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Surgical Management of Supratentorial Intra- ventricular Lesions: A Prospective Cohort Study at a Tertiary Centre in Upper Egypt (2022–2024)

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ABSTRACT

Background: Surgical management of supratentorial intraventricular lesions remains challenging because of their deep-seated location and proximity to critical neurovascular structures. Endoscopic techniques have expanded the surgical armamentarium, but their role as standalone or adjunctive procedures remains incompletely defined. **Objective:** To assess surgical outcomes and the feasibility of using endoscopy as either a sole or an adjuvant tool. **Methods:** This prospective clinical study included 35 consecutive patients with supratentorial intraventricular lesions treated over two years. Patients underwent either purely endoscopic surgery or endoscopic-assisted microsurgery (EAMS), with clinical and radiological outcomes assessed over 6 months. Predictors of functional outcome were evaluated using multivariable logistic regression. **Results:** Thirty-five patients (21 males, 14 females) with a mean age of 30.9 ± 17.0 years were included. Most lesions were located in the lateral ventricle (22/35, 62.9%), followed by the third ventricle (8/35, 22.9%) and combined lateral-third ventricular lesions (5/35, 14.3%). The commonest pathologies were colloid cysts (8/35, 22.9%), choroid plexus papillomas (7/35, 20.0%), and central neurocytomas (6/35, 17.1%). EAMS was performed in 28 patients (80.0%), while 7 (20.0%) underwent purely endoscopic surgery. Gross total resection was achieved in 20 patients (57.1%), with near-total resection in 9 (25.7%). At 6 months, favourable functional outcome (Glasgow Outcome Scale 4–5) was achieved in 30 patients (85.7%). Increasing age (OR 0.92 per year, 95% CI 0.85–0.99; p=0.033) and postoperative intraventricular haemorrhage (OR 0.03, 95% CI 0.001–0.58; p=0.021) were independent predictors of poorer functional outcome. **Conclusion:** Endoscopic-assisted microsurgery provides effective tumour resection with favourable functional outcomes for most supratentorial intraventricular lesions, while purely endoscopic surgery is best reserved for carefully selected small, cystic, or minimally vascular lesions. Advanced age and postoperative intraventricular haemorrhage independently predict poorer postoperative outcomes.

Keywords: Cyst, Endoscopic, Lesion, Microsurgery, Ventricular, Outcome.

INTRODUCTION

The management of intraventricular lesions remains a formidable challenge in neurosurgery. Their deep-seated location, proximity to critical neurovascular structures, and the delicate

ventricular architecture demand surgical approaches that maximize efficacy while minimizing morbidity. Traditionally, microsurgical techniques offer direct visualization and precise manipulation, but they are often associated with significant brain retraction, increased risk of neurological deficits and prolonged recovery times (1). By contrast, endoscopy enhances access to the ventricular system offering wide-angle visualization of hidden angles, minimizing the size of the transcortical corridor, reducing brain retraction and disruption to surrounding structures and allowing concurrent management of associated pathologies such as hydrocephalus (2). However, purely endoscopic approaches are limited by lesion size and vascularity, which may hinder complete excision (3). Nevertheless, controversy remains regarding the optimal surgical strategy for intraventricular lesions. The relative merits of purely endoscopic, endoscopic-assisted, and conventional microsurgical approaches continue to be debated, particularly in terms of resection efficacy, functional outcomes, and complication rates (4).

In the present study, we examine supratentorial intraventricular lesions managed through purely endoscopic or endoscopic-assisted microsurgical approaches. Our aim is to explore the factors that influence surgical outcomes and to evaluate the role of endoscopy in complementing microsurgical techniques. We hypothesize that endoscopic-assisted approaches can provide a balance between safe resection and reduced morbidity, while purely endoscopic strategies may be most suitable for select lesions.

METHODOLOGY

Study design and setting:

This prospective observational cohort study was conducted at Assiut University Hospital, Egypt, between 2022 and 2024.

Participants

Consecutive patients diagnosed with supratentorial intraventricular lesions during the study period were screened for eligibility.

Inclusion Criteria: Patients with lesions involving the lateral or third ventricles who underwent either purely endoscopic surgery or endoscopic-assisted microsurgery (EAMS) were included.

Exclusion Criteria: Patients with fourth ventricular lesions, previous cranial surgery or radiotherapy, metastatic lesions, inadequate preoperative imaging, or incomplete clinical follow-up were excluded. Participant selection is summarized in Figure 1.

Study Procedures:

All patients underwent standardized preoperative evaluation, including magnetic resonance imaging (MRI), followed by surgery under general anaesthesia. Procedures were performed using a Karl Storz LOTTA neuroendoscope (Karl Storz, Tuttlingen, Germany) and a Zeiss TIVATO 700 operating microscope (Carl Zeiss Meditec, Germany). Perioperative management followed institutional protocols.

External ventricular drainage (EVD) was inserted selectively in patients with preoperative hydrocephalus, anticipated intraoperative ventricular bleeding, or when postoperative CSF diversion was deemed likely. Antiepileptic prophylaxis was administered perioperatively for lesions requiring cortical entry or in patients with a prior seizure history. Intraoperative and early postoperative blood pressure was maintained within normotensive ranges to minimize the risk of intraventricular haemorrhage. Endoscopic third ventriculostomy (ETV) was performed in cases with dilated ventricles. Postoperative IVH was managed either conservatively with close observation or with ventricular drainage according to severity. Routine postoperative CSF diversion was not performed; ventriculoperitoneal shunting was reserved for patients with persistent or progressive hydrocephalus.

The choice of surgical technique was based on lesion size, location, ventricular anatomy, imaging characteristics, and surgeon judgement. Purely endoscopic surgery was preferred for small (<30 cm^3), cystic, or minimally vascular lesions, whereas EAMS was selected for larger (≥70–80 cm^3) lesions or those with greater vascularity, firm consistency, or complex anatomical extension requiring improved exposure and haemostasis.

Outcomes:

The primary outcome was early postoperative neurological status, assessed using the Glasgow Coma Scale (GCS) and categorized as good (13–15), moderate (9–12), or poor (3–8). The secondary outcome was functional recovery at 6 months, measured using the Glasgow Outcome

Scale (GOS), with a favourable outcome defined as GOS 4–5 and poor outcome as GOS 1–3.

Extent of resection was classified as gross total resection (GTR), near-total resection (NTR; residual tumour <1 cm^3), subtotal resection (STR; residual tumour >1 cm^3), or partial resection (>50% residual tumour). Residual tumour volume was determined by manual segmentation of postoperative T1-weighted MRI performed within two weeks of surgery. Postoperative complications, operative duration, length of hospital stay, and histopathological diagnosis were also recorded. All patients were followed for six months.

Statistical analysis:

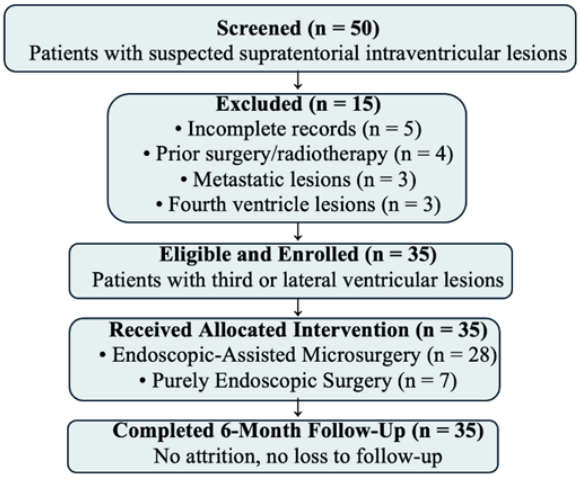
Statistical analyses were performed using SPSS version 23. Continuous variables are presented as mean ± standard deviation or median (interquartile range), as appropriate, while categorical variables are summarized as frequencies and percentages. All eligible patients treated during the study period were included. Missing data were handled using complete-case analysis.

Univariable analyses were performed to evaluate associations between clinical variables and outcomes. Variables with $p<0.10$ or considered clinically relevant were entered into multivariable logistic regression models to identify independent predictors of functional outcome. Multicollinearity was assessed using variance inflation factors, and model calibration was evaluated using the Hosmer–Lemeshow goodness-of-fit test. Results are reported as odds ratios (ORs) with 95% confidence intervals (CIs). A two-sided $p<0.05$ was considered statistically significant.

Ethics

The study was approved by the Institutional Research Ethics Committee (IRB No. 17200519). Written informed consent was obtained from all adult participants and from parents or legal guardians of minors, with assent obtained where appropriate. The study was prospectively registered on ClinicalTrials.gov (Identifier: NCT04569201). URL: https://clinicaltrials.gov/ct2/show/NCT04569201

Figure 1: Study participant flow diagram



RESULTS

Patient characteristics

Thirty-five patients with supratentorial intraventricular lesions underwent surgical treatment between November 2022 and November 2024 and completed at least 6 months of follow-up. The mean age was 30.9 ± 17.0 years (range, 1–72 years), with a slight male predominance (21/35, 60.0%).

Clinical presentation

Headache was the most common presenting symptom, occurring in 31 patients (88.6%), followed by blurred vision (15/35, 42.9%) and

persistent vomiting (13/35, 37.1%). Papilledema was observed in 3 patients (8.6%). Overall, 34 patients (97.1%) presented with at least one symptom of raised intracranial pressure. Additional presenting features are summarised in Table 1.

Imaging and pathological findings

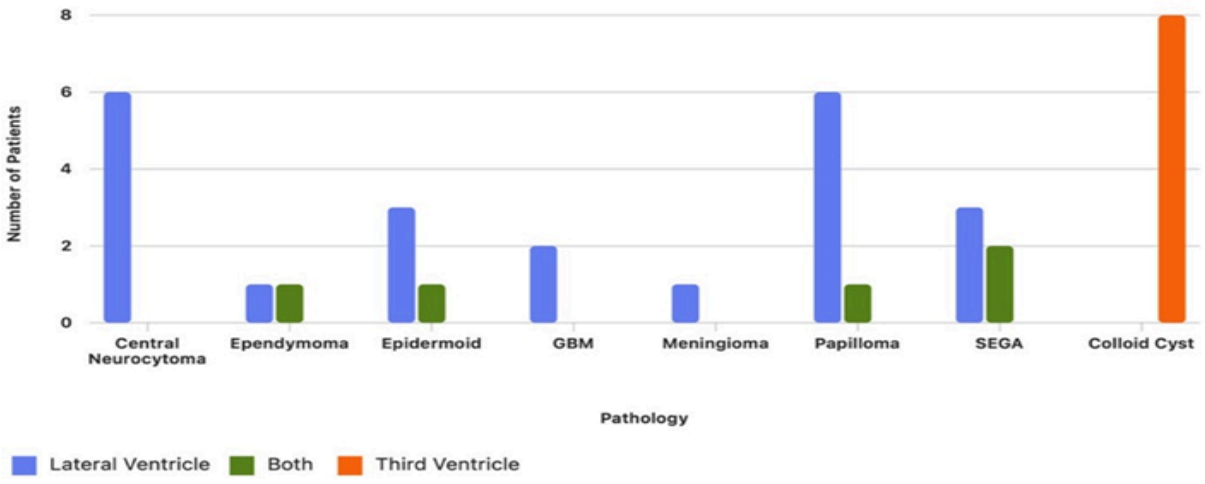
The mean lesion volume was 38.2 cm³ (range, 1.2–130 cm³), with a mean maximum diameter of 4.3 cm. Lesions were located in the lateral ventricle in 22 patients (62.9%), the third ventricle in 8 (22.9%), and both the lateral and third ventricles in 5 (14.3%). Eight histopathological diagnoses were identified, the most common being colloid cysts (8/35, 22.9%), choroid plexus papillomas (7/35, 20.0%), and central neurocytomas (6/35, 17.1%) (Figure 2).

Table 1: Clinical Presentation

Clinical Presentation	N (%)
Headache	31 (88.6%)
Blurring of vision	15 (42.9%)
Persistent vomiting	12 (34.3%)
Disturbed consciousness	5 (14.3%)
Seizures	4 (11.4%)
Papilloedema	3 (8.6%)
Hemiparesis	2 (5.7%)
Dysphasia.	2 (5.7%)
Lost vision in one eye (NPL)	1 (2.9%)
Rhinorrhea	1 (2.9%)
Dystonic movements	1 (2.9%)
Fainting attacks	1 (2.9%)

*Total number of patients = 35, Some patients had more than one presentation.

Figure 2: Distribution of pathologies within the ventricles



Bar chart showing distribution of pathologies within the ventricles, blue columns represent the lateral ventricle, orange represents the third ventricle and green both lateral and third ventricles. The most common location was the lateral ventricle. Colloid cysts were exclusive to the third ventricle.

Surgical Management

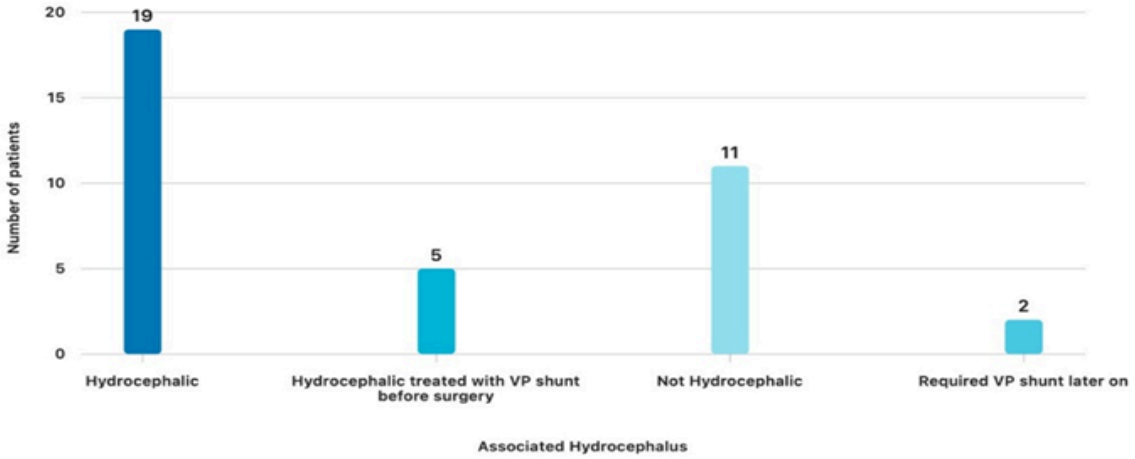
Nineteen patients (54.3%) presented with untreated hydrocephalus, five (14.3%) had a pre-existing ventriculoperitoneal shunt, and eleven (31.4%) had no hydrocephalus. Two patients required ventriculoperitoneal shunt insertion following surgery (Figure 3). Purely endoscopic surgery was performed in 7 patients (20.0%), while 28 (80.0%) underwent endoscopic-assisted microsurgery (Table 2).

Early Postoperative Outcomes

Twenty-nine patients (82.9%) had a good postoperative Glasgow Coma Scale (GCS) score (13–15), one (2.9%) had a moderate score (9–12), and five (14.3%) had poor postoperative GCS scores (3–8). Four of the five patients with poor postoperative GCS developed significant postoperative intraventricular haemorrhage (IVH).

On univariable analysis, age, pathology, and postoperative IVH were significantly associated with poorer postoperative GCS ($p<0.05$), whereas sex, lesion location, tumour size, hydrocephalus, and surgical technique were not. Multivariable logistic regression identified postoperative IVH as the strongest independent predictor of poor postoperative neurological status, with age remaining independently associated (Table 3).

Figure 3: Association of hydrocephalus in patients



Bar chart showing the association of hydrocephalus in patients. On presentation, 19 patients had untreated hydrocephalus, 5 had a prior ventriculoperitoneal (VP) shunt, and 11 had no hydrocephalus. Postoperatively, two patients from the untreated hydrocephalus group required new VP shunt placement.

Table 2: Lesion characteristics

Pathology	N (%)	Age (y)	Sex (M/F)	Size (cm³) Mean / Med (IQR)	Location	Technique	Resection
Colloid Cyst	8 (22.9%)	30.38	3 / 5	4.5 / 3.5 (2.4-5)	Third	Endo: 5, EAMS: 3	GTR: 5, NTR: 3
CP Papilloma	7 (20.0%)	19.71	5 / 2	36.6 / 35 (26-40)	Lat: 6, Both: 1	Endo: 1, EAMS: 6	GTR: 5, NTR: 2
Neurocytoma	6 (17.1%)	33.67	4 / 2	82.5 / 87.5 (55-105)	Lateral: 6	EAMS: 6	GTR: 2, NTR: 2, PR: 2
SEGA	5 (14.3%)	22.0	2 / 3	21.6 / 12 (8-12)	Lat: 3, Both: 2	Endo: 1, EAMS: 4	GTR: 4, NTR: 1
Epidermoid	4 (11.4%)	31.5	3 / 1	90 / 85 (78-96)	Lat: 3, Both: 1	EAMS: 4	NTR: 1, STR: 2, PR: 1
Ependymoma	2 (5.7%)	37.5	1 / 1	3.1 / 3.1 (2.7-3.6)	Lat: 1, Both: 1	EAMS: 2	GTR: 2
GBM	2 (5.7%)	67.0	2 / 0	18.5 / 18.5 (17-20)	Lateral: 2	EAMS: 2	NTR: 1, PR: 1
Meningioma II	1 (2.9%)	55.0	1 / 0	40 / 40	Lateral: 1	EAMS: 1	NTR: 1
Total	**35**	**-**	**21 / 14**	**-**	**L:22, 3:8, B:5**	**Endo:7, EAMS:28**	**GTR:20, NTR:9...**

The most common pathology was colloid cysts (n=8, 22.9%). Male patients were more than females (22: 14). The largest lesions were epidermoid cysts and central neurocytomas, with a mean size of 90 & 82.5 cm³ respectively. The lateral ventricle was the most common location (n=22). Total endoscopic resection (Endo) was done in 7 patients (20%), while the majority of surgeries (28 patients, 80%) were performed using the microscope with endoscopic assistance (EAMS). GTR was achieved in 20 of the 35 patients.

Table 3: Predictors of early postoperative outcomes

Variable	Univariable Analysis		Multivariable Analysis	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Age	0.92 (0.85–0.98)	**0.017**	0.89 (0.81–0.98)	**0.023**
Sex	0.33 (0.05–2.33)	0.366	—	—
Pathology	—	**0.018**	—	—
Location	—	0.920	—	—
Technique	4.33 (0.22–86.42)	0.311	—	—
Tumour Size	0.92 (0.74–1.15)	0.443	—	—
Postoperative IVH	0.05 (0.01–0.38)	**0.002**	0.007 (0.00–0.39)	**0.016**
Hydrocephalus	0.51 (0.07–3.58)	0.640	—	—

Model fit notes: Pseudo R^2 = 0.635; LLR p-value < 0.001. The model is statistically significant with very strong explanatory power.

Functional outcomes

At 6 months, favourable functional outcome (Glasgow Outcome Scale [GOS] 4–5) was achieved in 30 patients (85.7%), while 5 (14.3%) had poor outcomes (GOS 1–3). Immediate postoperative neurological status was strongly associated with 6-month functional outcome (p<0.0001).

Four patients (11.4%) died during follow-up, while one (2.9%) remained severely disabled because of persistent disconnection syndrome. Significant postoperative IVH was strongly associated with mortality (p=0.014).

Univariable analysis demonstrated significant associations between age (p=0.026), pathology (p=0.0035), and postoperative IVH (p=0.014) and 6-month functional outcome. On multivariable analysis, postoperative IVH remained the strongest independent predictor of poor functional outcome (OR 0.03, 95% CI 0.001–0.58; p=0.021), while increasing age was also independently associated with lower odds of favourable recovery (OR 0.92 per year, 95% CI 0.85–0.99; p=0.033) (Table 4).

Postoperative complications

Postoperative IVH was the most common complication, occurring in 9 patients (25.7%), including 5 (14.3%) with clinically significant haemorrhage requiring urgent intervention. Other complications included seizures and behavioural disturbances (Figure 4). Significant postoperative IVH independently predicted both poor immediate neurological status (adjusted OR 0.007; p=0.016) and poor functional outcome at 6 months (adjusted OR 0.03, 95% CI 0.001–0.58; p=0.021).

Extent of resection

Gross total resection was achieved in 20 patients (57.1%), near-total resection in 9 (25.7%), subtotal resection in 2 (5.7%), and partial resection in 4 (11.4%). Overall, maximal resection (gross total or near-total resection) was achieved in 29 patients (82.9%).

Larger tumour volume (p=0.015) and pathology (p=0.019) were associated with lower rates of maximal resection on univariable analysis. On multivariable analysis, tumour volume remained the only independent predictor, with each additional 1 cm^3 associated with a 3% reduction in the odds of achieving maximal resection (OR 0.97, 95% CI 0.94–0.996; p=0.019).

Operation time

The mean operative time was 4.6 hours (range, 2–9 hours). Purely endoscopic procedures were significantly shorter than endoscopic-assisted microsurgery (3.3 vs. 4.9 hours; p=0.004). Multivariable analysis identified smaller tumour volume, lateral ventricular location, and epidermoid pathology as independent predictors of shorter operative time (Table 5).

Duration of hospital stay

The mean hospital stay was 5.9 days (median, 6 days; range, 2–14 days). Patients undergoing purely endoscopic surgery had shorter hospital

stays than those treated with endoscopic-assisted microsurgery (4.6 vs. 6.3 days). Longer operative duration and postoperative IVH were independent predictors of prolonged hospitalization (Table 5).

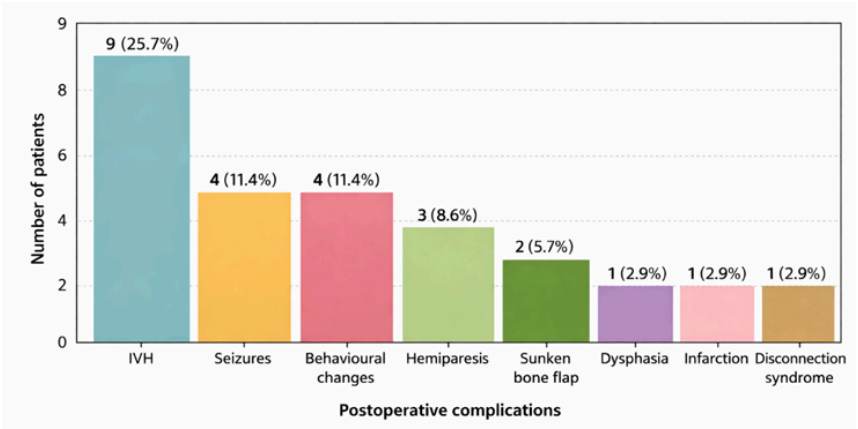
Representative cases demonstrating gross total resection of a colloid cyst and a choroid plexus papilloma are shown in Figure 6.

Table 4: Multivariate logistic regression results

Variable	OR	95% CI Lower	95% CI Upper	P-value
Age	0.92	0.85	0.99	**0.033**
IVH	0.03	0.001	0.58	**0.021**

Model fit notes: Pseudo R^2 = 0.499; LLR p-value < 0.0008. Indicates a moderate fit.

Figure 4: Frequency of postoperative complications



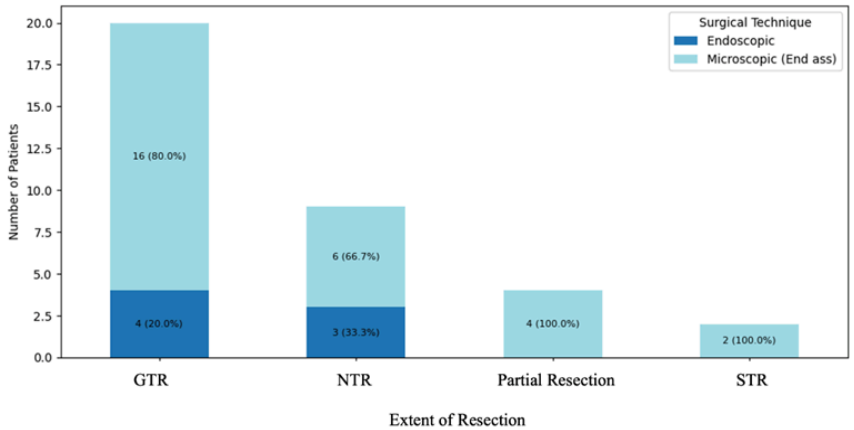
Bar chart illustrating the frequency of postoperative complications in the cohort. Percentages are calculated relative to the total cohort (n=35). Some patients experienced more than one complication. Intraventricular haemorrhage (IVH) occurred in 9 patients, of which 5 were clinically significant and associated with mass effect.

Table 5: Multivariate linear regression analysis of factors affecting hospital stay duration

Predictor	Coefficient (β)	95% CI	P-value	Interpretation
Operative time	**0.79**	**0.26-1.32**	**0.004**	Each extra operative hour prolongs hospital stay by ~0.8 days.
IVH	**1.59**	**0.19-3.00**	**0.028**	Presence of postoperative intraventricular haemorrhage prolongs stay by ~1.6 days, independent of other factors.
Surgical technique	0.47	-1.29-2.23	0.585	No significant independent effect.

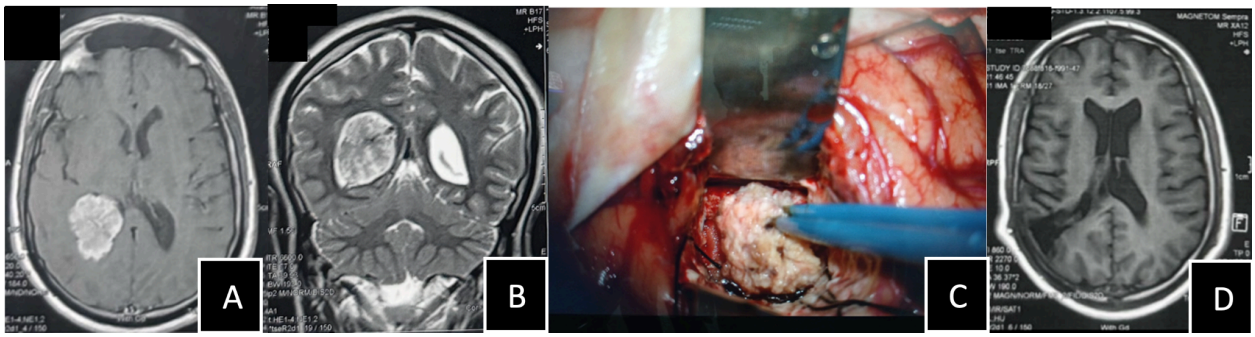
***Model fit**: R^2 = 0.431 → 43% of variation in hospital stay.

Figure 5: Extent of resection with surgical technique



Bar chart showing the extent of resection with surgical technique, pure endoscopic technique is shown in dark blue color while microscopic with endoscopic assistance (EAMS) is in light blue color. GTR is achieved in 20 patients, NTR in 9, STR in 2 and partial resection in 4 patients.

Figure 6: Representative cases demonstrating gross total resection of a choroid plexus papilloma



Preoperative MRI scans showing right lateral ventricle tumor (a - axial T1 contrast enhanced, b - coronal T2 weighted). Image c shows an intraoperative picture of the tumor. Image d is an MRI scan T1 contrast enhanced showing gross total resection of the tumor.

DISCUSSION

Intraventricular lesions constitute a small fraction of intracranial neoplasms, typically reported within the 1–10% range, but their surgical management remains particularly demanding because of their deep location, complex anatomy and heterogeneous outcomes (5). In this study, we present 35 patients diagnosed with intraventricular lesions over a 2-year period at our institute, representing around 7.3% of all intracranial lesions (480 patients) during this period. Age ranged from 1 to 72 years (mean ~31 years), encompassing both pediatric and adult cases, with a slight male predominance (60%), consistent with some reports suggesting a slight male bias (1). Others, such as Elwatidy et al., observed a mean age of 25 years and nearly equal sex distribution in a series of 42 lateral and third ventricular tumours (6).

The clinical presentation of lateral and third ventricular lesions depends on patient age, lesion size, and location, with symptoms primarily resulting from mass effect, obstruction, or CSF dynamics disturbance (6). Manifestations are often nonspecific and typically appear only after significant ventricular dilatation and raised intracranial pressure, with headache being the most frequent symptom (1,6,7) which was observed in 88.6% of patients in our series.

The pathological spectrum in our cohort included both benign and malignant entities. Colloid cysts were the most frequent (22.9%), followed by choroid plexus papillomas (20%), central neurocytomas (17.1%), SEGAs (14.3%), and epidermoid cysts (11.4%), with fewer cases of ependymomas, GBM, and atypical meningiomas. Notably, the proportion of colloid cysts was lower than in other adult-focused series, where they typically predominate, accounting for about two-thirds of cases in a meta-analysis of 3,059 patients (1) — likely due to the inclusion of pediatric cases, among whom papillomas are more frequent (8). Age strongly influences pathological distribution: papillomas predominate in children, pilocytic astrocytomas and SEGAs in adolescents and young adults (6–30 years), while meningiomas, metastases, and high-grade gliomas occur mainly after 30 years (8). Similarly, Schär et al. reported ten histological subtypes among 26 intraventricular tumours, with colloid cysts, subependymomas, and meningiomas comprising over half of cases (9).

Intraventricular lesions predominantly occur in the lateral ventricles, followed by the third and fourth ventricles, with distinct pathology-specific predilections—central neurocytomas typically arise near the foramen of Monro, ependymomas in the fourth ventricle, and subependymomas in the lateral or fourth ventricles (1,8,10–12). Our study focused on supratentorial lesions; thus, the fourth ventricle was excluded. Lesions were mainly lateral ventricular (63%), with 23% in the third ventricle and 14% involving both. Two elderly patients were diagnosed with GBM of a thalamic origin that extended to occupy the lateral ventricles. A significant correlation between pathology and location was noted: all colloid cysts were third ventricular, while most neurocytomas, papillomas, and epidermoids arose in the lateral ventricles, consistent with established anatomical patterns (1,8,10–12).

The mean lesion size in our cohort was 38 cm³, with a median diameter of 4 cm (range 1.2–8 cm). Epidermoid cysts and central neurocytomas were the largest (80–90 cm³), while colloid cysts and ependymomas were the smallest (3–5 cm³). Surgical management included pure endoscopic resection in 7 patients (20%) and endoscopic-assisted microsurgery (EAMS) in 28 (80%) via transcortical or transcallosal approaches. Consistent with Cappabianca et al., solid tumours exceeding 2–3 cm in diameter were treated micro-surgically due to the limitations of pure endoscopy (2). In our series, lesions >3 cm or >70–80 cm³ were approached via EAMS, aligning with reports proposing a 5 cm threshold for endoscopic feasibility (7,13). These results support the established paradigm of selecting endoscopy for small, favorable intraventricular lesions and microsurgery for larger or complex tumours. We conducted pure endoscopic resection for small, soft, intraventricular lesions (<5 cm) with low vascularity, including five colloid cysts and two benign tumours (choroid plexus papilloma and SEGA). Three cases of colloid cyst however required the introduction of the microscope due to strong adherence of their capsule wall to the surroundings and for a more meticulous haemostasis. In a larger study of 134 patients, 82% underwent open microsurgical resection, whereas 18% were treated endoscopically, reflecting the usual predominance of microsurgical techniques for intraventricular lesions (14).

Postoperative neurological status in our study was evaluated with immediate GCS and GOS at 6 months. Outcomes were generally favorable: 82.9% of patients had good GCS (13–15), one (2.8%) had moderate (9), and five (14.3%) had poor scores (3–8). Four of the poor-GCS cases were associated with significant postoperative IVH, which led to intensive care admission and eventual death (mortality = 11.4%), while the remaining case resulted in lasting disconnection syndrome. Older age and postoperative intraventricular haemorrhage (IVH) showed the strongest associations with poor immediate postoperative GCS, corresponding to an OR of approximately 0.894 per year (95% CI 0.811–0.985; p = 0.017) and an OR ≈ 0.007 (95% CI 0.000–0.388; p = 0.002), respectively. Elderly patients are known to have reduced neurological resilience, emphasizing the importance of considering age in perioperative management (15). Cappabianca et al. reported one major IVH among 19 endoscopic tumour cases, emphasizing the persistent risk of fatal bleeding despite overall low rates (2), while another series noted a 3.84% mortality due to postoperative IVH (16). Another study in 2024 noted that the chief anticipated postoperative issues in intraventricular lesions are haemorrhage and hydrocephalus (17).

Seizures are also a well-documented complication, especially with cortical entry. Epileptic seizures occurred in 11.4% of our patients postoperatively, and other series likewise report postoperative seizure rates around 8–12% (6). Milligan and Meyer reported a 69% incidence of complications in their cohort of 127 patients, including a 20% rate of persistent neurological morbidity (18). Another study also detailed minor intraventricular haemorrhage in 45% of patients, hydrocephalus in 45%, subdural hygroma in 35%, and transient hemiparesis in 25% (13). Other institutional series in developing countries in Africa demonstrate complication rates ranging from moderate to high. In Addis Ababa, the overall complication rate was 52.5%, mostly hydrocephalus and CNS infections (19). Our findings are broadly consistent with patterns reported in other contemporary series, with two notable distinctions: the rate of IVH in our cohort was at the higher end of the reported spectrum, and no newly developed hydrocephalus recorded as a post-operative complication in this cohort; as 19 patients had pre existing hydrocephalus at baseline, 5 already carried VP shunts, and among those without prior shunting only two required VP shunt insertion during follow up—hence no de novo postoperative hydrocephalus was evident.

At 6-month follow-up, 85.7% of patients achieved good recovery or mild disability (GOS 4– 5), while 14.3% had poor outcomes (GOS 1–3). Older age and postoperative IVH independently predicted unfavorable GOS, whereas a good immediate GCS strongly correlated with favorable long-term function. These findings parallel disease-specific reports, where intraventricular meningiomas show excellent recovery when complications are avoided (~83% GOS 5) (20), and intraventricular neuroepithelial tumours demonstrate similarly good outcomes following gross or near-total resection (12). Five patients (14.3%) had poor outcomes (GOS 1–3), including four deaths (11.4%). This mortality rate exceeds that reported in the most recent series (0–5%) (1), though higher rates up to ~36% have been described in mixed-pathology or resource-limited cohorts (6,18). Comparable studies reported

mortality between 5% and 13% with favorable outcomes in 73–75% of cases (21,22), while larger series noted rates from 4% in well-resourced centers to ~27% in low-resource settings (14,23).

Maximal safe resection remains central to intraventricular surgery, reported GTR rates vary widely (38–87%) depending on pathology and tumour size ((18,24,25). In our series, 82.9% achieved extensive resection—GTR in 57% and near-total resection (NTR) in 26%—comparable to literature values. A meta-analysis of 47 studies reported a mean GTR rate of 81.5%, slightly higher with microsurgery (~84%) than endoscopy (~80%) (1). All subtotal or partial resections in our cohort involved large, infiltrative microsurgical cases (e.g., GBM, giant central neurocytoma), where further resection risked eloquent injury. By contrast, purely endoscopic cases—all carefully selected small, favorably located lesions—achieved at least near-total resection, reflecting an inherent selection bias toward less complex tumours (7).

Tumour size was the sole independent determinant of maximal resection (GTR/NTR) in our series, with each additional cm^3 reducing the odds of achieving GTR/NTR by ~3% (OR 0.97, 95% CI 0.94–0.996; p = 0.019). Larger lesions were less amenable to complete resection due to proximity to critical structures, while smaller, well-circumscribed tumours (e.g., colloid cysts, averaging ~4 cm^3) were almost uniformly completely excised. Pathology showed significance on univariate analysis (p = 0.019) but not after adjusting for size, confirming size as the dominant factor. For malignant tumours, resection mainly serves debulking and diagnostic purposes, with prognosis dictated by tumour biology (26). Our two intraventricular GBM cases exemplified this—one achieved NTR, the other STR. Reported GTR rates across the series range from 57 to 80% (6, 19, 21, 22), with lower rates in large or high-grade lesions. Overall, our findings align with the literature, indicating that modern microsurgical and endoscopic techniques enable high GTR/NTR rates, particularly for benign intraventricular tumours, translating into durable disease control.

Technique selection followed lesion size/complexity. Consistent with our predefined criteria, lesions ≥70–80 cm^3 (or >3–5 cm) and those with firm, vascular, or complex extension were managed using EAMS, whereas lesions <30 cm^3 with favorable consistency were typically suitable for pure endoscopy. These thresholds align with published recommendations suggesting a practical 3–5 cm limit for safe, purely endoscopic tumor removal. Operative times were shorter with endoscopy in our series (3.3 h vs 4.9 h, p = 0.004), and each additional hour increased hospital stay by ~0.79 days (p=0.004), consistent with Li et al. (7). In contrast, prolonged surgeries exceeding 10–16 hours were reported in resource-limited settings (23), whereas purely endoscopic resections elsewhere averaged ≈2 hours (27) and endoscopic-assisted cases ≈2.7 hours (4). Postoperative hospital stay in our series averaged 5.91 days (range 2–14), shorter after endoscopy (4.57 days) than microsurgery (6.25 days). Similar studies report shorter stays with neuroendoscopy (≈11 vs. 17 days; p=0.039) (7), while large or complicated cases may extend to 21.5 days (28). Multivariate analysis confirmed that operative time and postoperative IVH independently prolonged hospitalization (~0.79 and ~1.59 days, respectively; p=0.004, 0.028), whereas surgical approach had no independent effect. Overall, shorter hospitalizations typically accompany minimally invasive approaches and uncomplicated recoveries, while longer stays reflect procedural complexity and perioperative morbidity (29).

Limitations

This study has several limitations. The small sample size (n = 35) and heterogeneous pathologies reduced the statistical power for subgroup analyses and increased the potential for residual confounding. The choice between pure endoscopy and EAMS was non-randomised and guided by lesion size, vascularity, and surgeon judgment, introducing selection bias. The 6-month follow up was also insufficient to assess tumour recurrence or long-term progression, particularly for slow growing lesions. Additionally, despite multivariable adjustment, unmeasured factors such as pathological aggressiveness and anatomical complexity may have influenced outcomes. Future studies should include larger, multicenter cohorts, longer follow-up, and propensity-matched or stratified analyses to better address selection bias and the interactions between pathology, tumour size, and surgical technique.

CONCLUSION

Endoscopic and endoscopic assisted microsurgical techniques served complementary roles in the management of intraventricular

lesions, with endoscopy favorable for small, well circumscribed lesions and EAMS essential for larger or more complex and vascular lesions. Across this cohort, postoperative intraventricular haemorrhage and patient age were the strongest independent predictors of poorer neurological and functional outcomes. These observations support thorough preoperative counselling and meticulous intraoperative haemostasis, particularly in higher risk profiles. Overall, a tailored, lesion specific surgical approach aims to maximise safe resection while minimising morbidity.

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