

RATE OF SHUNT INFECTION AFTER MYELOMENINGOCELE REPAIR

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ABSTRACT:

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Received: 22/11/ 2022
Accepted: 26/11/ 2022

Online ISSN: 2735-3540

Background: The standard treatment for myelomeningocele (MMC)-related hydrocephalus is a ventriculoperitoneal shunt (VPS). Many authors believe that simultaneous shunting with MMC repair increases shunt infection.

Aim of the work: This study aimed to detect the difference in the one-year incidence of shunt infection in the simultaneous versus delayed placement of VPS after MMC repair.

Methods: This retrospective cohort study reviewed the medical records at our institution. We identified the infants who underwent repair of an intact lumbosacral MMC from 2012 to 2019. Infants who underwent VPS placement within 90 days of MMC repair were included. We divided the infants into two groups; the simultaneous shunting group (I) and the delayed shunting group (II).

Results: This study included 102 patients. Two cases (4.7%) out of 42 in group (I) developed shunt infection, while six cases (10%) out of 60 in group (II) developed shunt infection. The mean duration between shunt placement and shunt infection was 48.5 and 29.3 days for groups (I) and (II), respectively.

Conclusions: There was no statistically significant difference in the one-year incidence of shunt infections among both groups. In addition, the mean duration between shunt placement and shunt infection was not statistically significant among the infected patients.

Keywords: cerebrospinal fluid leak; hydrocephalus; infection; myelomeningocele; ventriculoperitoneal shunt

INTRODUCTION:

Myelomeningocele (MMC) is a congenital neural tube defect. Its incidence varies significantly between countries, being highest in the UK, North India, and Egypt. The reported frequency was as high as 6.39 per 1000 live births^[1-3].

Postnatal MMC repair is best performed within 72 hours of birth to decrease the potential risk of infection^[4&5].

Hydrocephalus (HCP) remains a fundamental problem in MMC patients^[6]. The standard treatment for MMC-related

hydrocephalus is a ventriculoperitoneal shunt (VPS)^[7].

Today, myelomeningocele patients have longer survival; however, shunts are still responsible for the high rate of morbidity that affects this population. The most frequent complication of VPS is infection. The reported rate of VPS infection ranged between 2 and 39%^[8].

Currently, there is a controversy regarding the most appropriate timing of shunt insertion in MMC patients with ventriculomegaly. Many authors have

suggested the insertion of a VPS with MMC repair in one session [9-12]. Others believe that simultaneous shunting increases shunt infection and prefer to follow the infants after MMC repair. Then they place the shunt upon the development of clinical features of progressive hydrocephalus^[5,6,13&14].

Shunt insertion in one session with MMC repair may provide rapid recovery of the MMC wound, decrease the duration of hospitalization, and can help to protect the brain from increased intracranial pressure (ICP)^[9].

AIM OF THE WORK:

This study aimed to detect the difference in the one-year incidence of shunt infection in the simultaneous versus delayed placement of VPS after MMC repair.

MATERIAL AND METHODS:

This is a descriptive, retrospective cohort study. It was reported following the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.

The study procedures have been carried out under the Code of Ethics of the World Medical Association (Declaration of Helsinki). The collected clinical data was anonymized.

The study was approved by the faculty's research ethics committee at our university (FWA 000017585) on June 24, 2021. Informed consent was obtained as required.

We retrospectively reviewed the medical records at our institution. We identified the infants who underwent repair of an intact lumbosacral MMC from 1 January 2012 to 31 December 2019. Infants who underwent VPS placement either simultaneously or within 90 days of MMC repair were included. Low birth weight (> 2.5 kg) neonates and infants who underwent MMC repair after 72 hours of birth were excluded.

The included patients were divided into two groups:

- Group I (simultaneous shunting group): VPS was inserted with MMC repair in one session.
- Group II (delayed shunting group): VPS was placed in a separate operation within 90 days of MMC repair.

The collected data included the following: patients' demographics, pre-operative clinical state, radiological findings, the timing of VPS placement, and the incidence of shunt infection within one year of shunt placement.

At birth, the placode was kept moist and sterile until repaired. Latex precautions were maintained. A brain imaging, transfontanellar ultrasound, magnetic resonance imaging (MRI), or computed tomographic (CT) scan was performed before MMC repair.

Perioperative prophylactic antibiotics were administered for every MMC repair and/or shunting procedure. The MMC repair was done in the standard three-layer fashion.

Some neurosurgeons in our department prefer to place a VPS simultaneously with MMC repair. Others prefer to follow up with the infants (after MMC repair) and place a VPS upon the development of clinical features suggestive of progressive hydrocephalus.

Several clinical parameters were used to predict progressive HCP, such as head circumference crossing the percentile for age, bulging fontanelle, sun-setting sign, wound leak, and repeated vomiting or seizures.

Intraoperatively, during VPS placement, the CSF samples taken from the lateral ventricle were analyzed and their parameters were acceptable. The same shunt type (CSF Flow-Control non-impregnated medium-pressure shunt) was used in all cases. The ventricular catheter was inserted through a small burr-hole in the parieto-occipital area.

Shunt infection after MMC repair

Each patient was operated on by a consultant in neurosurgery, assisted by a resident.

Shunt infection was clinically suspected by recurrent fever, repeated vomiting, poor feeding, irritability, seizures, and a bulging anterior fontanelle. Thus, CSF samples were obtained for analysis and culture from the shunt reservoir or ventricular tapping under aseptic conditions. Shunt infection was confirmed biochemically by a WBC count of > 15 cells/mm³, protein concentration > 127 mg/dl, and glucose concentration < 25 mg/dl.

Once the VPS infection was confirmed, the shunt was removed and external ventricular drainage (EVD) was inserted. When three consecutive daily CSF samples became sterile with accepted CSF parameters, a new VP shunt was placed.

The acceptable CSF parameters to insert a VPS in our department were WBC count ≤ 15 cells/mm³, protein concentration ≤ 127 mg/dl, and glucose concentration ≥ 25 mg/dl.

Statistical analysis:

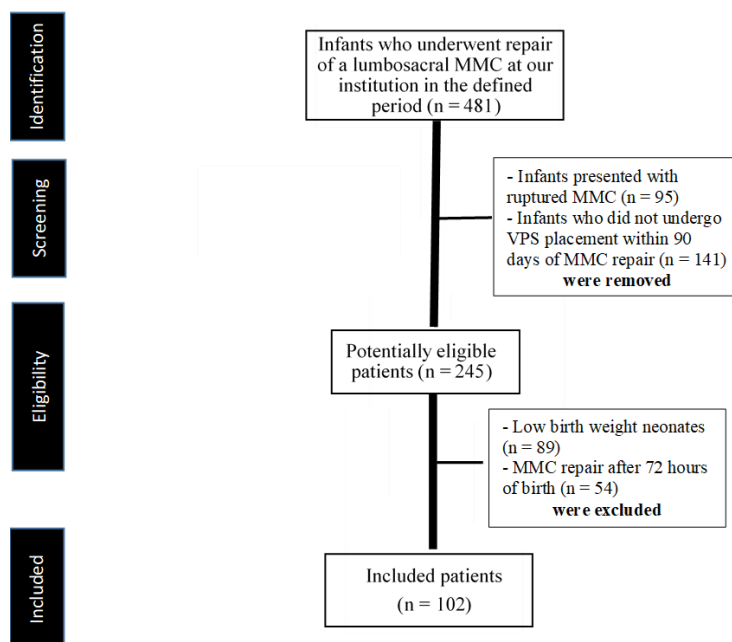
Quantitative data was described by the mean, standard deviation, and range, while qualitative data was described by frequencies. The comparison between groups with qualitative data was done using the *chi-square test*. The comparison between groups with quantitative data was done using the *Independent t-test*. The p-value was considered significant when $P < 0.05$. We conducted the statistical analyses using SPSS software version 21 (IBM Corp., Armonk, New York, USA).

RESULTS:

This study included 102 infants who met our selection criteria. There were 57 girls and 45 boys. The flow diagram of the patient selection is shown in Figure (1).

The number of cases in each group is listed in Table I.

In group (II), no chest, urinary, or other organ infection was documented within one week before the VPS procedure.



All the operations were uneventful. The myelomeningoceles were repaired adequately without tension sutures. The mean duration of the surgical repair of the MMC was 48.4 min ± 2.9 min (ranging between 43 and 54 min). The mean duration of the VP shunt operation was 41.5 min ± 5.2 min (ranging between 34 and 52 min).

The VPS operations in group (II) patients followed the MMC repair by a mean duration of 54.8 days ± 17.4 days (ranging from 9 to 89 days).

There was no mortality in the included patients during the follow-up period.

There were no MMC wound complications in group (I) patients.

In group (II), four patients (6.6%) experienced CSF leak from the wound of the repaired MMC. No MMC wound infection or necrosis was reported in any patient.

Eight patients (7.8%) developed VPS infection within one year of shunt placement; two cases (4.7%) out of 42 in group (I) and six patients (10%) out of 60 in group (II). There was no statistically significant difference in the incidence of shunt infections between both groups (p-value = 0.33).

The mean duration between shunt placement and shunt infection was 44.2 days (ranging between 25 and 54 days). The clinical features of the eight patients who developed shunt infections in this study are shown in Table 2. There was a statistically insignificant difference in the mean duration between shunt placement and shunt infection between both groups (p-value = 0.06).

All the cases that experienced CSF leak from the wound of the repaired MMC developed shunt infection.

Table (1): The number of cases in each group

	Simultaneous shunting group (I)	Delayed shunting group (II)	Total
Girls	23	34	57
Boys	19	26	45
Total	42	60	102

Table (2): Clinical features of the eight patients who developed shunt infections

	Simultaneous shunting (Group I)	Delayed shunting (Group II)	P-value
Number of shunt infection patients	2	6	0.33*
Gender	Boys	5	0.34*
	Girls	1	
The mean duration between shunt placement and shunt infection (days)	48.5	29.3	0.06†
CSF leak from the repaired MMC wound	0	4	0.1*

* Chi-square test

† t-test

DISCUSSION:

In the present study, 7.8% of the included patients developed VPS infection within one year of shunt placement. The one-year incidence of shunt infection in infants who underwent simultaneous VPS with MMC repair and infants who underwent VPS

placement within 90 days of MMC repair was 4.7% and 10%, respectively. The incidence of shunt infections between both groups was statistically insignificant. In addition, there was no statistically significant difference in the mean duration between shunt placement and shunt infection among both groups.

Shunt infection after MMC repair

The results of this study suggest that the timing of shunt placement (to MMC repair) did not have a significant impact on the incidence of shunt infection. Accordingly, performing a VPS on a newborn with normal birth weight at the same time as repairing an intact lumbosacral MMC does not seem to raise the chance of shunt infection.

All the cases that experienced wound CSF leaks after repairing the MMC (before shunting) developed shunt infections. Thus, we suggest managing wound CSF leak as a potential CSF infection and placing a VPS only when three consecutive daily CSF samples are sterile and with acceptable parameters.

The reported VP shunt infection rates in the simultaneous shunting group in Arslan et al., Gurbuz et al., and Margaron et al. studies were 12.3%, 13.6%, and 23.1%, respectively^[5,8&15].

Multiple variables can be related to shunt infection. Infants who underwent MMC repair after 72 hours of life and low birth weight neonates (low immunity and long NICU stays) were excluded from our study as these patients have a high risk of infection.

The rates of VPS infection in the delayed shunting group in Arslan et al., Gurbuz et al., and Margaron et al. studies were 3.44%, 5.7%, and 6.5%, respectively^[5,8&15]. However, Khattak et al. found a higher infection rate in the delayed shunting group (20%) than in the simultaneous shunting group (12%)^[9].

The simultaneous shunting with MMC repair limits tension on the MMC wound, hence promoting its rapid healing. In addition, this approach decreases hospital stays.

It may be reasonable to avoid simultaneous shunting with MMC repair in infants presenting after 72 hours of life, low birth weight neonates, and infants with ruptured MMC to limit shunt infections.

Although the retrospective nature of this study is one of its limitations, there was no missing data. Another limitation is the exclusion of neonates with low birth weight. However, our hospital's consensus is to repair the MMC in low birth weight neonates (without simultaneous shunting) and then monitor them for clinical manifestations of progressive HCP.

Conclusions:

The one-year incidence of shunt infection in infants who underwent simultaneous VPS with MMC repair and infants who underwent VPS placement within 90 days of MMC repair was 4.7% and 10%, respectively. That difference in the one-year incidence of shunt infection was not significant. In addition, there was no statistically significant difference in the mean duration between shunt placement and shunt infection among both groups. These results suggest that the timing of shunt placement (to MMC repair) does not affect the incidence of shunt infection.

Conflict of Interest:

The authors report no conflicts of interest.

Financial Disclosures:

No funding was received for this research

Authors' contributions:

The conception and the design of the study were made by MA, HI and MN. MM, MA and AA collected the data of the patients. MA, HI and AA analyzed and interpreted the patients' data. MA, MN and MM wrote the manuscript. All authors read and approved the final manuscript.

This paper has not been published in its current form or substantially similar form elsewhere including on a web site and also, it has not been accepted for publication elsewhere.

Acknowledgments:

Not applicable.

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معدل التهاب الصمام المخى بريتونى بعد إصلاح القيلة النخاعية السحائية

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الملخص

الخلفية: العلاج القياسي لاستسقاء الدماغ المرتبط بالقيلة النخاعية السحائية (MMC) هو الصمام المخى بريتونى (VPS). يعتقد العديد من الجراحين أن الصمام المتزامن مع إصلاح MMC يزيد من التهاب الصمام.

الهدف: هدفت هذه الدراسة إلى اكتشاف الاختلاف في حدوث عدوى الصمام لمدة عام بعد إصلاح MMC.

الطرق: استعرضت هذه الدراسة بأثر رجعي السجلات الطبية في مؤسستنا. حددنا الأطفال الذين خضعوا لإصلاح MMC السليم من عام 2012 إلى عام 2019. تم تضمين الرضع الذين خضعوا لوضع VPS في غضون 90 يومًا من إصلاح MMC. قسمنا الأطفال إلى مجموعتين؛ مجموعة التحويل المتزامن (I) ومجموعة التحويل المتأخر (II).

النتائج: شملت هذه الدراسة 102 مريض. أصيبت حالتان (4.7%) من أصل 42 في المجموعة (الأولى) بالتهاب الصمام ، بينما أصيبت ست حالات (10%) من أصل 60 في المجموعة (II) بالتهاب الصمام. كان متوسط المدة بين وضع الصمام والتهابه 48.5 و 29.3 يومًا للمجموعتين (I) و (II) ، على التوالي.

الاستنتاجات: لم يكن هناك فرق معتد به إحصائياً في وقوع التهاب الصمام لمدة عام بين المجموعتين. بالإضافة إلى ذلك ، لم يكن متوسط المدة بين وضع الصمام و التهابه ذات دلالة إحصائية بين المرضى المصابين.