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Research Article

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Analysis of the Short term Outcomes of Surgical Repair of Myelomeningocele

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ABSTRACT

Background: Myelomeningocele (MMC) is the most frequent form of spina bifida. This congenital malformation is a debilitating condition in neonates that profoundly impacts their quality of life, posing challenges for both the family and the healthcare system. This study's primary goal is to provide an overview of our experience treating myelomeningocele in our community. It will shed light on the specific issues that these patients face immediately postoperatively and spur additional research into the treatment of myelomeningoceles.

Methods: A retrospective analysis of 80 patients, who had surgical correction for myelomeningoceles in our department over 30 months was performed. Patients presenting to the hospital with complaints of myelomeningocele aged from 10 days to 2 years of age were included in the study. Patient demographics, preoperative imaging, and postoperative complications were recorded. Patients were monitored for one-month post-MMC repair to detect early postoperative complications.

Results: The study of 80 patients revealed that 56.25% of cases were aged 3 to 9 months, with 56.25% of cases being female. Medium-sized MMCs (75%) were common and predominantly affected the lumbosacral region (50%). Hydrocephalus was present in 25(31.25%) cases while Lower limb power was affected in 55% of cases preoperatively. Postoperative complications were low: wound-related complications (16.25%), CSF leaks (7.25%), hydrocephalus (5%), and neurological deficits (2.5%). Outcomes showed 12.5% readmission, 10% re-surgery, one single death, and an average hospital stay of 6.4 days.

Conclusion: The study concludes that early and meticulous surgical repair of myelomeningocele can lead to low complication rates and favourable outcomes; highlighting the success of comprehensive care strategies and the need for continuous improvement. It is necessary to conduct more research on preoperative strategies to reduce the risk of immediate postoperative complications and mortality.

Key-words: Cerebrospinal fluid (CSF), Hydrocephalus, Myelomeningocele (MMC), Neural tube defects, Spina bifida

INTRODUCTION

Neural tube defects are the most common malformations of the central nervous system and have a detrimental effect on the development of the brain, spinal cord, and nerves. It has been estimated that 4.1 babies out of 1000 live births in India are born with neural tube defects. [1]

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MMC, often termed “open spina bifida,” is the most common form of neural tube defects. It occurs as the spinal neural tube ceases to close posteriorly during fetal development, resulting in herniation of neural contents (meninges and spinal cord) through the unfused posterior vertebral elements [2]. Around 20 weeks of gestation, most cases are discovered during regular abnormality scanning, and most parents decide to terminate the pregnancy rather than carry it to term.

This has decreased the prevalence of neural tube abnormalities in recent decades, along with the growing usage of folic acid supplements during pregnancy.[3]

Though it's one of the most common congenital abnormalities, the underlying mechanism remains

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unclear. Previous studies show that poor maternal nutrition, folic acid deficiency, consuming caffeine or alcoholic beverages during pregnancy, smoking, taking anti-convulsants, and certain health problems like diabetes and obesity are some factors that can cause the development of MMC in unborn babies. [4,5]

MMC affects the standard of life of patients at an early age, along with their families and medical care system.[6] MMC patients suffer from permanent impairments that include lower limb paralysis, sensory loss, cognitive decline, and problems with the bladder, intestine, and sexual organs. Surgery is the sole solution to treat this malformation, focused on optimizing skin closure and repairing the dura defect while safeguarding the nervous system to the utmost extent. [7,8] Therefore, early detection and surgery are vital to improving their quality of life by attenuating neurological impairment and disabilities significantly.[9] When diagnosed and treated early, either by fetal or quick postnatal repair, myelomeningocele is a form of NTD with a favorable prognosis.[10] According to one study, almost 75% of infants born with spina bifida do not have an intellectual handicap.[5] When these lesions get infected and cause newborn meningitis, it leads to several medical issues and has a detrimental effect on neurocognitive outcomes.[11]

The prevailing surgical recommendations involve prompt correction of the myelomeningocele defect, usually within 48 hours, to prevent further infection and damage to neural tissues.[12] MMC patients concurrently present with other conditions, such as hydrocephalus and Chiari malformation. Simultaneous shunting of the hydrocephalus is recommended if it presents concurrently. Even post-repair, the baby is at risk for developing hydrocephalus and is constantly monitored for the emergence of hydrocephalus symptoms. [3,9] The current study's objective was to analyze the immediate outcomes and occurrence rates of different complications as they emerge in the early postoperative phase and to gauge the prevalence of these issues in our community. This series offers a modern cohort that could enhance parent counseling regarding the risks and issues associated with the postnatal repair.

MATERIALS AND METHODS

Research design- This is a retrospective cohort study of Myelomeningocele patients who underwent surgical repair at a tertiary care center in the Department of Neurosurgery at Sir Sayajirao Gaekwad Hospital, Vadodara, India, between January 2022 and June 2024. A clinical examination was performed and recorded to diagnose Myelomeningocele. MRI (Magnetic Resonance Imaging) of the whole neuraxis was utilized for the confirmation of MMC and any associated hydrocephalus or Chiari type II malformation. Data was collected on predesigned proforma. Different study variables were considered, such as age at presentation, gender, anatomical level of MMC, MMC size, concomitant hydrocephalus, preoperative CSF leak, postoperative stay, and occurrence of new complications or neurological deficits. The size of MMC was considered to be small if the maximum dimension was <3 cm, followed by 3-6 cm, which was medium and >6 cm fall under the category of large size. Different sites of MMC have been documented, including cervical, dorsal, dorsolumbar, lumbar and lumbosacral A neurological deficit was considered if any incidence of limb weakness in the lower limb was observed. Patients were monitored following surgery for up to at least one month after being discharged from the hospital. A neurosurgeon evaluated each patient for the likelihood of any complications, and appropriate treatment was administered. Monitoring was done for any wound infection, wound dehiscence, and the requirement of the placement of VP shunt to check hydrocephalus or cerebrospinal fluid (CSF) discharge.

Inclusion & Exclusion criteria- Informed consent was taken from the patient's parents and attendants. Patients presenting with myelomeningocele of all ages and both genders were included in the study.

Patients presenting with other neural tube defects such as encephalocele or occult spina bifida, any previous history of operated myelomeningoceles, severe kyphotic deformity and concomitant renal or cardiovascular anomalies were excluded from the study.

RESULTS

In our study, 80 children underwent surgical repair of myelomeningocele, of which 45 were female and 35 were male patients. All belonged to the low socio-economic class. In Table 1, the age and sex distribution of the patients shows that the majority presented early, within three months, with 56.25% of patients falling

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within the 3 months age range. Patients aged 3 to 6 months comprised 37.5%, and those aged 6 months or older made up 6.25%. In terms of gender, 43.75% of the patients were male, while a larger proportion, 56.25%, were female.

Table 1: Demographics of the patients

Age	
0-3 month	45 (56.25%)
>3-6 months	30(37.5%)
>6 months	05 (6.25%)
Gender	
Male	35 (43.75%)
Female	45 (56.25%)

Regarding MMC size (Table 2), it was noted that the most common size of MMC at the time of presentation fell into the medium category, affecting 75% of the patients, followed by large MMCs at 18.75% and small MMCs at 6.25%. The lumbosacral region (50%) was the most commonly affected site, followed by lumbar (26.25%), dorsolumbar (10%), dorsal (6.25%), sacral (5%) and cervical (2.50%). At presentation, 19 (23.75%) patients were leaking cerebrospinal fluid; however, no purulence was noted in any of these patients. Thirty-six (45%) patients had paraplegia pre-operatively and twenty (25%) patients had decreased limb power. Hydrocephalus was the most associated lesion and was detected in 25(31.25%) of patients, while CM Type II was detected in 4 (5%) of patients. Eighteen (72%) out of 25 patients who were symptomatic for hydrocephalus required a ventriculoperitoneal shunt before MMC repair. Seven (28%) out of 25 patients underwent shunt surgery simultaneously with definitive repair. All patients were operated within 7 days (mean 3 days) of admission. Five patients with a large skin defect require flap closure by a plastic surgeon.

Table 2: Lesion characteristics and associations

MMC size	
small	05 (6.25%)
Medium	60 (75%)
Large	15 (18.75%)
MMC site	
Cervical	2 (2.50%)
Dorsal	5 (6.25%)
Lumbosacral	40 (50%)
lumbar	21 (26.25%)
Dorsolumbar	8 (10%)
Sacral	4 (5%)
Power of limbs	
Spontaneous	24 (30%)
Decreased	20 (25%)
Absent	36 (45%)
Preop CSF leak	
Present	19 (23.75%)
Absent	61 (76.25%)
Associated Hydrocephalus	
Present	25 (31.25%)
Absent	55 (68.75%)
Chiari Malformation	
Present	4 (5%)
Absent	76 (95%)

Postoperatively, the complication rate amounted to 26.25%, with 21 of these patients having one or the other complications. Wound dehiscence was the major complication present in 8(10%) patients, CSF leak/ collection in 6 (7.5%) patients, and wound infections were noted in 5(6.25%) patients. New cases of hydrocephalus occurred in 4 (5%) patients. Post-operative new neurological deficits were rare, occurring in only 2 (2.5%) patients, with the vast majority (97.5%) experiencing no such issues. No complications related to shunt placement were noted in the follow-up period. Table 3 shows the complications experienced by the patients postoperatively (Table 3).

Table 3: Thirty-day postoperative complications and events

CSF Leak	
Present	6 (7.5%)
Absent	74 (92.5)
Wound infection	
Present	5 (6.25%)
Absent	75 (93.75%)
Wound dehiscence	
Present	8 (10%)
Absent	72 (90%)
New Hydrocephalus	
Present	4 (5%)
Absent	76 (95%)

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Post-operative neurological problem	
Present	2 (2.5%)
Absent	78 (97.5%)

There was a single death recorded in the postoperative period where the patient developed sepsis and respiratory complications. Most of these complications were managed conservatively, with 8 (10%) patients requiring reoperation within 30 days for wound revisions. The rest of the complications were managed by conservative wound care. The length of hospital stays ranges from 4 days to 13 days for these patients, and the average stay was found to be 6.4 days (Table 4).

Table 4: Outcome of the patients

Outcome	Patients No
Patients readmitted within 30 days	10 (12.5%)
Re- Surgery (%)	8 (10%)
Death rate (%)	1 (1.25%)
Average No of days of stay	6.4

DISCUSSION

Neural tube defects stand as the second most frequent congenital anomaly after cardiac anomalies, and folic acid deficiency is the most commonly acknowledged risk factor.[13] Myelomeningocele is a debilitating congenital condition that has a profoundly negative influence on people, families, and societies due to the associated disabilities and the burden of a chronic illness.[14]

Over 30 months, we documented the surgical outcomes for 80 pediatric patients with MMC in our hospital. Many of them had hydrocephalus as a co-occurring clinical condition. All patients had myelomeningocele repair, which included dural closure, removal of fibrous bands and non-functioning neural structures, and restoration of the neural placode. Two patients had worsening of their neurological condition, while one death was reported within the course of the follow-up.

In our series, the male-to-female ratio was 1:1.3. The anatomical site of myelomeningocele presentation varies in the literature; however, the lumbosacral region remains the most common site. In our analysis, the most common anatomical defect site was the lumbar and lumbosacral area, accounting for over 76.25% of cases. Dorsolumbar regions (10%) and sacral regions (5%) followed closely behind. Our findings closely match those of Rehman *et al.* [15], who reported 80.4% of lesions in lumbar and lumbosacral regions. Oncel *et al.* [16] also reported a somewhat similar distribution in their study, with 40% lumbar and 46.6% lumbosacral lesions. An intact L3 segmental level is predictive of good motor function in lower limbs, according to Idris [17], who also emphasized the importance of the spinal segmental level of lesion ($p<0.001$). Other studies also draw attention to the importance of neurosegmental level, implying that the higher the level of lesion, the higher the chances of lower limb motor dysfunction and sphincter dysfunction. [17–19]

In our study, hydrocephalus was present along with MMC in 25 (31.25%) cases. When compared to Western literature, this incidence is notably lower. [3,20] As previously demonstrated by Kumar *et al.* [21,22], the lower incidence of hydrocephalus in our study aligns with its rarity in this subcontinent. Another potential factor could be biased in referrals to our tertiary healthcare center. The diminished rate of hydrocephalus may be attributed to the fact that only children who survive their early months are brought to our hospital. This inference is supported by our finding that the average age at presentation in our study was 72 days. In this cohort, no procedures were performed to decompress the Chiari II malformation within 30 days following MMC correction. The high prevalence of hydrocephalus and Chiari II malformation in association with MMC necessitates screening for these anomalies by cranial imaging.

The complication rate in our series (27%) matches that of the literature by Cherian *et al.* [23]. Following surgical intervention, the most common postoperative consequences were wound dehiscence (10%) and wound infection (6%). The data from NSQIP database of 114 babies with MMC by Cherian *et al.* [23] reported similar complication rates of 27%, the majority of them being wound dehiscence at 11% and wound infection at 6%. Our study's CSF leak rate of 7.5% is like that of Khan *et al.* [24], who reported 7.5%, and Hashim *et al.* [25], who reported 5.3% postoperative CSF leakage. Superficial dehiscence was responsible for approximately half of these wound complications. In 20% of instances, a revisit to the operating theatre occurred within 30 days for the treatment of disrupted wounds, regardless of the presence of a CSF leak. Tending to wounds in children with myelomeningocele is challenging due to the proximity of the lumbosacral lesion to the anus and

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feces. Malnutrition presents a further risk to wound healing in MMC patients beyond the basics of wound management. In this study, we recorded one mortality (1.25%) due to sepsis and respiratory complications, which is in line with mortality reported by Hashim *et al.* [25] (1.2%) and Cherian *et al.* [23] (2%). This is quite low compared to mortality rates reported by Noman *et al.* [26] (15.7%) and Khan *et al.* [19] (17.7%). Our study's modest sample size and one-month follow-up period are its main drawbacks. Long-term monitoring is required to identify long-term outcomes and quality of life at later stages of life.

CONCLUSIONS

In conclusion, myelomeningocele is likely the most debilitating form of spina bifida, necessitating urgent surgery in newborns. The analysis of patient demographics, clinical characteristics, complications, and outcomes provides several key insights. It is essential to conduct a preoperative comprehensive radiographic and neurophysiological evaluation regardless of the patient's age or neurological status. Medium-sized MMCs located primarily in the lumbar region are the most common, and a significant proportion of patients experience decreased or absent limb power. Accompanying hydrocephalus presents a notable concern, affecting nearly a third of the patients, though new cases post-operation is rare. Complication rates are generally low, with CSF leaks and wound dehiscence being relatively common. Post-operative neurological problems are minimal, indicating generally effective surgical interventions. The outcomes indicate a low re-admission and re-surgery rate, with minimal mortality and short hospital stay duration. This study suggests that while there are challenges associated with hydrocephalus and limb power, the overall prognosis for patients is positive, with effective management of complications and favorable recovery times. Low complication rates, especially CSF leaks and new hydrocephalus, indicate effective managemen protocols, while favorable outcomes with minimal readmissions and short hospital stays validate comprehensive care strategies. Through ongoing research, our goal is to predict better results in myelomeningocele and develop new strategies to tackle this challenge.

CONTRIBUTION OF AUTHORS

Research concept- Ankit S. Shah, Madhur Shroff
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