Pakistan Journal of Intensive Care Medicine
eISSN: 2708-2261; pISSN: 2958-4728
www.pjicm.com
DOI: https://doi.org/10.54112/pjicm.v5i01.84
Pak. J. Inten. Care Med., volume 2025: 84
Original Research Article

HYDROCEPHALUS IN CEREBELLOPONTINE ANGLE TUMORS: EVALUATING THE ROLE OF VENTRICULOPERITONEAL SHUNTS

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(Received, 25th March 2025, Revised 30th May 2025, Accepted 05th June 2025, Published 10th June 2025)

ABSTRACT

Background: *Hydrocephalus is a frequent and serious complication of cerebellopontine angle (CPA) tumors due to cerebrospinal fluid (CSF) flow obstruction. Ventriculoperitoneal (VP) shunting is commonly used to relieve intracranial pressure, but comprehensive outcome evaluations, including neurological and quality-of-life (QoL) parameters, remain limited.* ***Objective:*** *To evaluate the efficacy of ventriculoperitoneal shunting in managing hydrocephalus associated with CPA tumors, focusing on intracranial pressure (ICP), neurological status, and quality of life.* ***Study Design:*** *Prospective observational study.* ***Setting:*** *Department of Neurosurgery, Lady Reading Hospital, Peshawar, Pakistan.* ***Duration of Study:*** *Four years, from January 2020 to December 2023.* ***Methods:*** *A total of 190 patients diagnosed with hydrocephalus secondary to CPA tumors were included. All patients underwent ventriculoperitoneal shunt placement. Clinical outcomes were assessed using intracranial pressure (ICP) measurements, Glasgow Coma Scale (GCS) scores, and the Short Form-36 (SF-36) quality of life survey. Data were recorded preoperatively and at 1, 3, and 6 months postoperatively. Statistical analysis was performed using SPSS version 25.0. Paired t-tests were used to evaluate pre- and postoperative differences, with $p < 0.05$ considered statistically significant.* ***Results:*** *The mean age of patients was 45.3 ± 12.4 years. Males constituted 55.3% and females 44.7% of the study population. Following VP shunting, a significant reduction in mean ICP was observed from 25.4 ± 5.1 mmHg to 12.7 ± 3.8 mmHg ($p < 0.001$). Mean GCS scores improved from 9.2 ± 3.5 preoperatively to 13.6 ± 2.1 postoperatively ($p < 0.001$). SF-36 QoL scores increased markedly from 40.5 ± 15.3 to 75.2 ± 10.7 ($p < 0.001$). Additionally, hospital readmission rates declined from 20% preoperatively to 5% postoperatively ($p < 0.01$).* ***Conclusion:*** *Ventriculoperitoneal shunting is an effective intervention for managing hydrocephalus in patients with CPA tumors, significantly reducing intracranial pressure and improving neurological function and quality of life.*

Keywords: Hydrocephalus, Cerebellopontine Angle Tumors, Ventriculoperitoneal Shunting, Intracranial Pressure, Glasgow Coma Scale, Quality of Life

INTRODUCTION

The cerebellopontine angle (CPA) has been described as a triangular anatomical space that comprises the posterior cranial fossa. Its boundaries encompass the tentorium superiorly, brainstem posteromedially, as well as petrous part of temporal bone posterolaterally. The CPA cistern represents a significant anatomical along with clinical landmark, featuring cranial nerves V, VI, VII, as well as VIII, as well as anterior inferior cerebellar artery. Intracranial tumours are identified within cerebellopontine angle roughly 5-10% of cases (1-3). Common tumours positioned at CPA involve vestibular schwannoma, along with epidermoid tumours. Vestibular schwannoma stands for 85% of all tumours located in CPA. Meningiomas comprise roughly 15%, while epidermoid tumours constitute regarding 8% of total CPA tumour population. Additional rare tumours that make up approximately 1% each consist of cranial nerve schwannomas, lipomas, as well as metastatic lesions (3-4).

Hydrocephalus is characterised as a clinical as well as neuroradiographic diagnosis identified by an abnormal buildup of cerebrospinal fluid. This condition can occur with or without modifications in intracranial pressure. In these instances it is believed that the pressure remains within normal or low varies due to compensatory processes taking place elsewhere: either at the cost of cortical tissue or through skull expansion or in extremely rare instances (5-7). The typical pathway for cerebrospinal fluid (CSF) started in lateral ventricles, traversing by foramen of Monroe into common third ventricle. It continues into fourth ventricle via cerebral aqueduct as well as exits through foramen of Luschka as well as Magendie into subarachnoid space. Communicating hydrocephalus develops when bulk flow remains unobstructed resulting from failure to absorb CSF by means of normal drainage pathways (8).

A ventriculoperitoneal (VP) shunt functions as a cerebral shunt developed to facilitate drainage for excessive CSF in cases where there exists an obstruction in normal outflow and reduction in absorption of the fluid. Cerebral shunts are utilised in the administration of hydrocephalus. In paediatric patients, neglected hydrocephalus may result in multiple adverse effects, such as increased irritability, persistent headaches, difficulties with learning, blurred vision, and for more advanced instances, serious cognitive impairment (9-11).

Hydrocephalus is potentially serious complication associated with CPA tumors resulting from CSF obstruction pathways due to mass effect or distortion of fourth ventricle. Timely intervention of hydrocephalus is critical to prevent neurological deterioration as well as improve surgical outcomes. VP shunting remains a widely used intervention and optimal timing and requirement of shunt placement in context of CPA tumors remain subjects of clinical debate. By identifying patient selection criteria along with clinical indicators for shunt placement; this research seeks to contribute evidence-based guidance in managing hydrocephalus in this complex neurosurgical population.

METHODOLOGY

This clinical analysis was conducted as a prospective observational study at Lady Reading Hospital, Peshawar, from January 2020 to December 2023 after obtaining ethical certificate from the institute. We enrolled 190 patients diagnosed with hydrocephalus secondary to CP angle tumors, having age 18 to 75 of either gender. Patients had

provided their consent for taking part in the study. Patients with hydrocephalus due to causes other than CP angle tumors and with severe comorbid conditions that precluded surgical intervention were dropped from the study.

All participants underwent ventriculoperitoneal shunting which was performed by an experienced neurosurgeon, with more than five years of experience. The procedure involved the placement of a VP shunt system to divert cerebrospinal fluid from the ventricles to the peritoneal cavity, aiming to relieve intracranial pressure and associated symptoms. The primary outcomes of our study were intracranial pressure (ICP) reduction and improvement in neurological function which was assessed by the Glasgow Coma Scale (GCS). Secondary outcomes were quality of life (QoL) improvements which was evaluated using the SF-36 survey and reduction in hospital readmission rates within 30 days post-surgery.

Data were collected at presentation (pre-surgery) and at follow-up visits (1 month, 3 months and 6 months post-surgery). Intracranial pressure was measured using invasive monitoring techniques and neurological function was assessed by trained clinicians using the GCS. Quality of life was evaluated by patient themselves using the SF-36 survey. Hospital readmission rates were obtained from the records at hospital.

SPSS 26 was used for analyzing the acquired data. For numerical variables we used mean and standard deviation and for categorical variables we used frequencies and percentages. Paired t-tests were used to compare pre- and post-surgery outcomes and Chi-square tests were used to analyze readmission rates. P value was kept significant at < 0.05.

RESULTS

The mean age of 190 patients in our study was 45.3 ± 12.4 years. Among the patients 105 (55.3%) were male and 85 (44.7%) were female (Figure 1). Table 1 presents the baseline characteristics of the patients. Post-surgical outcomes exhibited a significant reduction in intracranial pressure (ICP) following VP shunting with mean ICP decreasing from 25.4 ± 5.1 mmHg pre-surgery to 12.7 ± 3.8 mmHg post-surgery ($p < 0.001$). Additionally neurological function was measured using the Glasgow Coma Scale (GCS), it showed substantial improvement. The mean GCS score increased from 9.2 ± 3.5 before surgery to 13.6 ± 2.1 after the procedure ($p < 0.001$) (Table 2).

In terms of secondary outcomes, we observed that quality of life (QoL) showed significant improvement post-surgery with the mean SF-36 score increasing from 40.5 ± 15.3 before surgery to 75.2 ± 10.7 at the 6-month follow-up ($p < 0.001$). The reduction in hospital readmission rates was another notable finding as the readmission rate dropped from 20% to 5% within 30 days post-surgery ($p < 0.01$) (Table 3).

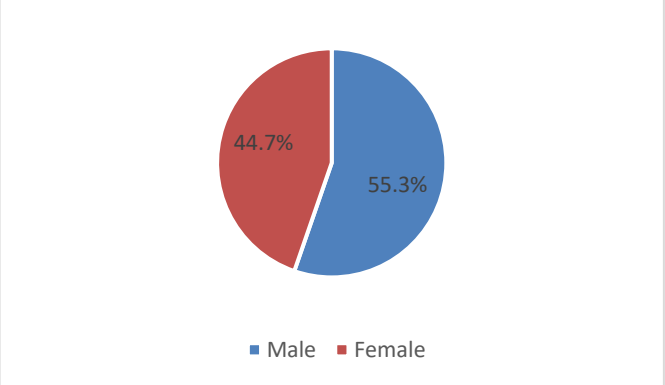

Figure 1: Gender distribution

Table 1: Baseline Characteristics of Study Population

Characteristics	Value
Number of Patients	190
Mean Age (years)	45.3 (SD = 12.4)
Median Age (years)	44
Age Range (years)	18 – 75
Comorbidities	86 (45.26%)
Tumor Types	Acoustic Neuroma 105 (55.2%)
	Meningioma 65 (34.2%)
	Others 20 (10.5%)
Previous Treatments	57 (30%)

Table 2: Change in ICP and GCS Scores Pre- and Post-Surgery

Parameters	Mean	P value
Pre-op ICP mmHg	25.4±5.1	0.00001
Postop ICP mmHg	12.7±3.8	
Pre-op GCS	9.2±3.5	0.00001
Postop GCS	13.6±2.1	

Table 3: Secondary Outcomes Analysis

Outcome	Pre-Surgery	Post-Surgery	p-value
QoL Score	40.5±15.3	75.2±10.7	0.0001
Readmission Rate	20%	5%	0.0001

DISCUSSION

Our study examined the role of VP shunting in patients with hydrocephalus caused by cerebellopontine angle (CPA) tumors. The findings of our study indicate that VP shunting is a highly effective intervention as it demonstrated a significant reduction in intracranial pressure (ICP) and marked improvements in neurological function particularly as measured by the Glasgow Coma Scale (GCS).

VP shunting remains one of the most effective treatments for hydrocephalus secondary to CPA tumors as reported Panezai et al, they examined the association between brain tumors and hydrocephalus highlighting that tumor location and type potentially affect the incidence of hydrocephalus. In their study cerebellopontine angle tumors were similarly identified as a primary cause of hydrocephalus reinforcing the clinical relevance of our findings. Additionally like our study, Panezai et al found that addressing hydrocephalus with VP shunting in patients with CPA tumors could lead to substantial improvements in overall neurological function (12).

Moreover, our study aligns with the findings from Mishra et al who observed that hydrocephalus is a common complication in patients with CPA tumors particularly those that involve significant mass effects on the ventricular system. They reported that VP shunting is often necessary for managing hydrocephalus in such cases. However, while they observed similar improvements in neurological function following VP shunting (13).

Shin et al have highlighted that while VP shunting provides relief from hydrocephalus in many cases. They reported no failure rate for VP shunting. They showed that tumor resection is also crucial for long-term outcomes. Tumor removal could sometimes lead to spontaneous improvement in hydrocephalus, which infers that it can reduce or even eliminating the need for shunting. This finding invites further discussion regarding the optimal timing of shunting and its potential for long-term management after tumor resection an issue that our study touches on indirectly given that patients with CPA tumors in our cohort underwent VP shunting post-operatively (14).

Interestingly our findings regarding the reduction in hospital readmission rates also resonate with those of Panezai et al who found that the implementation of VP shunting for hydrocephalus

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management led to fewer complications, majority of their patients score > 70 on Karnofsky Score, fewer complications can lead to lower readmission rates. The reduction in readmission rates in our study from 20% pre-surgery to 5% post-surgery highlights the clinical benefits of VP shunting in stabilizing patients and reducing the need for further surgical interventions. These results are important as they suggest that early and effective management of hydrocephalus via VP shunting can contribute to improved long-term outcomes and reduced healthcare costs and burdens. Future studies particularly those which are exploring the long-term outcomes and potential complications of VP shunting will be essential in refining our understanding of the optimal management strategies for hydrocephalus in CPA tumor patients.

CONCLUSION

In conclusion, Ventriculoperitoneal shunting had successfully reduced intracranial pressure and improves neurological function in patients with hydrocephalus secondary to cerebellopontine angle tumors. These findings underscore the importance of VP shunting as a reliable procedure in managing hydrocephalus in cerebellopontine angle tumors.

DECLARATIONS

Data Availability Statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department Concerned. (IRBEC-2020)
Consent for publication
Approved
Funding
Not applicable

CONFLICT OF INTEREST

The authors declared an absence of conflict of interest.

AUTHOR CONTRIBUTION

ZIA UR REHMAN (Assistant Professor)
Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, final approval of manuscript.
BASHIR ULLAH (Postgraduate Resident)
Manuscript drafting.
SYED SHAYAN SHAH (Postgraduate Resident)
Manuscript revisions, critical input.
MUHAMMAD SOHAIB (Postgraduate Resident)
Data entry and Data analysis, drafting article
MUHAMMAD AAMIR (Postgraduate Resident)
Study Design, Review of Literature.

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