

## CLINICAL PREDICTORS OF THE NEED FOR VENTRICULOPERITONEAL SHUNT PLACEMENT IN MYELOMENINGOCELE PATIENTS

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### ABSTRACT:

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**Background:** *There is some degree of ventriculomegaly that occurs after myelomeningocele (MMC) repair.*

**Aim of the study:** *This study aimed to identify the clinical predictors of the need for ventriculoperitoneal shunt placement in MMC patients to avoid unnecessary shunting with its complications.*

**Methods:** *This retrospective cohort study included infants with lumbosacral myelomeningocele who were managed in the neurosurgical department in Ain Shams University Hospital from January 2016 to December 2018. The study was approved by the Research Ethics Committee of the Faculty of Medicine at our university. Informed consent was obtained as required.*

**Results:** *Fifty patients met our selection criteria. Twenty-two patients (44%) needed shunts. The statistically significant clinical predictors of shunt placement in MMC patients were crossing the HC percentile for age, tense AF, sun setting of eyes, persistent vomiting, delayed or deteriorating developmental milestones, and CSF leakage from the MMC wound.*

**Conclusion:** *Applying the statistically significant clinical predictors of shunt placement to decide shunt placement in MMC patients is of utmost importance to avoid unnecessary shunting.*

**Keywords:** *Hydrocephalus; Myelomeningocele; Ventriculoperitoneal shunt*

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### INTRODUCTION:

Myelomeningocele (MMC) is a neural tube defect. It is one of the most common congenital defects compatible with life. It occurs at a rate of 0.3–0.5 per 1000 live births<sup>[1]</sup>.

Almost all children born with MMC have other structural brain anomalies. The most commonly observed is the Chiari II malformation, which results in a variable degree of obstruction of the fourth ventricle, resulting in hydrocephalus (HCP)<sup>[2]</sup>.

The rate of shunt placement in MMC patients varied from 52% to 92%<sup>[3]</sup>.

In addition to the financial burden, shunt complications have a great adverse effect on intelligence in MMC patients<sup>[4,5]</sup>.

These complications provide an incentive to reduce the rate of shunting in MMC patients to those who only need cerebrospinal fluid (CSF) diversion.

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**AIM OF THE WORK:**

This study aimed to identify the clinical predictors of the need for CSF diversion in MMC patients.

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**METHODS:**

This retrospective cohort study was reported under the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) principles. All data was anonymized.

The present study has been carried out following the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

The study was approved by the Research Ethics Committee of the Faculty of Medicine at university (FWA 000017585- FMASU MD 191/2016) on 24/7/2016. Informed consent was obtained as required.

***Inclusion criteria:***

Infants presented with intact lumbosacral MMC sacs that were repaired in the neurosurgical departments in our university Hospital from January 2016 to December 2018.

***Exclusion criteria:***

Patients presenting with active hydrocephalus (showing symptoms and signs of increased intracranial pressure) before MMC repair.

***Preoperative evaluation (before MMC repair):***

- 1- Obtaining a complete medical history.
- 2- General and neurological examination with special emphasis on the head circumference (HC) and anterior fontanelle (AF).
- 3- Investigations:
  - A- Routine laboratory investigations.

- B- Radiological investigations including brain imaging [transfontanellar ultrasound (U/S) or magnetic resonance imaging (MRI), or computed tomography (CT) scan] and MRI spine.

***Myelomeningocele management:***

At birth, the placode was kept moist. The MMC was repaired in a three-layered fashion.

During the hospital stay, the infants were daily examined regarding the MMC wound, the AF bulge, and the HC. On discharge, the parents of the patients received detailed instructions regarding the warning signs of progressive HCP.

***Postoperative evaluation (after MMC repair):***

At the outpatient clinic, clinical examinations were done every two weeks for two months, then monthly thereafter for at least 1.5 years.

The following data was observed and documented: the head circumference; size and bulge of the anterior fontanelle; manifestations of increased intracranial pressure (ICP) like repeated vomiting and seizures; developmental milestones; and any episode of apnoeic spells.

The decision on shunt placement was taken by two consultants in neurosurgery.

The included patients were divided into two groups:

Group I: Infants who did not require a shunt.

Group II: Infants who require shunt placement.

***Statistical analysis:***

Data was collected, coded, and entered into the Statistical Package for Social Science (IBM SPSS) version 23. The quantitative data was presented as mean, standard deviations, and ranges. Qualitative variables were presented as numbers and percentages. The

## Predictors for shunt placement

comparison between groups with qualitative data was done using the *chi-square test*. The comparison between groups with quantitative data and parametric distribution was done using the *Independent t-test*, while data with non-parametric distribution was done using the *Mann-Whitney test*. The confidence interval was set to 95% and the margin of error accepted was set to 5%. The p-value was considered significant when  $P < 0.05$  and highly significant when  $P < 0.01$ .

### RESULTS;

This study included a cohort of 50 patients who met our selection criteria.

Twenty-two patients (44%) needed shunts during the defined follow-up period. The duration between MMC repairs and shunt surgeries ranged from 7 to 180 days.

Table 1 illustrates the demographic data of both groups. There were no statistically significant differences between the study groups regarding the demographic data.

Table 2 reveals the HC in both study groups. Crossing the HC percentile for age was statistically highly significant for the need for shunt placement.

The clinical characteristics of both groups during follow-up are illustrated in table 3.

Tense AF, sun setting of eyes, persistent vomiting, delayed or deteriorating developmental milestones, and CSF leakage from MMC wound were statistically significant for the need of shunt placement.

Four cases (8%) suffered from CSF leakage from MMC wounds around day 5-7 after MMC repair, didn't respond to repeated dressing, and required a shunt.

Table (1): Comparison of demographic data between study groups.

		Didn't need a shunt n = 28	Needed a shunt n = 22	P-value	Statistical significance
Age at presentation (days)	Mean	11.2	8.3	0.06‡	NS
	Range	3 – 23	1 – 18		
Gender	Female	22 (78.6%)	12 (54.5%)	0.071*	NS
	Male	6 (21.4%)	10 (45.5%)		
Consanguinity	No	12 (42.9%)	8 (36.4%)	0.642*	NS
	Yes	16 (57.1%)	14 (63.6%)		

NS: Non-significant    \*: Chi-square test    ‡: Mann Whitney test

Table (2): The HC for both study groups.

Head circumference (HC)		Didn't need a shunt n = 28	Needed a shunt n = 22	P-value	Statistical Significance
Initial HC	Mean ± SD	40.62 ± 2.91	42.55 ± 2.90	0.064*	NS
	Range	34.50 – 45.50	36.50 – 46.50		
HC percentile for age	Matched	28 (100.0%)	0 (0.0%)	0.000*	HS
	Crossed	0 (0.0%)	22 (100.0%)		

NS: Non-significant    HS: highly significant    SD: standard deviation    \* t-test

Table (3): The clinical characteristics of both groups during follow-up.

		Didn't need a shunt		Needed shunt		P-value	Significance
		N	%	n	%		
AF status	Lax	26	92.9%	0	0%	0.000*	HS
	Mild bulge	2	4%	0	0%		
	Tense bulge	0	0%	22	100%		
Persistent Vomiting	No	28	100%	0	0.0%	0.000*	HS
	Yes	0	0%	22	100%		
Sun setting of eyes	No	28	100%	6	27.3%	0.000*	HS
	Yes	0	0%	16	72.7%		
Developmental milestones	Normal	22	78.6%	0	0%	0.000*	HS
	Deteriorating	0	0%	8	36.4%		
	Delayed	6	21.4%	14	63.6%		
Leakage from MMC wound	No	28	100%	18	81.8%	0.019*	S
	Yes	0	0%	4	18.2%		

HS: highly significant S: Significant AF: anterior fontanelle \*Chi-square test

## DISCUSSION

The results of this study showed that the statistically significant predictors of shunt placement in MMC patients were crossing the HC percentile for age, tense AF, sun setting of eyes, persistent vomiting, delayed or deteriorating developmental milestones, and CSF leakage from the MMC wound. Twenty-two patients (44%) needed shunts during the defined follow-up period.

The shunt insertion rate in the first 2 years of life in MMC patients was 81% and 70.24% in Rintoul et al. (2002) and Marreiros et al. (2015) studies, respectively [6,7].

Chakraborty et al. found that the rate of shunt insertion was reduced after applying conservative management of a mild increase in ventricular size after myelomeningocele repair [10].

In our study, we found no statistically significant differences in the demographic data between those patients who did not need a shunt and those who needed a shunt. All the

cases that achieved normal developmental milestones didn't need a shunt, and all the patients who had deterioration in the developmental milestones required a shunt.

Shunt placement and revision have many long-term complications for the patients' intelligence and quality of life [8,9].

There is still a controversy about MMC patients with stabilized ventriculomegaly regarding whether it's either progressive or arrested hydrocephalus.

It is highly important to determine which patient will benefit from a shunt as it was noticed that there was some degree of ventriculomegaly that will always occur after MMC repair [11,12]. As a result, our study aimed to identify clinical predictors that can indicate which patients require a shunt in order to avoid unnecessary shunting.

The incidence of neural tube defects in Egypt was found to be 1.38% per 1000 live births, which is high compared with other parts of the world, where the reported

incidence ranges from 0.3% to 0.5%<sup>[1,13]</sup>. So, it's reasonable and beneficial to avoid or reduce shunting in MMC patients to reduce the burden of shunt-related complications with their economic burden.

The limitations of this study are the small number of patients, the relatively short period of follow-up, and the selection bias of the types of families that reach our tertiary hospital.

### **Conclusions:**

The results of this study showed that the statistically significant predictors of shunt placement in MMC patients were crossing the HC percentile for age, tense AF, sun setting of eyes, persistent vomiting, delayed or deteriorating developmental milestones, and CSF leakage from the MMC wound. Applying these clinical predictors to decide shunt placement is of utmost importance to avoid unnecessary shunting.

### **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 HI and MN. MM and AA collected the data of the patients. MA and MM analyzed and interpreted the patients' data. MA 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.**

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### العوامل السريرية التي تنبئ بالحاجة إلى صمام مخى بريتونى في مرضى القيلة النخاعية السحائية

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الخلفية: هناك درجة معينة من تضخم البطين الذي يحدث بعد إصلاح القيلة النخاعية السحائية (MMC).

الهدف: تهدف هذه الدراسة إلى تحديد المؤشرات السريرية للحاجة إلى وضع الصمام المخى بريتونى في مرضى MMC لتجنب الصمام غير الضروري مع مضاعفاته.

الطريقة: تضمنت هذه الدراسة بأثر رجعي الرضع المصابين بالقيلة النخاعية القطنية العجزية الذين تم علاجهم في قسم جراحة الأعصاب في مستشفى جامعة عين شمس من يناير 2016 إلى ديسمبر 2018. تمت الموافقة على الدراسة من قبل لجنة أخلاقيات البحث بكلية الطب في جامعتنا. تم الحصول على الموافقة المسبقة كما هو مطلوب.

النتائج: استوفى خمسون مريضاً معايير الاختيار الخاصة بنا. احتاج اثنان وعشرون مريضاً (44%) إلى صمامات. كانت المتنبئات السريرية ذات الدلالة الإحصائية لوضع الصمام في مرضى MMC تعدى النسبة المئوية لمحيط الرأس بالنسبة للعمر، والتقيؤ المستمر، وتأخر أو تدهور العلامات التنموية، وتسرب السائل الدماغي النخاعي من جرح MMC.

الخلاصة: تطبيق المتنبئات السريرية ذات الدلالة الإحصائية لوضع الصمام لتحديد موضع التحويل في مرضى MMC له أهمية قصوى لتجنب التحويل غير الضروري.