



ORIGINAL ARTICLE

Delayed Presentation of Meningomyelocele in a Tertiary Care hospital of Northern India

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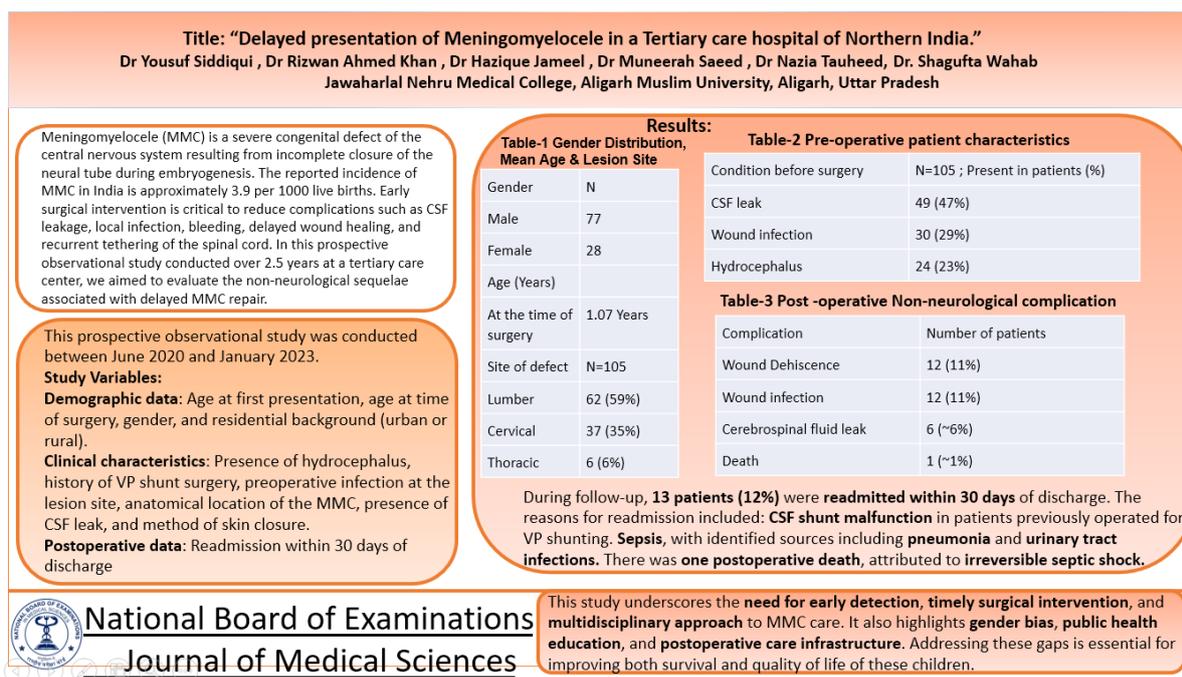
Abstract

Meningomyelocele (MMC) is a severe congenital defect of the central nervous system resulting from incomplete closure of the neural tube during embryogenesis. The reported incidence of MMC in India is approximately 3.9 per 1000 live births (range: 3.6 to 7.48), which is significantly higher than that in developed countries- almost three times greater. Early surgical intervention is critical to reduce complications such as cerebrospinal fluid (CSF) leakage, local infection, bleeding, delayed wound healing, and recurrent tethering of the spinal cord. Unfortunately, due to limited awareness and inadequate healthcare infrastructure, particularly in remote regions, many patients present late and receive suboptimal initial care. In this prospective observational study conducted over 2.5 years at a tertiary care center, we aimed to evaluate the non-neurological sequelae associated with delayed MMC repair. A total of 105 patients were included, comprising 77 males and 28 females, with a mean age at presentation of 1.07 years. The most frequent site of lesion was the lumbosacral region. Postoperative follow-up revealed that wound infection was the most commonly encountered complication. Our findings highlight that delayed presentation of MMC is associated with technically challenging surgeries and a higher incidence of postoperative complications. These observations underscore the need for increased public health awareness, timely diagnosis, and early referral to specialized centers to improve outcomes in affected patients.

Keywords: Meningomyelocele (MMC), surgical outcome, neural tube defect

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Graphical Abstract



Introduction

Meningomyelocele (MMC) is the most severe form of spina bifida, a neural tube defect (NTD) arising from incomplete closure of the spinal cord during early fetal development [1]. It is characterized by a protrusion of the spinal cord and meninges through a defect in the vertebral column, forming a fluid-filled sac on the infant's back [2]. NTDs are particularly prevalent in developing countries and contribute significantly to the global burden of congenital anomalies, both in terms of morbidity and healthcare costs. In low- and middle-income nations, the high incidence of MMC is often attributed to nutritional deficiencies, particularly inadequate maternal intake of micronutrients such as folic acid during the periconceptional period [3–6]. In India, the incidence of NTDs is reported to be approximately 4.5 per 1000 total births, with meningomyelocele accounting for 42% of these cases.

By contrast, developed nations have observed a marked decline in the incidence of MMC, primarily due to improved prenatal care, widespread folic acid supplementation, early antenatal diagnosis of spina bifida, and an increase in medically indicated terminations of affected pregnancies [7]. The management of children with MMC remains complex and resource-intensive. Surgical closure of the defect is a critical intervention aimed at preserving viable neural tissue and preventing complications such as cerebrospinal fluid (CSF) leakage and infection. Early surgical intervention—preferably within the first 48 hours of life—is associated with significantly improved outcomes [8–11]. However, infection at the lesion site, either preoperatively or postoperatively, can be life-threatening [12]. In untreated cases, mortality rates range from 65% to 75% within the first six months of life. Even among treated patients, mortality remains high—30% to 40% in the first year, and up

to 50% to 60% within the first three to five years [13–15].

In Northern India, delayed presentation of MMC is often influenced by socio-economic constraints, cultural and religious beliefs, lack of awareness, and limited access to specialized surgical care. These challenges underscore the urgent need to identify outcome determinants and bridge existing gaps in care delivery.

Material and Methods

Study Design and Data Acquisition

This prospective observational study was conducted at a tertiary care hospital located in a district of Northern India. The study included all patients who underwent surgical repair for meningocele (MMC) between June 2020 and January 2023. All patients were admitted to the Paediatric Surgery ward and followed a standardized institutional protocol for evaluation and management.

Study Variables

The following variables were collected and analyzed:

- **Demographic data:** Age at first presentation, age at time of surgery, gender, and residential background (urban or rural).
- **Clinical characteristics:** Presence of hydrocephalus, history of ventriculoperitoneal (VP) shunt surgery, preoperative infection at the lesion site, anatomical location of the MMC, presence of cerebrospinal fluid (CSF) leak, and method of skin closure.
- **Postoperative data:** Readmission within 30 days of discharge.

Neurological sequelae such as neurogenic bladder or bowel, lower limb weakness, complications from hydrocephalus, or history of meningitis were excluded from the scope of this study.

Perioperative Evaluation and Management

All patients underwent a thorough clinical evaluation and relevant investigations. A non-contrast CT head scan was performed in each case to assess for hydrocephalus. The age of patients at presentation ranged from 5 days to 4 years.

The primary surgical objective was repair of the MMC sac. In cases with local infection, surgical intervention was deferred until infection was controlled. For patients with significant hydrocephalus, a VP shunt was placed prior to MMC repair. Early intervention was prioritized to minimize the risk of complications, including lesion site infection, bleeding, delayed wound healing, recurrent spinal cord tethering, and CSF leak.

Surgical Principles of Myelomeningocele Repair

Timing of Surgery

Whenever feasible, surgical repair was performed within 24–48 hours of birth to reduce the risk of infection and progressive neurological damage.

Surgical Objectives

- Protection of exposed neural placodes and repositioning into the spinal canal.
- Achieving watertight dural closure to prevent CSF leakage.
- Layered closure of muscle and skin to ensure robust coverage, often utilizing V–Y advancement flaps for larger defects.

Multidisciplinary Approach

Management involved a collaborative team comprising pediatric surgeons, neurosurgeons, urologists, and orthopedic specialists to address associated conditions such as hydrocephalus, urinary dysfunction, and skeletal deformities.

Surgical Technique

After induction of general anesthesia, the child is positioned prone. As per institutional protocol, intravenous ceftazidime is administered 30 minutes before incision. The operative field is cleaned with Savlon, followed by triple cleansing with 10% povidone-iodine (Betadine), allowing it to dry before sterile draping.

A standard midline incision is made. Dissection is carried down to expose the dura. Neural placodes are gently detethered and repositioned within the spinal canal (Figure 1). A watertight dural closure is achieved, followed by closure of the paraspinal muscle layers and skin. For large defects, a V-Y plasty technique is employed to facilitate tension-free skin closure (Figure 2).

Postoperative Care

Postoperatively, all patients are nursed in the prone position for five days. Broad-spectrum intravenous antibiotics are continued as per protocol. Wound care, vital monitoring, and serial neurological assessments are performed regularly during hospital stay.

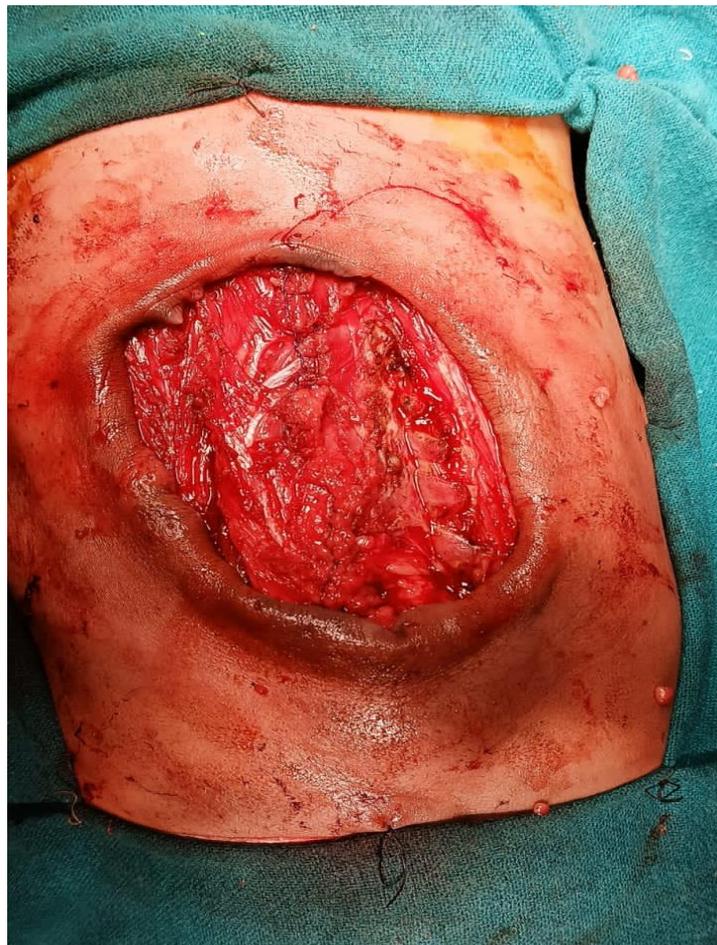


Figure 1. Separation of the skin and neural elements until Dura mater



Figure 2. Closure of the defect with fascia overlying the Para spinal muscles.

Postoperative Period

Post-surgical assessment was conducted immediately following the procedure and subsequently during follow-up visits scheduled at 1.5-month intervals. Preoperative meningomyelocele (MMC) infection was clinically diagnosed based on wound characteristics, such as erythema, discharge, or sloughing. The primary outcomes evaluated were mortality and postoperative non-neurological complications occurring within 30 days of surgery.

Results

A total of **105 patients** were included in the study, comprising **77 males** and **28 females**, yielding a male-to-female ratio of **2.7:1**. The **mean age at presentation** was **1 year and 7 days**, with the oldest patient being **4 years** of age.

Age Distribution at Presentation

- **Neonatal period (≤ 28 days):** 23.3% of patients

- **1 to 6 months:** 58.4%
- **>6 months:** 18.3%

Demographics

- **Rural background:** 59%
- **Urban background:** 41%

Clinical Features at Presentation:

- **Tethering of the spinal cord** was observed in **100%** of patients at presentation.
- **Defect size** varied from **4 × 4 cm to 11 × 9 cm**.
- The **shape of the lesion** was **elliptical** in **93 cases (88.6%)**.
- Lesion site distribution:
 - **Lumbosacral region:** 59%
 - **Cervical region:** 35%
 - **Thoracic region:** 6%

Notably, **none** of the patients underwent surgical repair **within the first three days of life**, which is the ideal window for minimizing complications.





Figure 3. A, B, C, D Gross presentation of Meningomyelocele at various anatomical location

Table 1. Gender Distribution, Mean Age & Lesion Site

Gender	N
Male	77
Female	28
Age (Years)	
At the time of surgery	1.07 Years
Site of defect	N=105
Lumber	62 (59%)
Cervical	37 (35%)
Thoracic	6 (6%)

29% Lesion were infected and 47% had cerebrospinal fluid leak. 23% cases already had hydrocephalus that underwent

ventriculoperitoneal shunting prior to MMC repair (Table 2).

Table 2. Pre-operative patient characteristics

Condition before surgery	N=105 ; Present in patients (%)
CSF leak	49 (47%)
Wound infection	30 (29%)
Hydrocephalus	24 (23%)

In the follow up period, 29% of patients experienced postoperative complication. The most common was wound dehiscence (12 patients) and wound

infection (12 patients). Transient cerebrospinal fluid leak was noted in 6 patients. However most complications were managed conservatively (Table 3).

Table 3. Post -operative Non-neurological complication

Complication	Number of patients
Wound Dehiscence	12 (11%)
Wound infection	12 (11%)
Cerebrospinal fluid leak	6 (~6%)
Death	1 (~1%)

Follow up outcomes

During follow-up, **13 patients (12%)** were **readmitted within 30 days** of discharge. The reasons for readmission included:

- **CSF shunt malfunction** in patients previously operated for ventriculoperitoneal (VP) shunting
- **Sepsis**, with identified sources including **pneumonia** and **urinary tract infections**

There was **one postoperative death**, attributed to **irreversible septic shock** in a patient with a severely infected lesion.

Discussion

This study provides valuable insights into the surgical management and

short-term outcomes of meningocele repair in a tertiary care hospital in Northern India. Neural tube defects (NTDs) are significantly more prevalent in Northern India, with a reported incidence of 7.48 per 1000 live births. However, the **true incidence remains underreported**, especially in rural settings, due to the high frequency of home deliveries and limited access to healthcare facilities. In addition, **societal stigma** often results in inadequate postnatal care for both mothers and children with congenital anomalies. This frequently leads to **delayed presentation**, a trend driven by socioeconomic constraints, lack of antenatal awareness, cultural barriers, and gender-based disparities in education and healthcare-seeking behavior [16–18].

Timing of Surgery and Gender Disparity

According to international guidelines—such as those by the **Congress of Neurological Surgeons** and the **Spina Bifida Association**—MMC repair is ideally performed within **48 hours of birth** to reduce infection risk and neurological deterioration. [8–11] However, **none** of the patients in our cohort underwent surgery within the first three days of life, highlighting a significant deviation from global standards. This delay can be attributed to **preoperative infections, unrecognized hydrocephalus,** and limited local surgical resources.

In our study, the **mean age at surgery was 1.07 years,** and **male predominance (73.3%)** was observed. A similar male preponderance was reported in studies from Sub-Saharan Africa by O.E. Down et al. In contrast, Aftab S. et al. in Pakistan reported a female predominance (58.5%). This **regional gender variation** may reflect underlying **cultural attitudes,** especially in parts of Northern India, where gender bias may contribute to healthcare access disparities.

Anatomical Distribution and Complications

The **lumbosacral region** was the most commonly involved anatomical site in our study, consistent with findings by Zoghi et al., Karsonovich et al., and Alruwaili et al., who reported lumbosacral involvement in **22.3% to 55.7%** of cases. Cervical and thoracic MMCs were relatively less frequent.

A key concern in MMC surgery is the **risk of postoperative complications,** particularly wound-related issues. In our cohort, **12% of patients developed wound infections,** often associated with

wound dehiscence and CSF leaks. This is consistent with previous reports:

- **Reynolds R.A. et al. (Zambia)** reported an infection rate of 8% and mortality of 7%.
- **Rebecca et al.** observed wound dehiscence in 10 of 75 cases.
- **A study from Texas** reported wound dehiscence in 11% and infection in 6% of cases.
- **Khan A. et al.** found wound infections in 13.5%, CSF leaks in 23.7%, and hydrocephalus in 22.4% postoperatively.

Our findings highlight the **universally challenging nature of MMC wound care,** especially given the proximity of the lesion to the anal region, which increases the risk of fecal contamination. In developing countries, **malnutrition and poor hygiene** further complicate postoperative recovery. Although nutritional status was not assessed in our study, it remains a key variable for future investigations [18–19].

Mortality and Readmission

The **postoperative mortality rate in our study was 1%,** which is comparatively low. Higher mortality rates have been documented in other resource-limited settings: 6% in Tanzania and 7% in Zambia. A U.S.-based study reported a 3% mortality rate. Our study also recorded a **12% readmission rate** within 30 days, primarily due to **VP shunt malfunction, sepsis,** and **urinary tract infections.**

Limitations and Future Directions

While our study offers a **regional perspective on MMC repair,** it is not without limitations: [20–22].

- **Long-term outcomes**—such as cognitive function, motor ability, and neurogenic bladder/bowel dysfunction—were **not assessed**.
- The **nutritional status** of patients was not documented, although it likely played a role in wound healing.
- The **gender disparity** observed requires further sociological exploration.
- As only **surviving patients** presented to the hospital, the study may not capture the **true burden** of disease or mortality in the community.

Conclusion and Implications

This study underscores the **pressing need for early detection, timely surgical intervention, and a multidisciplinary approach** to MMC care in India. It also highlights broader issues of **gender bias, public health education, and postoperative care infrastructure**. Addressing these gaps is essential for improving both survival and quality of life in children affected by this debilitating congenital anomaly.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

Funding

No funding was received for conducting this study.

Ethical Approval

Prior to initiation, ethical clearance was obtained from the institutional ethics committee.

Informed Consent

Informed written consent was acquired from the parents or legal guardians of all enrolled patients.

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