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INCIDENCE OF PSEUDOMENINGOCELE IN CASES UNDERGOING POSTERIOR FOSSA SURGERY

Neurosurgery

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ABSTRACT

Introduction: Pseudomeningocele is a common complication following posterior fossa surgery, characterized by an abnormal collection of cerebrospinal fluid surrounded by extradural soft tissue. This study investigated the incidence of pseudomeningocele following posterior fossa surgery and analyzed associated risk factors. **Methods:** This prospective observational study included 100 patients who underwent intradural posterior fossa surgery at Osmania General Hospital, Hyderabad, between January 2023 and October 2024. Data collected included demographics, comorbidities, preoperative parameters (GCS, hemoglobin, albumin), surgical details (approach, type of dural closure), and postoperative outcomes. Statistical analysis was performed using SPSS version 26. **Results:** The mean age of patients was 27.3±20.7 years with a male-to-female ratio of 0.8:1. The most common lesions were cerebellopontine angle space-occupying lesions (26%), fourth ventricular tumors (15%), and cerebellar tumors (11%). Craniotomy was performed in 75% of cases and craniectomy in 25%. The overall incidence of pseudomeningocele was 17%. Patients with pseudomeningocele had lower mean albumin levels (3.62 g/dL) compared to those without (4.32 g/dL). Lower incidence of pseudomeningocele was observed in patients who had preoperative ventriculoperitoneal shunt placement (14.71%) compared to those without (18.18%). Autologous grafts were associated with a lower incidence of pseudomeningocele compared to primary closure or combined techniques. **Conclusion:** The incidence of pseudomeningocele following posterior fossa surgery was 17%. Preoperative optimization of nutritional status, performing craniotomies when possible, using autologous grafts for dural closure, and preoperative ventriculoperitoneal shunt placement in cases with hydrocephalus may help reduce the incidence of pseudomeningocele. Early intervention is recommended to minimize complications and morbidity.

KEYWORDS

Pseudomeningocele, posterior fossa surgery, craniotomy, craniectomy, dural closure, cerebrospinal fluid leak, ventriculoperitoneal shunt

INTRODUCTION

One commonly seen complication following posterior fossa surgery is pseudomeningocele.[1,2] This can be detrimental to the patient as it may cause positional headaches, persistent meningitis, cosmetic deformities, and/or impingement on important structures that results in neurological impairments.[3,4] According to published data, 4-23% of patients who undergo posterior fossa surgery go on to develop clinically significant pseudomeningoceles.[5,6]

An aberrant collection of CSF surrounded by extradural soft tissue is called a pseudomeningocele. It is a well-known potential side effect of any spinal or intracranial surgery. Tumours of the central nervous system, especially those of the posterior fossa, are more prevalent in the pediatric age group than other solid tumours.[7,8] A recent systematic review estimated its rate to be around 8%.^9^ Following posterior fossa tumour surgery, pseudomeningocele formation is a frequent complication that causes anxiety for the patient, their loved ones, and the surgeon. Not only can pseudomeningocele result in cosmetic disfigurement, but it can also cause wound infection, meningitis, delayed adjuvant therapy, and extended hospital stays.[10-12]

Pseudomeningocele can arise from a variety of primary causes, including inadequate dural closure, posterior fossa craniectomy rather than craniotomy, or underlying hydrocephalus.[13] There are various approaches for managing postoperative pseudomeningocele, ranging from conservative procedures including head elevation, tap and wrap technique, to treating underlying infection. However, surgical alternatives include wound investigation & re-exploration, lumbar CSF drainage, and CSF diversion in the event of hydrocephalus, should conservative procedures fail. To the best of our knowledge, a detailed understanding of predisposing risk factors, prophylactic measures, natural history, and treatment options is lacking. This study aims to assess the incidence of pseudomeningocele in patients undergoing posterior cranial fossa surgery and to identify factors that may influence its occurrence.

Methodology

This prospective observational study was conducted at the Department of Neurosurgery of Osmania General Hospital, Hyderabad, from January 2023 to October 2024. All patients who underwent any intradural posterior fossa surgery during the study period were screened for eligibility. The sample size was calculated based on a previous study reporting a 13% prevalence of postoperative pseudomeningocele, resulting in a minimum requirement of 89 subjects, with 100 patients ultimately included in the study.

Inclusion criteria encompassed patients of all age groups undergoing any intradural posterior fossa surgery, while exclusion criteria included patients undergoing re-do surgery, those with evidence of preoperative CSF leak, and unwilling patients or caretakers. After obtaining informed consent, patients' demographic data, clinical features, and preoperative investigations including MRI brain and surgical profiles were documented. Surgical details including the approach (craniotomy vs. craniectomy), type of dural closure, and complications were recorded. Patients were followed up postoperatively for the development of pseudomeningocele and other complications.

Data were analyzed using SPSS version 26. Qualitative data were presented as percentages and displayed in tables and diagrams. Quantitative data were presented as means and standard deviations. Statistical analyses included paired t-test and chi-square test for hypothesis testing, with a p-value of <0.05 considered statistically significant.

RESULTS

Demographics And Preoperative Characteristics

The mean age of the study population was 27.3±20.7 years, with 55% female and 45% male patients (Table 1). The study included 35% children under 10 years of age. Most patients (76%) had no comorbidities, while 15% had hypertension, 4% had diabetes mellitus, 4% had both hypertension and diabetes, and 1% had hemophilia. Risk factors included smoking (6%), alcohol consumption (1%), and both smoking and alcohol (6%). The majority of patients (88%) had normal built, 8% were thin, and 4% were obese.

Preoperative findings revealed a mean Glasgow Coma Scale (GCS) score of 14.07±1.6, with 84% having mild (13-15), 14% moderate (9-12), and 2% severe (3-8) scores. The mean hemoglobin level was 11.1±1.7 g/dL, and mean serum albumin was 4.1±0.8 g/dL. Preoperative hydrocephalus was present in 36% of patients, and

ventriculoperitoneal (VP) shunt was performed in 34%.

Table 1: Demographic And Preoperative Characteristics Of Patients

Characteristic	Value
Demographics	
Mean age (years)	27.3±20.7
Gender (M:F ratio)	0.8:1
Comorbidities	
Hypertension	15%
Diabetes mellitus	4%
Hypertension + Diabetes	4%
Hemophilia	1%
None	76%
Preoperative Parameters	
Mean GCS score	14.07±1.6
Mean Hemoglobin (g/dL)	11.1±1.7
Mean Albumin (g/dL)	4.1±0.8
Preoperative hydrocephalus	36%
Preoperative VP shunt	34%

Pathology And Surgical Details

The most common pathologies were cerebellopontine angle space-occupying lesions (26%), fourth ventricular tumors (15%), cerebellar tumors (11%), and brainstem tumors (10%) (Table 2). Histopathological examination revealed schwannoma (22%) as the most common finding, followed by glioma (12%), ependymoma (8%), medulloblastoma (8%), and cerebellar bleed (8%).

Craniotomy was performed in 75% of cases and craniectomy in 25%. The most common surgical approaches were retromastoid retrosigmoid (RMRS) craniotomy (39%), midline suboccipital craniotomy (23%), midline suboccipital craniectomy (14%), and lateral suboccipital craniotomy (9%).

For dural closure, autologous graft was used in 45% of cases, primary closure in 21%, autologous graft with adhesive barrier matrix in 20%, adhesive barrier matrix alone in 6%, and no dural closure in 8%. Among the autologous grafts, pericranium was used in 50%, temporalis fascia in 39.06%, and fascia lata in 10.94%.

Table 2: Pathology And Surgical Details

Parameter	Frequency
Type of Lesion	
CP Angle SOL	26%
4th Ventricular Tumor	15%
Cerebellar Tumor	11%
Brain Stem Tumor	10%
Other lesions	38%
Surgical Approach	
RMRS Craniotomy	39%
Midline Suboccipital Craniotomy	23%
Midline Suboccipital Craniectomy	14%
Lateral Suboccipital Craniotomy	9%
Other approaches	15%
Dural Closure	
Autologous graft	45%
Primary	21%
Autologous graft + adhesive barrier matrix	20%
Adhesive barrier matrix	6%
None	8%

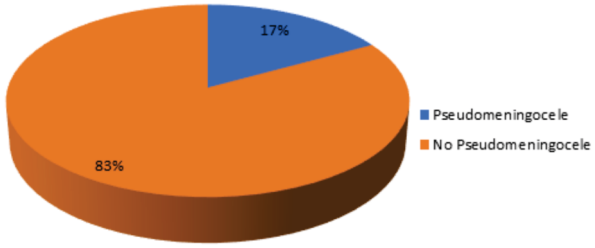
Pseudomeningocele Incidence And Associated Factors

The overall incidence of pseudomeningocele was 17% (Table 3). Among these 17 cases, 12 (70.6%) occurred after craniotomy and 5 (29.4%) after craniectomy. No statistically significant relationship was found between the type of surgical approach and pseudomeningocele occurrence (p=0.765).

Regarding dural closure techniques, pseudomeningocele occurred in 7 of 45 cases (15.6%) with autologous graft, 5 of 21 cases (23.8%) with primary closure, 4 of 20 cases (20%) with combined autologous graft and adhesive barrier matrix, 0 of 6 cases with adhesive barrier matrix alone, and 1 of 8 cases (12.5%) with no dural closure. No statistically significant relationship was found between the type of dural closure and pseudomeningocele occurrence (p=0.694).

Patients who developed pseudomeningocele had similar mean GCS (14.12 vs. 14.06) and hemoglobin levels (11.06 vs. 11.21 g/dL) compared to those without pseudomeningocele, but lower mean albumin levels (3.62 vs. 4.32 g/dL). However, these differences were not statistically significant (p=0.294).

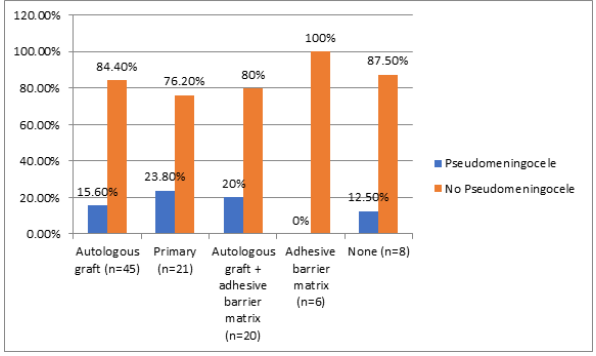
The incidence of pseudomeningocele was lower in patients with preoperative hydrocephalus (13.89%) compared to those without (18.75%), and in patients who underwent preoperative VP shunt placement (14.71%) compared to those who did not (18.18%).



Graph 1: Incidence of Pseudomeningocele

Table 3: Pseudomeningocele Incidence And Associated Factors

Parameter	Pseudomeningocele (n=17)	No Pseudomeningocele (n=83)
Surgical Procedure		
Craniotomy (n=75)	12 (16%)	63 (84%)
Craniectomy (n=25)	5 (20%)	20 (80%)
Dural Closure		
Autologous graft (n=45)	7 (15.6%)	38 (84.4%)
Primary (n=21)	5 (23.8%)	16 (76.2%)
Autologous graft + adhesive barrier matrix (n=20)	4 (20%)	16 (80%)
Adhesive barrier matrix (n=6)	0 (0%)	6 (100%)
None (n=8)	1 (12.5%)	7 (87.5%)
Preoperative Parameters		
Mean GCS	14.12	14.06
Mean Hb (g/dL)	11.06	11.21
Mean Albumin (g/dL)	3.62	4.32
Hydrocephalus & VP Shunt		
With preoperative hydrocephalus (n=36)	5 (13.89%)	31 (86.11%)
Without preoperative hydrocephalus (n=64)	12 (18.75%)	52 (81.25%)
With preoperative VP shunt (n=34)	5 (14.71%)	29 (85.29%)
Without preoperative VP shunt (n=66)	12 (18.18%)	54 (81.82%)



Graph 2: Comparison Of Dural Closure Among Those With And Without Pseudomeningocele

Postoperative Outcomes

Postoperative CSF leak occurred in 8% of patients (Table 4). Postoperative management was required in 27% of cases, including conservative management (9%), external ventricular drainage (7%), VP shunt (5%), lumbar drain (3%), and other interventions (3%). Of the 17 patients who developed pseudomeningocele, 9 responded to conservative management, 7 required CSF diversion procedures (VP shunt or external drainage), and 1 needed anatomical repair of the pseudomeningocele.

The final outcome showed 96% of patients were discharged, 1%

required surgical repair, and 3% died.

Table 4: Postoperative Outcomes

Outcome	Frequency
CSF Leak	
Present	8%
Absent	92%
Postoperative Management	
None	73%
Conservative	9%
EVD	7%
VP shunt	5%
Lumbar drain	3%
Other interventions	3%
Final Outcome	
Alive/discharged	96%
Surgical repair	1%
Dead	3%

DISCUSSION

This prospective observational study aimed to determine the incidence of pseudomeningocele following posterior fossa surgery and identify associated risk factors. The overall incidence of pseudomeningocele in our study was 17%, which falls within the range of 4-23% reported in previous literature.[5,6] This variation in reported incidence can be attributed to differences in surgical techniques, patient populations, and diagnostic criteria used across studies. Lee YM et al. reported a lower incidence of 4.1% for CSF leak,[14] whereas Mohamed et al. found a 10% rate of CSF leak in their study.[15] Sastry RA et al. reported a 13% incidence of pseudomeningocele,[16] which is comparable to our findings.

Our study found that factors such as nutritional status (as indicated by albumin levels), type of surgical approach, and dural closure technique may influence the development of pseudomeningocele, although these associations did not reach statistical significance. Patients who developed pseudomeningocele had lower mean albumin levels (3.62 g/dL) compared to those without (4.32 g/dL), suggesting that nutritional status may play a role in wound healing and prevention of CSF leakage. This aligns with general surgical principles where adequate protein levels are necessary for tissue repair. Additionally, the incidence of pseudomeningocele was slightly higher after craniectomy (20%) compared to craniotomy (16%), which is consistent with findings from Gnanalingham et al., who demonstrated that craniotomy significantly reduces postoperative CSF leakage and pseudomeningocele formation compared to craniectomy.[17] Legnani FG et al. reported a higher complication rate of 32.6% for the craniectomy group compared to 7% for the craniotomy group.[18]

The type of dural closure technique also appeared to influence pseudomeningocele formation, with lower rates observed when using autologous grafts alone (15.6%) compared to primary closure (23.8%) or combined techniques (20%). This finding supports the importance of tension-free dural closure using autologous grafts when primary closure cannot be achieved. Furthermore, our study found a lower incidence of pseudomeningocele in patients with preoperative hydrocephalus who underwent VP shunt placement (14.71%) compared to those without preoperative VP shunt (18.18%). This suggests that addressing underlying hydrocephalus may help reduce the risk of pseudomeningocele formation, as supported by studies like Culley DJ et al., who emphasized the importance of CSF diversion in patients with hydrocephalus.[10] Hadanny A et al. also reported a similar finding with a 14% incidence of pseudomeningocele in their study,[13] highlighting the consistency of our results with existing literature.

CONCLUSION

The incidence of pseudomeningocele following posterior fossa surgery in this study was 17%. While no statistically significant associations were found between pseudomeningocele formation and factors such as type of surgical approach, dural closure technique, or preoperative parameters, trends were observed suggesting potential protective factors. These include preoperative optimization of nutritional status (as indicated by albumin levels), performing craniotomies rather than craniectomies when possible, using autologous grafts for dural closure, and preoperative ventriculoperitoneal shunt placement in cases with hydrocephalus.

Based on these findings, we recommend preoperative optimization of nutritional status, albumin and hemoglobin levels, performing craniotomies whenever possible, tension-free dural closure using autologous grafts, and preoperative ventriculoperitoneal shunt placement in cases with hydrocephalus to reduce the incidence of pseudomeningocele. Early intervention is also recommended to minimize complications and morbidity associated with pseudomeningocele formation.

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