

## Original Article

# H-reflex Studies in Lumbosacral Meningomyelocele

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## Abstract

Objective of this work was to assess the effects of meningomyelocele (MMC) and its surgical intervention on spinal H-reflex. Twenty nine full term infants with age varying from 1-37 days were the study subject. Out of them 14 were normal infants and the rest were suffering from lumbosacral MMC. MMC babies were further investigated one week after surgical removal of sac. H-reflex latency (HRL) and related parameters (Hmax, Mmax and H/M ratio) were recorded at posterior tibial nerve-soleus muscle of right lower limb. H-reflex was absent in few MMC infants before surgery and their number were increased after surgery. Further, HRL and Mmax values were significantly less in MMC compared to normal infants. These observations suggest that some components of reflex arc were damaged in MMC, but the impulse conduction had increased in the viable neural tissue. Surgical intervention had limited role in restoration of neural function.

## Introduction

Spina bifida is one of the most common congenital anomalies of the central nervous system that is compatible with life. The majority of cases belong to meningomyelocele (MMC), where primary neural tube fails to close (1) and portion of spinal cord along with nerve and meninges protrudes as a cyst. The impact of neurodevelopment malformation affects the segment of spinal cord. Neurological motor deficit in

lower limb along with denervation potential in EMG in spina bifida were reported by Sival *et al* (2, 3). Non-invasive electrophysiological studies using Hoffmann reflex(4-6) may help in assessing the motor neuronal excitability and conduction in peripheral nerves (7).

The present study was designed to measure the electrophysiological parameters in MMC infants and compare them with normal infants of similar age group. The outcome of surgery was further assessed after surgical repair of meningomyelocele sac. Electrophysiological parameters viz: H-reflex latency (HRL), Hmax (maximum amplitude of reflexly excitable motor neurons), Mmax (maximum amplitude of motor response) and H/M ratio in % (proportion of reflexly excitable motor neuron) were measured in right lower limb of all infants (8, 9).

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## Materials and Methods

The study protocol was duly approved by the ethical committee of Institute of Medical Science, Banaras Hindu University, India. The study population (both normal and MMC) comprised of 29 infants who were registered in the Department of Pediatric Surgery, S.S. Hospital, Banaras Hindu University. The period of study was from September, 2011 to August, 2015. These infants were full term appropriate for gestational age with birth weight above the 10<sup>th</sup> percentile of the Indian local standard (10). Fourteen infants were normal and remaining 15 were clinically diagnosed as meningomyelocele (MMC) of lumbosacral region. The average size of sac was 5 × 5 cm (Fig. 1). Infants were subjected to anthropometric measurements and electrophysiological studies. Electrophysiological investigations were undertaken only after obtaining a written consent from the parents. This is in compliance with declaration of Helsinki (1964) amended at Edinburgh (2000).

Infants born to diabetic mothers or those who suffered from birth anoxia, septicemia, meningitis, hypoglycemia and haemodynamically unstable were excluded. Infants with hydrocephalus or other chromosomal anomalies were also excluded. Pre



Fig. 1: Infant with meningomyelocele.

operative investigations were done a day before the surgery and post operative evaluation was done one week after surgery. Surgical repair of the spinal herniation was done under general anesthesia involving release of neural tissue from surrounding structure and their restoration inside the vertebral canal. This was followed by watertight closure of duramater, vertebral approximation and closure of skin. Long term follow-up could not be done because of poor turnout of patients after post-operative care was over.

Electrophysiological investigations were performed at the Neurophysiology Research Unit of the Department of Physiology, Institute of Medical Sciences. Biopac Student Lab Advance System (Biopac Systems Inc., 42 Aero Camino, Santa Barbara, Calif 93117, USA) and GRASS stimulator model S88 (GRASS Technologies, 600 East Greenwich Avenue, West Warwick, RI 02893, USA) were used in this investigation. The procedure has been standardized over the years in our laboratory (7, 9, 11). Infants were neither restrained nor sedated during these tests. They were comfortably placed in prone position on the lap of mothers. A small pillow was placed underneath the right lower limb to keep it extended (7, 11). Surface electrodes (Ag-AgCl) were placed along with electrolyte jelly after proper cleaning of skin. Stimulating electrodes were placed over the posterior tibial nerve in popliteal fossa whereas the recording electrodes were placed over the calf muscle (soleus). Stimulus duration of 1ms was employed to preferentially activate the large Ia sensory fibers (12). The trigger level of the recorder was set above the baseline EMG amplitude. The H-reflex latency (HRL) was measured from the end of stimulus artifact to the onset of H wave (8). The investigations were concluded in a single sitting for each baby.

The arithmetic mean and standard deviation (SD) were calculated for quantitative variables. Unpaired student 't' test was used for comparison between MMC and normal infants. 'p' value <0.05 was taken as significant. Sigma Plot 10.0 and MS Excel software were used for the statistical and graphical analysis.

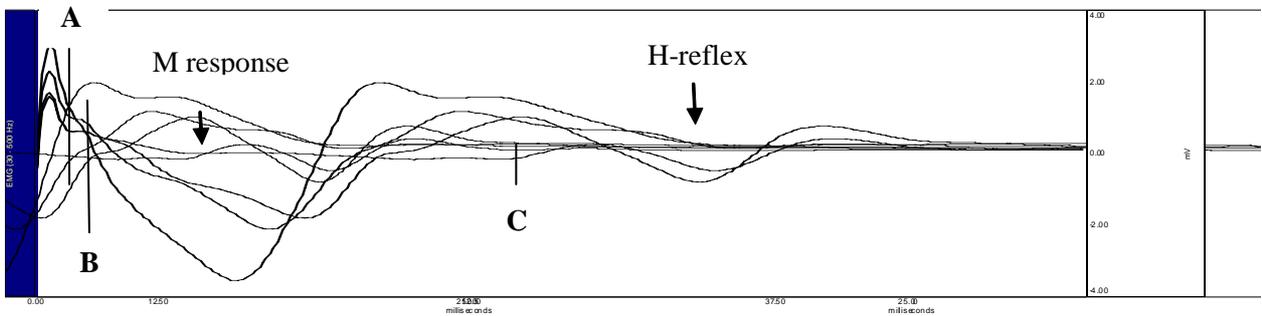
## Results

Anthropometric parameters (Age, weight, crown heel length [CHL], Head circumference [HC]) of three groups of infants (Normal, preoperative MMC and postoperative MMC infants) were given in Table I. CHL was comparable in both normal and MMC group whereas weight and HC were significantly more in MMC infants.

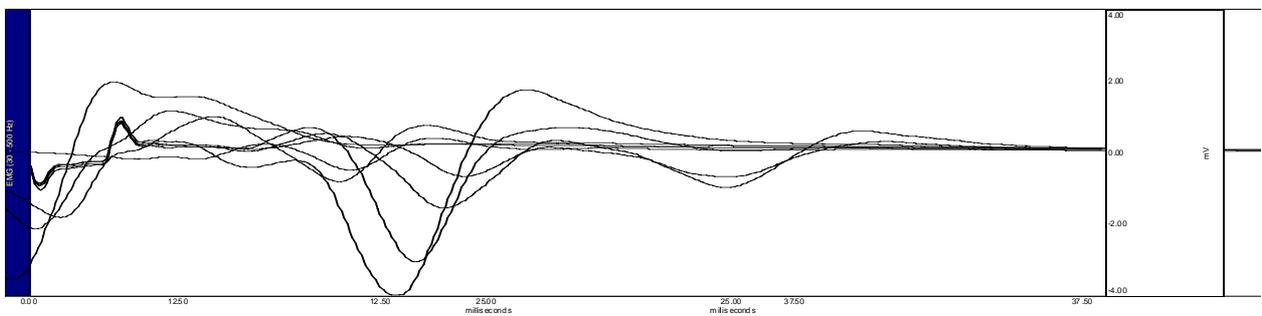
Table II represents the electrophysiological data of

normal and MMC infants (pre and postoperative). Sample tracings of H-reflex and M response of normal and MMC (pre and postoperative) infants were given in Fig. 2. H-reflex was elicited in all the normal infants. But it was absent in 3 babies suffering from MMC. The MMC infants had comparatively less values of HRL, Hmax and Mmax compared to normal. However, statistically significant differences were found only in HRL (Fig. 3) and Mmax values (Fig. 4). The H/M ratio (in %) were similar in both the normal (44.98%) and MMC (46.44%) infants.

### a) Normal infant



### b) MMC infant



### c) MMC infant after surgery

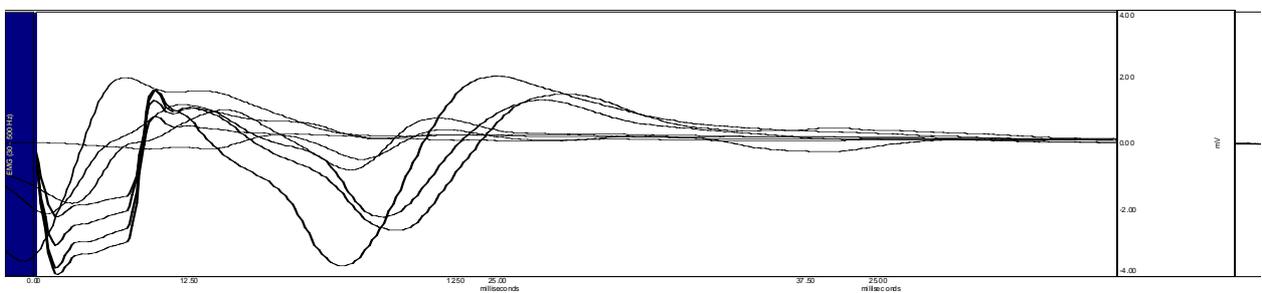


Fig. 2: Sample recordings of H-reflex and M response in right lower limb of infants  
 Top traces (a) - Normal infant,  
 AB=M response latency,  
 AC=H-reflex latency  
 Middle traces (b) - MMC infant  
 Bottom traces (c) - MMC infant after surgery  
 (Note: Pre and post operative recording were taken from the same infant.)

TABLE I: Anthropometric parameters and age (Mean±SD) of normal and MMC infants (pre-operative and postoperative).

Parameter	Normal (n=14)	Pre op MMC (n=15)	Post op MMC (n=15)	p value	
				Normal vs pre op MMC	MMC vs post op MMC
Age (days)	14.14±11.43	15.47±9.99	23.40±9.26	NS	NS
Weight (kg)	2.56±0.53	3.24±0.75	3.19±0.73	<0.05	NS
CHL (cm)	48.46±1.83	49.17±1.73	49.17±1.73	NS	NS
HC (cm)	32.59±0.93	34.54±1.41	34.67±1.55	<0.001	NS

NS = Not significant.

TABLE II: Electrophysiological parameters (Mean±SD) in right lower limb of normal and MMC infants (pre and postoperative). Figures in parenthesis denote the number of subjects where parameter was elicited. NS = Not significant.

Parameter	Normal (14)	Pre op MMC (15)	Post op MMC (15)	p value	
				Normal vs pre op MMC	MMC vs post op MMC
HRL (ms)	13.92±1.73	12.52±1.64 (12)	12.59±1.27 (8)	<0.05	NS
Hmax (mv)	2.06±0.80	1.74±0.85 (12)	1.45±0.46 (8)	NS	NS
Mmax (mv)	4.65±1.26	3.52±1.46	3.57±1.72 (13)	<0.05	NS
H/M%	44.98±14.45	46.44±20.34 (12)	39.34±19.19 (8)	NS	NS

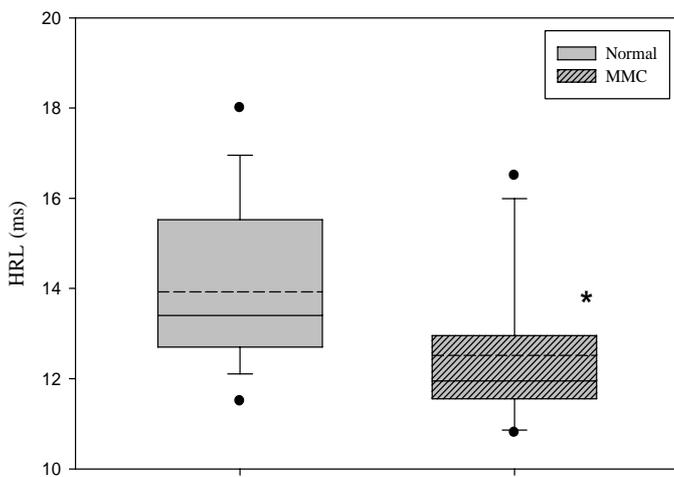


Fig. 3: Boxplot representation of HRL in normal and MMC infants  
 Horizontal dashed line is mean,  
 Solid line is median  
 Lower and upper borders of each box mark 25<sup>th</sup> and 75<sup>th</sup> centiles respectively.  
 Error bars mark 5<sup>th</sup> and 95<sup>th</sup> centiles.  
 Points lying beyond error bar mark 5<sup>th</sup> and 95<sup>th</sup> centiles.  
 \*= $p < 0.05$  between normal and MMC infants.

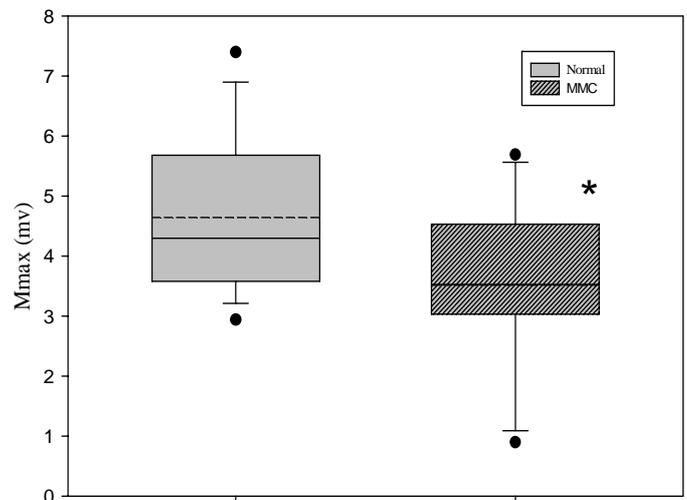


Fig. 4: Boxplot representation of Mmax in normal and MMC babies  
 Horizontal dashed line is mean,  
 Solid line is median  
 Lower and upper borders of each box mark 25<sup>th</sup> and 75<sup>th</sup> centiles respectively.  
 Error bars mark 5<sup>th</sup> and 95<sup>th</sup> centiles.  
 Points lying beyond error bar mark 5<sup>th</sup> and 95<sup>th</sup> centiles.  
 \*= $p < 0.05$  between normal and MMC infants.

Electrophysiological parameters of MMC infants (pre and postoperative) were depicted in Table III. H-reflex was absent in 7 MMC infants after surgical repair of the sac. Further, M-response

was not elicited in 2 postoperative MMC infants. Otherwise all the electrophysiological parameters were similar in both pre and postoperative MMC infants.

TABLE III: Effect of surgery on electrophysiological parameters (Mean±SD) in MMC infants. Figures in parenthesis denote the number of subjects where parameter was elicited.

Parameter	MMC (15)	MMC after surgery (15)	p value
HRL (ms)	12.52±1.64 (12)	12.59±1.27 (8)	NS
Hmax (mv)	1.74±0.85 (12)	1.45±0.46 (8)	NS
Mmax (mv)	3.52±1.46	3.57±1.72 (13)	NS
H/M%	46.44±20.34 (12)	39.34±19.19 (8)	NS

NS = Not significant.

## Discussion

We observed higher values of weight and head circumference in MMC though they were within the normal range of Indian population (10th to 90th percentiles; (10)). Hayes-Allen in 1972 first identified short stature and obesity among children with spina bifida (13). Excessive adipose tissue deposition in MMC was also reported by others (14, 15). CHL values representing the body length were comparable in normal and MMC infants.

The neural elements (spinal cord with roots) which are exposed to body surface in meningomyelocele are always at risk to get injured (1). These tissues are also not well connected with the vasculature and therefore ischemia is prevalent (16). In this study, the parameter representing the quantum of motor units in spinal neuronal pool i.e. Mmax was significantly less in MMC. Further, H-reflex could not be elicited in 3 of these infants. The reduction in motor neuronal pool along with absence of H-reflex indicates that some neuronal components were damaged in these infants. The latency (HRL) was significantly reduced in cases where the reflex was elicited as compared to normal infants. These infants having comparable length with normal infants, the shorter latency (HRL) could be either due to faster conduction in the existing reflex pathway or reduction

in the synaptic delay time.

Hmax values were less in MMC babies indicating that they had relatively smaller number of reflexly excitable neurons. Mmax was recorded in all the normal and MMC infants before surgical intervention, though the values were less in MMC. Our observations indicate an intact motor neuronal pool with viable motor units in MMC infants. The decreased amplitude of Mmax might be due to partial motor neuronal lesion in these cases. This parameter was absent in 2 cases after surgery.

Surgical intervention was essential for these infants to prevent rupture of meningomyelocele sac and the consequential complications. However, once these babies were operated upon and settled for one week after surgery, the electrophysiological parameters were not very encouraging as the H-reflex was absent in almost 50% cases (7 out of 15) and even M response was absent in two infants. In babies where the reflex was elicitable, the electrophysiological parameters were comparable in pre and post operative period. The study could not be carried out further in the post operative period of these babies because of their poor compliance after hospital discharge. The surgical maneuvers had little role in protecting the neural tissue in these infants.

## Conclusion

H reflex latency was reduced in MMC babies with absence of reflex in few cases. Reduction in motor units was also observed in these babies. The outcome of surgery was limited role for neurological recovery.

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