Pakistan Journal of Intensive Care Medicine
eISSN: 2708-2261; pISSN: 2958-4728
www.pjicm.com
DOI: https://doi.org/10.54112/pjicm.v5i01.54
Pak. J. Inten. Care Med., volume 2025: 54

Original Research Article

COMPARISON OF CSF LEAK IN NEONATES UNDERGOING MENINGOMYELOCELE REPAIR WITH AND WITHOUT VENTRICULOPERITONEAL SHUNT DONE IN A TERTIARY CARE HOSPITAL

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(Received, 05th March 2025, Revised 26th March 2025, Accepted 4th April, Published 05th April 2025)

ABSTRACT

Background: *Cerebrospinal fluid (CSF) leakage is a significant complication following meningomyelocele (MMC) repair, potentially leading to infections and poor surgical outcomes. The role of ventriculoperitoneal (VP) shunt placement in reducing CSF leaks remains a topic of debate. Understanding the impact of VP shunts on CSF leak rates can help optimize neurosurgical management strategies in neonates undergoing MMC repair.* ***Objective:*** *To compare the incidence of CSF leaks in neonates undergoing MMC repair with and without VP shunt placement.* ***Study Design:*** *Descriptive analysis.* ***Setting:*** *The study was conducted in the Department of Neurosurgery at Lady Reading Hospital, Peshawar.* ***Duration of Study:*** *This study was conducted from August 04, 2024, to February 04, 2025.* ***Methods:*** *A total of 100 neonates (aged 1 to 28 days) diagnosed with MMC were enrolled. Exclusion criteria included neonates with a low Apgar score (less than 5) and those whose parents declined consent. All neonates underwent standard neurosurgical closure of the MMC defect within 24 hours of admission. Patients were categorized into two groups: those who received a VP shunt (n = 72) and those who did not (n = 28). CSF leaks were assessed clinically based on the presence of osseous defects with fluid leakage. The incidence of CSF leaks was compared between the two groups using statistical analysis. A p-value of less than 0.05 was considered statistically significant.* ***Results:*** *The mean age of neonates was 13.73 ± 8.22 days. Among the 100 neonates, VP shunts were placed in 72, while 28 did not receive shunts. The overall incidence of CSF leaks was 9%. A significant difference in CSF leak rates was observed between the groups: only 2.8% of neonates with VP shunts developed CSF leaks compared to 25% of those without VP shunts (p = 0.0001), indicating a strong protective effect of VP shunt placement.* ***Conclusion:*** *This study demonstrates that VP shunt placement significantly reduces the incidence of CSF leaks in neonates undergoing MMC repair. Neonates who did not receive VP shunts had a markedly higher rate of CSF leaks, highlighting the potential benefit of early VP shunt placement in improving postoperative outcomes. Further studies with larger cohorts are warranted to validate these findings and guide clinical decision-making.*

Keywords: Asphyxia, Neonatal deaths, Resuscitation, Mortality

INTRODUCTION

Cerebrospinal fluid (CSF) constitutes an ultrafiltrate of plasma found within the brain's ventricles, as well as the subarachnoid spaces of the cranium and spine (1). Cerebrospinal fluid is primarily generated by the choroid plexus, with additional sources contributing in a less defined manner. The continuous production of cerebrospinal fluid (CSF) facilitates a complete renewal of CSF approximately four to five times within a 24-hour cycle in the typical young adult. The decrease in cerebrospinal fluid turnover may play a role in the accumulation of metabolites observed in aging, as well as in neurodegenerative conditions. The composition of cerebrospinal fluid (CSF) is meticulously regulated, and any deviations can serve as valuable diagnostic indicators. 1. [1 It] carries out essential functions, such as delivering nourishment, facilitating waste removal, and safeguarding the brain (2).

Folate deficiency is recognized as an essential contributor to the development of myelomeningocele (MMC), and folate supplementation has garnered substantial interest as a preventive measure (3). Anti-epileptic medications raise the risk of MMCs, with sodium valproate contributing to a 20-fold increase in risk. Five Additional factors believed to elevate the risk of MMCs include diabetes, obesity, prolonged exposure to heat, fever, alcohol consumption, tobacco use, and use of illicit substances. 4The survival rate for neonates born with a myelomeningocele before the 1960s ranged from 10% to 12% (4).

Treatment was generally deferred until the patient reached 2 years of age, with survival outcomes relying on a self-selected cohort. The availability of antibiotics, advancements in the development of ventriculoperitoneal (VP) shunts, and successful management of neuropathic bladder have significantly enhanced survival rates in neonates born with myelomeningocele (MMC). This progress has resulted in a paradigm shift, encouraging the repair of MMCs within 48 to 72 hours post-birth (5). It has been demonstrated that performing repair immediately after birth, referred to as “time zero repair,” yields superior long-term outcomes. According to this paradigm shift, it is anticipated that at least 75% of kids born with MMCs will reach early adulthood (5-8). A study reported the frequency of CSF leak was 15% after meningomyelocele repair (9).

MMC repair is a relatively uncommon procedure in the Western World secondary to better nutrition and early detection. However, it still poses a significant health burden in the developing World, like Pakistan, with devastating outcomes for the affected child and family. Therefore, I plan to compare the frequency of CSF leaks in neonates undergoing meningomyelocele repair with and without a ventriculoperitoneal shunt at Lady Reading Hospital, Peshawar.

METHODOLOGY

This research was conducted as a descriptive analysis in the Department of Neurosurgery at Lady Reading Hospital, Peshawar, from August 04, 2024, to February 04, 2025. We calculated a sample of 100 neonates with a 95% confidence interval and a 7% margin of error, and an expected frequency of cerebrospinal fluid (CSF) leak of 15% following meningomyelocele repair, as reported in a prior study (9). Non-probability consecutive sampling was employed to select

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participants. Neonates aged between 1 and 28 days, of both genders, diagnosed with myelomeningocele with or without ventriculoperitoneal (VP) shunt placement, were included in the study. Neonates with a low Apgar score (less than 5) at birth or those whose parents declined to provide consent were omitted.

Data collection commenced after obtaining ethical approval from the hospital. Baseline demographic information, which included age, weight, gender, and the presence or absence of a preoperative VP shunt, was recorded for each participant. All neonates underwent standard neurosurgical closure of the myelomeningocele defect within 24 hours of admission. Postoperatively, the stitches were removed after 10 days, and the presence or absence of a CSF leak was evaluated based on the visualization of an osseous defect with cerebrospinal fluid leakage from the wound site. This information was documented on a specially designed proforma.

For the analysis of our data, we used SPSS 25. Frequencies with percentages were calculated for gender, VP shunt status, and CSF leak occurrence. Age and weight were presented as mean ± standard deviation. The chi-square test was used to compare the incidence of CSF leaks between neonates with and without VP shunts, with a p-value of less than 0.05 considered significant. Additionally, CSF leak rates were stratified by demographic variables, and post-stratification analysis was performed using the chi-square test, with a notable P value of less than 0.05.

RESULTS

The average age of the neonates was 13.73 ± 8.223 days, while their mean weight was 4.87 ± 1.412 kg. Among the participants, 61 (61%) were male and 39 (39%) were female. Regarding the use of ventriculoperitoneal (VP) shunts, around 72 (72%) neonates underwent the procedure with a VP shunt, whereas 28 (28%) did not receive a shunt (Figure 1). Cerebrospinal fluid (CSF) leaks occurred in around 9 (9%) neonates (Table 1).

When examining the relationship between VP shunt placement and CSF leaks, notable differences were observed. Among the 72 neonates with a VP shunt, only 2 (2.8%) had a CSF leak, whereas 28 neonates without a VP shunt had 7 (25%) with a CSF leak. This association was statistically not worthy (P = 0.0001) (Table 2).

We also explored whether demographic factors influenced the occurrence of CSF leaks. CSF leaks were not associated with demographic factors such as age, weight, and gender in neonates (Table 3).

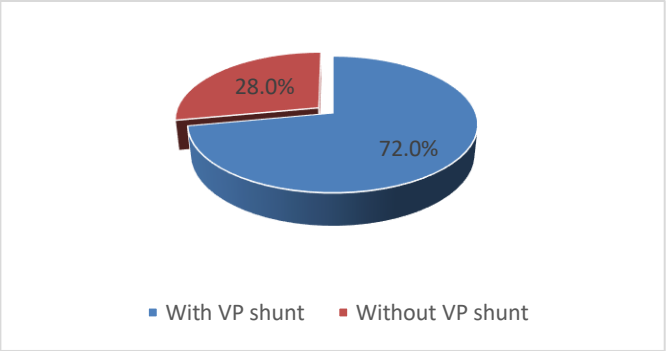

Figure 1: Use of ventriculoperitoneal shunt

Table 1: Frequency of CSF leak

CSF leak	Frequency	Percent
Yes	9	9.0
No	91	91.0
Total	100	100.0

Table 2: Comparison of CSK leak between meningomyelocele repair with VP shunt and without VP shunt

		CSF leak		Total	P value
		Yes	No		
Meningomyelocele repair VP shunt	With VP shunt	2	70	72	0.0001
		2.8%	97.2%	100.0%	
	Without a VP shunt	7	21	28	
		25.0%	75.0%	100.0%	
Total		9	91	100	
		9.0%	91.0%	100.0%	

Table 3: Stratification of CSK leak with demographics

Demographics		CSF leak				P value
		Yes		No		
		N	%	N	%	
Age distribution (Years)	1 to 15	7	77.8%	48	52.7%	0.15
	16 to 28	2	22.2%	43	47.3%	
Gender	Male	5	55.6%	56	61.5%	0.72
	Female	4	44.4%	35	38.5%	
Weight (Kg)	3 to 5	6	66.7%	57	62.6%	0.81
	> 5	3	33.3%	34	37.4%	

DISCUSSION

In our study, 72% of the neonates underwent VP shunt placement while 28% did not receive a shunt. CSF leaks occurred in 9% of the neonates, with a striking difference observed between those with and without VP shunts. Specifically, only 2.8% of neonates with a VP shunt experienced CSF leaks, compared to 25% of those without a shunt.

The findings from our study align well with several previous investigations, although there are variations in the reported rates of CSF leaks and the impact of VP shunt placement. In the study by Yilmaz et al., the authors compared synchronous and sequential VP shunt placement in neonates with myelomeningocele or myeloschisis and hydrocephalus. They found no notable difference in CSF leakage rates between the two groups. Still, their study highlighted that early shunt placement could reduce the duration of hospital stay and potentially lower the risk of complications (10). Similarly, Hashim Almusawi's study on neonates with lumbar meningocele and

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hydrocephalus, comparing VP shunt placement before and after meningocele repair, indicated that neonates who underwent VP shunt placement before repair had better outcomes, with fewer instances of CSF leaks and wound infections (11). This supports our observation that VP shunt placement may mitigate the risk of CSF leaks.

In contrast, some studies have reported higher frequencies of CSF leaks in neonates without VP shunts. Gohar et al. found that 16.3% of neonates had CSF leaks after spinal dysraphism repair, with a higher incidence in those without VP shunts. Their study also noted that most CSF leaks could be managed with VP shunt placement in cases complicated by postoperative hydrocephalus (12). This finding is consistent with our results, which show that neonates without VP shunts had a notably higher rate of CSF leaks compared to those with shunts. The protective effect of VP shunts may be attributed to the reduction in intracranial pressure and CSF dynamics, which can help prevent leakage from the repair site.

Demographic factors, such as age, weight, and gender, did not exhibit an association with CSF leaks in our study. Khan et al. reported that short-term complications such as CSF leaks were more influenced by surgical factors and the presence of hydrocephalus (9).

The higher incidence of CSF leaks in neonates without VP shunts underscores the importance of promptly placing shunts for managing hydrocephalus associated with MMC. Delayed shunt placement can lead to increased intracranial pressure, which may exacerbate cerebrospinal fluid (CSF) leakage from the repair site. This is supported by the findings of Radmanesh et al., who demonstrated that early shunt placement could reduce the risk of complications such as CSF leaks and wound infections. Additionally, the study by Yilmaz et al. stressed that synchronous VP shunt placement and MMC repair could be more cost-effective and decrease the duration of hospital stay, further supporting the benefits of early intervention (10).

Our study also raises important considerations for clinical practice. The notable reduction in CSF leaks among neonates with VP shunts suggests that shunt placement should be strongly considered in cases where hydrocephalus is present.

Our study demonstrates that VP shunt placement is linked with a notably lower incidence of CSF leaks in neonates undergoing MMC repair. While demographic factors did not influence the incidence of CSF leaks, other factors, such as nutritional status and surgical technique, may play a role. Future studies should further explore these variables to develop inclusive guidelines for managing MMC and its associated complications.

CONCLUSION

We conclude that VP shunt placement reduces the incidence of CSF leaks in neonates undergoing myelomeningocele repair. Among 72 neonates, only 2.8% had CSF leaks, compared to 25% of 28 neonates without shunts. These findings emphasize the importance of VP shunt placement in managing hydrocephalus and preventing postoperative complications in this vulnerable population.

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. (IRB-REF-155/LRH/MTI)

Consent for publication

Approved

Funding

Not applicable

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTION

BASHIR ULLAH (Postgraduate Resident)
Conception of the Study, Date Collection, Development of Research Methodology Design, Study Design, Review of the manuscript, and manuscript drafting.
ZIA-UR-REHMAN (Assistant Professor)
Manuscript revisions, critical input.
HAIDER ALI (Registrar Neurosurgery)
Review of Literature.
SARDAR ALI (Postgraduate Resident)
Review of Literature.
NAVEED KHAN (Postgraduate Resident)
Review of Literature.
MUHAMMAD BILAL (Postgraduate Resident)
Review of Literature.

REFERENCES

1. Sakka L, Coll G, Chazal J. Anatomy and physiology of cerebrospinal fluid. Eur Ann Otorhinolaryngol Head Neck Dis. 2011;128(6):309-16.
2. Spector, R., Snodgrass, R., & Johanson, C. E. A balanced view of cerebrospinal fluid composition and functions, with a focus on adult humans. Exp Neurol. 2015;273:57-68.
3. Dias MS. Neurosurgical management of myelomeningocele. Pediatr Rev. 2005;26(2):50-60.
4. Copp AJ, Adzick NS, Chitty LS, Fletcher JM, Holmbeck Gn, Shaw GM. Nat Rev Dis Prim. 2015;1(1):1-8.
5. Pruitt LJ. Living with Spina Bifida: A Historical Perspective. Pediatrics. 2012;130(2):181-3.
6. Pinto FC, Matushita H, Furlan AL, Alho EJ, Goldenberg DC, Bunduki V, Krebs VL, Teixeira MJ. Surgical treatment of myelomeningocele is carried out at 'time zero ', immediately after birth. Pediatr Neurosurg. 2009;45(2):114-8.
7. Türk Ç, Sevgi Ut, Öncel Ek, Çamlar M, Akgül O, Özer F. Clinical outcomes and complication rates of ventriculoperitoneal shunts in hydrocephalic infants with meningomyelocele: A Ten-year review at a single institution. Children. 2024;11(12):1508.
8. Saarinen O, Piironen S, Pokka T, Sinikumpu JJ, Serlo W, Salokorpi N, et al. To shunt or not to shunt when closing myelomeningocele? A systematic review and meta-analysis of simultaneous versus delayed ventriculoperitoneal shunt placement in neonates undergoing myelomeningocele closure. Journal of Neurosurgery: Pediatrics. 2024.
9. Khan MI, Ullah W, Ishfaq M, Khan BZ, Ali M. Short-term complications of myelomeningocele repair. An experience in the neurosurgery department of Lady Reading Hospital, Peshawar. Pak J Neurol Surg. 2018;20(2):94-9.
10. Yilmaz A, Müslüman AM, Dalgıc N, Çavuşoğlu H, Kanat A, Çolak I, Aydın Y. Shunt insertion in newborns with myeloschisis/myelomeningocele and hydrocephalus. *J Clin Neurosci*. 2010;17(12):1493-1496.
11. Hashim Almusawi AA. Whether or not a shunt is placed in the brain (pre-/post-repair) for patients with a lumbar meningocele and

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hydrocephalus undergoing a lumbar meningocele procedure. *Indian J Forensic Med Toxicol.* 2021;15(3):1748-1750.
12. Gohar R, Rehman L, Bokhari I, Ahmed T, Ahmed S, Mumtaz D. Incidence of post-operative cerebrospinal fluid leak in patients operated for spinal dysraphism. *Pak J Neurol Surg.* 2023;27(2):187-192.
13. Radmanesh F, Nejat F, El Khashab M, Ghodsi SM, Ardebili HE. Shunt Complications in Children with Myelomeningocele: The Effect of Timing of Shunt Placement. *J Neurosurg Pediatr*. 2009;3(6):516-520.

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