25 deaths (53.2%), 95% CI (39.1–66.9). Mortality increased substantially at 2 years, with 36 deaths (76.6%), 95% CI (63.2–86.9) and only 11 survivors (23.4%), 95% CI (13.1–36.8), and outcomes were poorest at 3 years, when 45 patients had died (95.7%), 95% CI (87.0–99.1) and only 2 remained alive (4.3%), 95% CI (0.9–13.0) (Figure 8). In a subgroup analysis of institutional outcomes among patients with medulloblastoma, overall survival was evaluated for those treated at Tikur Anbessa Specialized Hospital (TASH; $n = 39$) and Myungsung Christian Medical Center (MCM; $n = 8$). The 12-month overall survival rate was 48.0% (95% CI: 32.2%–63.8%) in the TASH subgroup, compared with 60.0% (95% CI: 24.4%–95.6%) in the MCM subgroup. At 24 months, overall survival in the TASH subgroup declined to 36.0% (95% CI: 19.3%–52.7%), whereas survival

in the MCM subgroup remained unchanged at 60.0% (95% CI: 24.4%–95.6%). The study population comprised 38 pediatric patients (≤15 years) and 9 adult patients (>15 years). Subgroup survival analysis demonstrated comparable overall survival between the two age groups. The 12-month overall survival rate was 49.4% (95% CI: 33.4%–65.5%) in pediatric patients and 50.8% (95% CI: 16.2%–85.4%) in adults. At 24 months, overall survival in the pediatric cohort declined to 34.6% (95% CI: 16.6%–52.6%), whereas survival in the adult cohort remained unchanged at 50.8% (95% CI: 16.2%–85.4%). No statistically significant difference in overall survival was observed between the two groups (p = 0.478), indicating that age at diagnosis, dichotomized at 15 years, was not a significant predictor of mortality in this cohort.

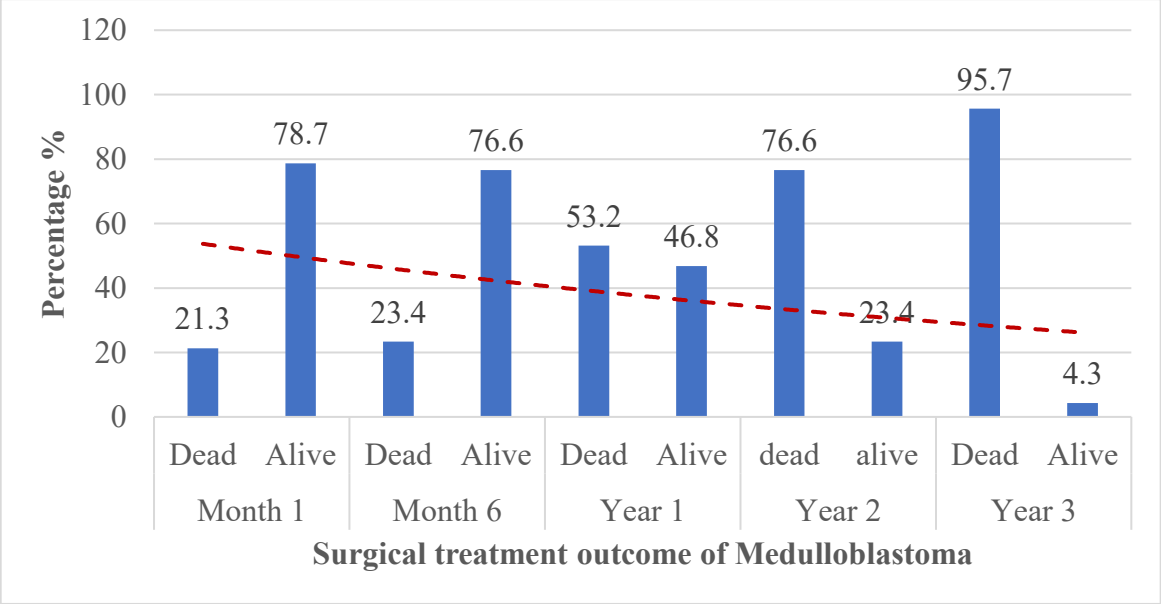

Figure 5: Surgical treatment outcome among Medulloblastoma Patients Operated at TASH, Addis Ababa, Ethiopia, 2025.

6.1. Factors associated with poor functional outcomes

In the bivariate logistic regression analysis, factors that showed an association with poor functional outcomes and were considered as candidates for multivariable analysis included: Sex, Tumor Size, Brainstem compression, Immediate postoperative complication, and Preoperative CSF diversion, with P-value < 0.25. Variables that remained statistically significant in the

multivariable logistic regression analysis were: brainstem compression and immediate postoperative complications, with AORs and 95% CIs as reported and P-value < 0.05.

In multivariable analysis, medulloblastoma patients who had brainstem compression were about 52.5 times more likely to experience poor functional outcomes compared with those without brainstem compression (AOR = 52.544; 95% CI: 1.754–1574.066). Similarly, patients who had immediate postoperative complications were approximately 93.9 times more likely to have poor functional outcomes than those without complications (AOR = 93.887; 95% CI: 1.985–4440.072) as compared to their counter parts (Table 9).

Variable	Functional outcomes		COR (95% CI)	AOR (95% CI)	P-value
	Poor n (%)	Good n (%)			
Sex					
Female	11 (64.7)	6 (35.3)	1	1	
Male	25 (83.3)	5 (16.7)	2.727 (0.684, 10.868)	48.812(0.840, 2836.550)	0.061
Residence					
AA	16 (64.0)	9 (36.0)	1	1	
Not AA	20 (90.9)	2 (9.1)	5.625 (1.062, 29.799)	8.568 (0.427, 172.020)	0.160
Had a cyst					
No	10 (62.5)	6 (37.5)	1	1	
Yes	26 (83.9)	5 (16.1)	3.120 (0.775, 12.564)	7.028 (0.370, 133.321)	0.194
Tumor Size					
≤ 5 cm	11 (64.7)	6 (35.3)	1	1	
> 5 cm	25 (83.3)	5 (16.7)	2.727 (0.684, 10.868)	3.965 (0.302, 52.112)	0.295
Brainstem compression					
No	6 (50.0)	6 (50.0)	1	1	
Yes	30 (85.7)	5 (14.3)	6.000 (1.372, 26.237)	52.544(1.754, 1574.066)	0.022*
Had Immediate postoperative complication					

No	8 (57.1)	6 (42.9)	1	1	
Yes	28 (84.8)	5 (15.2)	4.20(1.012, 17.434)	93.887(1.985, 4440.072)	0.021*
Preoperative CSF diversion					
No	5 (50.0)	5 (50.0)	1	1	
Yes	31 (83.8)	6 (16.2)	5.167 (1.134, 23.548)	6.988 (0.200, 243.553)	0.283

*NB; * P-value < 0.05 was statistically significant on multivariable, 1= Reference*

Table 8: The factors associated with poor functional outcomes of Medulloblastoma Patients Operated at TASH Addis Ababa, Ethiopia, 2025

Variables	First month		6th month		first year		second year		third year	
	frequency	**%**	**frequency**	**%**	**Frequency**	**%**	**frequency**	**%**	**frequency**	**%**
Alive	39	78.7	32	76.6	22	46.8	11	23.4	1	4.3
Dead	8	17	5	10.6	8	17	38	80.9	46	97.9
Complications	4	8.5	5	10.6	4	8.5	2	4.3	1	2.1
Residual/recurrence	4	8.5	5	10.6	8	17	1	2.1	1	2.1
Radiotherapy	0	0	10	21.3	8	17	0	0	0	0
Performance KPS									0	0
Moderate disability	4	8.5	7	14.9	7	14.9	7	14.9	1	2.1
Severe disability	3	6.4	0	0	0	0	0	0	0	0
Performance PCPC									0	0
Moderate disability	32	68.1	27	57.4	14	29.8	5	10.6	0	0
Severe disability	0		0	0	0	0	0	0	0	0

Table 9. Follow-up status of study participants, (n=13) operated at TASH and MCM Hospitals, from January 1, 2010 to April 30, 2018 and enrolled to follow-up clinics

CHAPTER VI

Discussion

The study shows that the survival declined markedly, being alive, 78.7%, 95% CI (65.5–88.5) at 1 month, decreasing to 76.6%, 95% CI (63.2–86.9) at 6 months, then 46.8%, 95% CI (33.1–60.9) at 1 year, further to 23.4%, 95% CI (13.1–36.8) at 2 years, and only 4.3%, 95% CI (0.9–13.0) remaining alive at 3 years following surgery; conversely, mortality increased progressively, being dead, 21.3%, 95% CI (11.5–34.5) at 1 month, rising slightly to 23.4%, 95% CI (13.1–36.8) at 6 months, then 53.2%, 95% CI (39.1–66.9) at 1 year, further to 76.6%, 95% CI (63.2–86.9) at 2 years, and reaching 95.7%, 95% CI (87.0–99.1) by 3 years following surgery.

The current study demonstrates a steep decline in survival following surgery, with only 4.3% of patients surviving at three years. This pattern is consistent with findings from several African studies, where overall survival after major oncologic or neurosurgical interventions remains relatively low due to delayed presentation, limited access to advanced surgical techniques, and inadequate post-operative care. For example, a study in Nigeria reported a 3-year survival rate of 5–10% for high-grade brain tumor patients, highlighting the challenges faced in resource-limited settings. [33, 34] The progressive increase in mortality over time observed in our study reflects the aggressive nature of the underlying disease combined with systemic healthcare limitations.

Medulloblastoma remains the most common malignant pediatric brain tumor, and its management requires a delicate balance between aggressive oncological control and preservation of neurological function. This study provides a detailed analysis of surgical outcomes, recurrence patterns, postoperative morbidity, and early survival among pediatric medulloblastoma patients treated in a resource-limited setting. By incorporating direct numerical comparisons with published regional and international studies, our findings help contextualize local outcomes within the broader global literature.

In the present cohort, the overall recurrence rate was 19.1%, which was significantly higher among patients with incomplete resection compared with those who achieved gross total

resection (p = 0.03), and aligns closely with rates reported in African and other low- and middle-income country (LMIC) series, where recurrence typically ranges from 15% to 25%.[1–3] Yemisirach et al. reported a recurrence rate of approximately 17% in an Ethiopian pediatric medulloblastoma cohort, emphasizing the role of delayed adjuvant therapy and treatment interruptions as major contributors to disease relapse [1]. Similar recurrence rates have been documented in institutional series from Asia and Latin America, particularly in settings with limited access to radiotherapy facilities and prolonged waiting times. [2,3]

By contrast, large cooperative group trials from high-income countries consistently report lower recurrence rates, generally in the range of 10–15%, reflecting timely initiation of craniospinal irradiation, standardized chemotherapy protocols, and structured follow-up programs. [4,5] The higher recurrence observed in LMIC settings, including our cohort, underscores the importance of health system factors—rather than surgical factors alone—in achieving durable disease control.

The histopathological distribution in our study was dominated by the classic subtype (≈64%), followed by desmoplastic tumors (≈28%), a pattern consistent with multiple African and Asian series where classic histology accounts for 55–70% of cases. [1,6,7] Although early survival appeared numerically higher among patients with classic histology, no statistically significant long-term survival advantage was observed (p = 0.41). Similar findings have been reported in several retrospective studies, which demonstrated that histopathology alone does not reliably predict long-term outcome. [8,9]

Contemporary literature has increasingly emphasized the limitations of histology-based risk stratification. Molecular subgroup–based analyses have demonstrated marked survival differences, with reported 5-year overall survival rates exceeding 90% for WNT tumors, approximately 70–80% for SHH and Group 4 tumors, and as low as 40–50% for Group 3 disease. [10,11] The absence of routine molecular subgrouping in our cohort likely obscures underlying biological heterogeneity and may explain the lack of observed survival differences between histological subtypes.

Extent of surgical resection remains a cornerstone of medulloblastoma management. In our cohort, gross total or near-total resection was achieved in approximately 70% of patients, which compares favorably with large contemporary surgical series reporting rates between 65% and 85%. [5,7,12] Patients undergoing gross total resection demonstrated significantly improved early survival compared with those with subtotal resection (p = 0.02), consistent with studies showing superior progression-free and overall survival following maximal safe resection. [5,12]

However, aggressive resection of fourth ventricular tumors carries a substantial risk of neurological morbidity due to the close relationship between the tumor and critical brainstem nuclei. Large posterior fossa tumor series report postoperative cranial nerve deficits in 20–40% of patients and cerebellar mutism syndrome in 8–24%, particularly when aggressive resection

is pursued. [13,14] These data highlight the need for a balanced surgical approach, prioritizing neurological preservation when complete resection risks unacceptable morbidity.

Postoperative neurological morbidity in our cohort—including cranial nerve palsies, ocular disturbances, and gait abnormalities—was comparable to the ranges reported in the literature, and immediate postoperative complications were significantly associated with poorer functional outcomes at follow-up ($p < 0.001$). Cranial nerve deficits, in particular, have been shown to persist in up to 30% of patients at long-term follow-up, making them among the least reversible complications after posterior fossa tumor surgery [13]. Cerebellar mutism syndrome, while not universally present, has been associated with prolonged hospitalization, delayed initiation of adjuvant therapy, and poorer neurocognitive outcomes. [14]

These findings emphasize the importance of perioperative neurocritical care, meticulous microsurgical technique, and early multidisciplinary rehabilitation. In LMIC settings, limited access to pediatric intensive care units, speech therapy, and rehabilitation services may further exacerbate the long-term impact of postoperative complications. [15]

Adjuvant therapy played a decisive role in determining survival outcomes in our cohort. Patients who completed both radiotherapy and chemotherapy demonstrated significantly superior survival compared with those who did not ($p < 0.001$), consistent with established evidence showing that multimodal therapy improves 5-year overall survival to 65–75% in standard-risk medulloblastoma patients [4,5,16]. In contrast, reported 5-year survival rates in LMIC settings often remain between 30% and 50%, reflecting systemic barriers to timely and complete adjuvant treatment. [1–3]

Delayed initiation of radiotherapy, prolonged treatment interruptions, and chemotherapy-related toxicity were common challenges in our setting and have been repeatedly identified as predictors of poor outcome in similar cohorts. [2,3] These findings reinforce the need for coordinated multidisciplinary care pathways and improved access to oncologic services.

The absence of routine molecular subgrouping represents a major limitation of this study. International consensus recognizes four principal molecular subgroups—WNT, SHH, Group 3, and Group 4—which together account for nearly 100% of medulloblastoma cases and demonstrate distinct biological behavior and survival profiles [10,11]. More recent large cohort studies have further refined these groups into biologically and clinically relevant subgroups, improving prognostic accuracy and risk stratification. [17]

In resource-constrained environments where genomic testing is unavailable, MRI-based surrogates have emerged as a potential alternative. Tumor location and enhancement patterns have been shown to predict molecular subgroup with an accuracy of approximately 65–70%, offering a pragmatic approach to risk stratification in LMIC settings [18]. Incorporation of such imaging-based predictors may help guide treatment decisions until molecular diagnostics become more widely accessible.

This study is limited by its retrospective design, modest sample size, and incomplete long-term follow-up, which may underestimate late recurrence and long-term treatment-related morbidity. Additionally, the lack of molecular data limits direct comparison with contemporary risk-adapted treatment protocols. Despite these limitations, the study provides valuable real-world data on medulloblastoma management in a low-resource setting.

Future efforts should focus on strengthening early diagnosis, reducing delays to adjuvant therapy, expanding radiotherapy capacity, and gradually integrating molecular or radiological surrogates for risk stratification. Multicenter collaboration within the region may further enhance data quality and improve outcome benchmarking.

In conclusion, pediatric medulloblastoma outcomes in our cohort remain inferior to those reported in high-income countries but are comparable to other LMIC series. Our recurrence rate of 19.1%, gross total resection rate of ≈70%, and strong dependence of survival on access to adjuvant therapy mirror regional experience. Addressing systemic barriers to comprehensive care—alongside continued emphasis on maximal safe resection—will be essential to improving survival and functional outcomes for children with medulloblastoma in similar resource-limited settings. [1–3,10]

LIMITATION OF THE STUDY

This study is limited by its retrospective observational design, which restricts causal inference and relies on the completeness and accuracy of existing medical records. Incomplete documentation and a relatively small sample size reduced statistical power, necessitated non-parametric analyses, and precluded meaningful multivariable modeling. Consequently, some established prognostic factors described in the literature may not have demonstrated a measurable effect in this cohort. Variable follow-up and loss to follow-up may also have led to underestimation of late recurrence and long-term outcomes, limiting generalizability beyond similar resource-limited settings.

Despite these limitations, the study provides important baseline data on medulloblastoma outcomes in a low-resource context. Future efforts should focus on prospective studies with standardized data collection, improved medical record systems, and sufficient sample sizes to allow robust multivariable analysis. Strengthening multidisciplinary care pathways and fostering collaborative partnerships, including twinning programs, may further improve treatment delivery and outcomes.

CONCLUSIONS

In this single-center cohort from a resource-limited setting, pediatric medulloblastoma outcomes remain suboptimal when compared with high-income countries but are consistent with reports from similar LMIC contexts. Despite an acceptable rate of gross or near-total resection, overall outcomes were driven predominantly by access to timely and complete adjuvant therapy and by the burden of postoperative neurological complications. A recurrence rate of 19.1% underscores the impact of incomplete resection and systemic delays in oncologic treatment. Extent of resection and receipt of combined chemoradiotherapy were significantly associated with improved survival, whereas histopathological subtype alone did not predict long-term outcome. These findings emphasize that maximal safe resection must be coupled with reliable multidisciplinary care pathways to achieve meaningful gains in survival. Strengthening early diagnosis, ensuring uninterrupted access to radiotherapy and chemotherapy, enhancing perioperative neurocritical care and rehabilitation, and progressively integrating molecular or validated imaging surrogates for risk stratification are essential steps to improve outcomes for children with medulloblastoma in similar low-resource settings.

RECOMMENDATIONS

Based on the results and findings of the following recommendations provided:

At the health system and policy level, priority should be given to strengthening pediatric oncology and neurosurgical services through improved access to radiotherapy, timely chemotherapy, and streamlined referral pathways. Policymakers should support context-appropriate national or institutional guidelines for medulloblastoma care.

At the institutional and clinical level, effective management requires a coordinated multidisciplinary approach involving all relevant specialties. Regular multidisciplinary tumor board meetings should guide treatment decisions and follow-up.

Enhancement of preoperative and postoperative care is essential to reduce morbidity. Emphasis should be placed on early diagnosis, standardized perioperative protocols, robust postoperative neurocritical care, and early rehabilitation.

From a community and public health perspective, awareness of early symptoms of posterior fossa tumors should be increased among primary healthcare providers and the public. Targeted education and frontline health worker training may reduce diagnostic delays.

Strengthening health information systems and research capacity is also recommended. Improved documentation, prospective data collection, and participation in collaborative or twinning programs may enhance care quality and outcomes.

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ANNEXES

Annex 1: Questionnaire/ Checklists

Questionnaire To Study the Surgical Outcome of MDB

Hospital: TASH

1. Socio-demographic data

1.1. Age: 1.4. Height: 1.5. Chart No:

1.2. Sex: 1.6. Address: 1.7. Phone No:

1.3. Weight:

2. Clinical Presentation

2.1. Headache: Yes□ No□ 2.2. Nausea &Vomiting: Yes□ No□

2.3. Cerebellar ataxia: Yes□ No□ If yes: Appendicular□ Truncal □

2.4. Visual symptoms: Yes□ No□If yes; specify:

2.5. Nystagmus: Yes□ No□ 2.6. Body weakness: Yes□ No□

2.7. Seizure: Yes□ No□ 2.8. Level of consciousness: Conscious□ Impaired□

2.9. Cranial nerve palsy: Yes□ No □If yes, specify involved cranial nerve:

2.10. Specify predominant symptom:

2.11. For infants; HC: 2.12. Developmental milestones: Achieved□ Delayed□ Regressed□ 2.13. Level of consciousness: Conscious□ Impaired□ 2.14. Nausea & Vomiting: Yes□ No□ 2.15. Seizure: Yes□ No□ 2.16. Upward gaze palsy: Yes□ No□

2.17. Nystagmus: Yes□ No□ 2.18. Body weakness: Yes□ No□

2.19. Cranial nerve palsy: Yes□ No□ If yes, specify involved cranial nerve:

2.20. Predominant sign:

2.21. Preoperative KPS: 2.22. Preoperative PCPCS:

3. Duration of symptoms: <3 months□ 3months-6months□ 7months-1year□>1year□

4. Radiologic features

4.1. Mode of diagnosis: Brain CT□ Brain MRI□

4.2. CT density: Hyperdense□ Isodense □ Hypodense□

4.3. Brain CT contrast enhancement: Yes□ No□ Calcification: Yes□ No□ Cyst: Yes□ No□

4.4. Brain MRI features: T1WI: Hypointense□ Isointense□ Hyperintense□

Contrast enhancement: Yes□ No□

T2WI: Hyperintense□ Hypointense □ Isointense □

4.5. Tumor size (ϕ): <3 cm□ 3-5 cm□>5 cm □

4.6. Brainstem infiltration: Yes□ No□ Brainstem compression: Yes□ No □

4.7. HCP: Yes□ No□

4.8. Tumor location: Vermis □ Hemisphere □

4.9. Gross nodular seeding: Yes□ No□

4.10. Whole spine MRI: Done□ Not done□

If done; Spinal seeding: Present□ Absent□ Unknown□

4.11. Extra neural metastasis: Yes□ No□ Unknown□

4.12. Modified Chang's staging: "T"- 1□ 2□ 3A□ 3B□ 4□ "M"- 0□ 1□ 2□ 3□ 4□

5. Duration of preoperative stay in the wards:

6. Preoperative CSF diversion: Yes□ No□ If yes; specify type: EVD□ ETV□ VPS□

Date of diversion:

7. Date of tumor excision:

8. Intraoperative extent of resection: GTR□ NTR□ STR□ Partial□ Biopsy□

9. Duration of Procedure:

10. Postoperative disposition: Ward□ SICU□

11. Postoperative open EVD: Yes□ No□

12. Duration of stay in SICU:

13. Immediate postoperative complication: Yes□ No□

14. If there is any complication, specify:

15. Immediate postoperative scan: Yes□ No□

16. Postoperative scan finding: GTR□ NTR□ STR□ HCP□

17. Immediate reoperation: Yes□ No□

17.1. If yes; specify reason:

17.2.Date of reoperation:

18. Histopathologic diagnosis: Classic □ Desmoplastic□ Large cell or anaplastic □ Extensively Nodularity □

19. Postoperative CSF cytology: Done□ Not done□

20. If present, finding: Positive□ Negative□

21. Duration of postoperative stay in the wards:

22. Postoperative status at discharge: 22.1. KPS= 22.2 PCPCS= 22.3. Risk Strata: Standard risk□ High risk□ Unknown□

23. Oncology side interventions:

23.1. Cranial radiotherapy □ Spinal radiotherapy □ Chemotherapy □ None □

23.2. Radiation dose:

23.3. Chemotherapy regimen:

23.4. Radiation site:

23.5. Treatment cycle:

23.6. Interval duration between surgery and radio-chemotherapy:

23.7. Control scan: Yes□ No□

23.8. If present, radiologic finding: Normal □ Recurrence/Residual□ HCP□ Radiation necrosis□

23.9. Post Radiation / Chemotherapy status: 23.9.1. KPS= 23.9.2. PCPCS=

23.10. Any complication: Yes□ No□ If present, specify:

23.11. Any intervention: Yes□ No□ If intervened, specify:

23.12. If no oncology intervention, reason not to intervene:

24. Outcome at 1 month: Alive□ Dead□ Lost-to-follow up□

24.1. Control scan: Yes□ No□

24.2. Finding: Normal□ Recurrence□ Radiation necrosis□

24.3. Any complication: Yes□ No□ If yes, specify:

24.4. Any intervention: Yes□ No□ If yes, specify:

24.5. CSF seeding: Yes□ No□ Result not found□

24.6. Recurrence pattern: Tumor bed□ Remote□

24.7. Chemo- radiotherapy initiated: Yes□ No□ If no, reason:

24.8. Follow up status: 24.8.1. KPS= 24.8.2. PCPCS=

25. Outcome at 6 months: Alive□ Dead□ Lost-to-follow up□

25.1. Control scan: Yes□ No□

25.2. Finding: Normal□ Recurrence□ HCP□

25.3. Any complication: Yes□ No□ If yes, specify:

25.4 Any intervention: Yes□ No□ If yes, specify:

25.5. CSF seeding: Yes□ No□ Result not found□

25.6. Recurrence pattern: Tumor bed□ Remote□

25.7. Chemo- radiotherapy initiated: Yes□ No□ If no, reason:

25.8. Follow up status: 25.8.1. KPS= 25.8.2. PCPCS=

26. Outcome at 1 year: Alive□ Dead□ Lost-to-follow up□

26.1. Control scan: Yes□ No□

26.2. Finding: Normal□ Recurrence□ HCP□

26.3. Any complication: Yes□ No□ If yes, specify:

26.4 Any intervention: Yes□ No□ If yes, specify:

26.5. CSF seeding: Yes□ No□ Result not found□

26.6. Recurrence pattern: Tumor bed□ Remote□

26.7. Chemo- radiotherapy initiated: Yes□ No□ If no, reason:

26.8. Follow up status: 26.8.1. KPS= 26.8.2. PCPCS=

27. Outcome at 2 years: Alive□ Dead□ Lost-to-follow up□

27.1. Control scan: Yes□ No□

27.2. Finding: Normal□ Recurrence□ HCP□

27.3. Any complication: Yes□ No□ If yes, specify:

27.4 Any intervention: Yes□ No□ If yes, specify:

27.5. CSF seeding: Yes□ No□ Result not found□

27.6. Recurrence pattern: Tumor bed□ Remote□

27.7. Chemo- radiotherapy initiated: Yes□ No□ If no, reason:

27.8. Follow up status: 27.8.1. KPS= 27.8.2. PCPCS=

28. Outcome at 3 years: Alive□ Dead□ Lost-to-follow up□

28.1. Control scan: Yes□ No□

28.2. Finding: Normal□ Recurrence□ HCP□

28.3. Any complication: Yes□ No□ If yes, specify:

28.4 Any intervention: Yes□ No□ If yes, specify:

28.5. CSF seeding: Yes□ No□ Result not found□

28.6. Recurrence pattern: Tumor bed□ Remote□

28.7. Chemo- radiotherapy initiated: Yes□ No□ If no, reason:

28.8. Follow up status: 28.8.1. KPS= 28.8.2. PCPCS=

29. Outcome at 4 years: Alive□ Dead□ Lost-to-follow up□

29.1. Control scan: Yes□ No□

29.2. Finding: Normal□ Recurrence□ HCP□

29.3. Any complication: Yes□ No□ If yes, specify:

29.4 Any intervention: Yes□ No□ If yes, specify:

29.5. CSF seeding: Yes□ No□ Result not found□

29.6. Recurrence pattern: Tumor bed□ Remote□

29.7. Chemo- radiotherapy initiated: Yes□ No□ If no, reason:

29.8. Follow up status: 29.8.1. KPS= 29.8.2. PCPCS=

30. Outcome at 5 years: Alive□ Dead□ Lost-to-follow up□

30.1. Control scan: Yes□ No□

30.2. Finding: Normal□ Recurrence□ HCP□

30.3. Any complication: Yes□ No□ If yes, specify:

30.4 Any intervention: Yes□ No□ If yes, specify:

30.5. CSF seeding: Yes□ No□ Result not found□

30.6. Recurrence pattern: Tumor bed□ Remote□

30.7. Chemo- radiotherapy initiated: Yes□ No□ If no, reason:

30.8. Follow up status: 30.8.1. KPS= 30.8.2. PCPCS=

31. Outcome at 6 years: Alive□ Dead□ Lost-to-follow up□

31.1. Control scan: Yes□ No□

31.2. Finding: Normal□ Recurrence□ HCP□

31.3. Any complication: Yes□ No□ If yes, specify:

31.4 Any intervention: Yes□ No□ If yes, specify:

31.5. CSF seeding: Yes□ No□ Result not found□

31.6. Recurrence pattern: Tumor bed□ Remote□

31.7. Chemo- radiotherapy initiated: Yes□ No□ If no, reason:

31.8. Follow up status: 31.8.1. KPS= 31.8.2. PCPCS=

32. Recurrence

32.1. Interval duration between the first surgery and recurrence:

32.2. Site of recurrence: 32.2.1. Tumor bed□ 32.2.2. Remote□

Version

ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCES

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DREC'S Decision

Meeting No. DoS/REC/192/18/25 Meeting Date:

Protocol Number:

Protocol Title	RETROSPECTIVE COHORT STUDY ON SURGICAL OUTCOME OF MEDULLOBLASTOMA AMONG OPERATED PATIENTS IN TIKUR ANBESSA SPECIALIZED HOSPITAL AND MCM HOSPITAL ADDIS ABABA, ETHIOPIA, BETWEEN MAY 1, 2018 AND OCTOBER 30, 2025

Name of PI	Dr. Alemu Gemeda
Phone Number	+251911518315
Department	Neurosurgery
Collaborator	
Type of Study	☐ Masters ☐ Phd students ☐ Staff ☐ External
Final Decision	☐ Approved ☐ To College IREC
Valid Period	
Reporting Period	3 months_____ 6months'_____ 12months_____

Chairperson, DREC

Signature:

Dr. Hailu Wondim
General & GI Su

Department of Surgery
Medical Faculty A.A.
Addis Ababa University

RETROSPECTIVE STUDY ON SURGICAL OUTCOME OF MEDULLOBLASTOMA AMONG OPERATED PATIENTS IN TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA, BETWEEN MAY 1, 2018 AND SEPTEMBER 30, 2025

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