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Myocardial dysfunction in newborns with severe birth asphyxia

Shivangi Kachhwaha[1], Anjali Bharani[2], Dharmanshu Chaube[3], Nirbhay Mehta[4], Puneet Goyal[5]

[1]Postgraduate Resident, [2]Associate Professor, [3]Assistant Professor, [4]Professor, Department of Paediatrics, [5]Associate Professor, Department of Medicine, Mahatma Gandhi Memorial Medical College and Maharaja Yashwantrao Hospital, Indore, Madhya Pradesh, India

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ABSTRACT

Background: Severe birth asphyxia is one of the leading causes of mortality and morbidity in developing countries like India. Severe birth asphyxia can result in transient myocardial ischemia, myocardial dysfunction, and cardiac failure. **Aims and Objectives:** The current study was undertaken for a better understanding of myocardial dysfunction with the help of serum levels of CPKMB and their correlation with mortality. **Materials and Methods:** It was a prospective observational study. We studied 150 newborns with severe birth asphyxia admitted to be SNCU of Maharaja Yashwantrao Hospital Indore from August 2021 to July 2022 after clearance from the Institutional Ethics Committee and informed parental consent. **Results:** A total of 150 newborns with severe birth asphyxia were enrolled. Nearly 75% were males, and 25% were females. Most of the mothers (80%) were multigravidas. Antenatal complications were present in 85.33% of cases. Amniotic fluid was meconium stained in 73.33%, and fetal distress was present in 72.70%. CPKMB was deranged in 93%, and the ejection fraction was reduced in 53%. Out of the total 150 cases, 72 died, with levels of CPKMB elevated in 70 cases and ejection fraction reduced in 62 cases. **Conclusion:** We conclude that serum CPKMB levels rise early before ejection fraction is reduced and can help us identify myocardial dysfunction early. There is a statistically significant association between CPKMB, ejection fraction, and mortality in babies with severe birth asphyxia. Cardiac-specific enzyme CPKMB helps in the early recognition of myocardial dysfunction, and there is significant correlation with neonatal mortality.

Key words: Hypoxic-ischemic encephalopathy; Cardiac dysfunction; Isoenzyme CPK-MB

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INTRODUCTION

Asphyxia at birth is the primary contributor to both morbidity and mortality in newborns. Severe birth asphyxia is one of the major contributors to the neonatal mortality rate.[1] It is associated with multiorgan failure, including myocardial dysfunction. A poor clinical outcome in asphyxiated newborns is frequently linked to cardiovascular system dysfunction.[2] There is limited data available on the incidence and severity of myocardial dysfunction. Most of the studies assessing the effects of perinatal asphyxia mainly assess the neurological involvement, and only a few studies assess the role of cardiac involvement.[3]

Aims and objectives

Primary objective

To estimate the incidence of myocardial dysfunction in newborns with severe birth asphyxia.

Secondary objective

To know the correlation between myocardial dysfunction and outcome.

MATERIALS AND METHODS

This study was prospective observational study conducted over 1 year from August 2021 to July 2022 at department

Address for Correspondence:
Dr. Anjali Bharani, Associate Professor, Department of Pediatrics, Mahatma Gandhi Memorial Medical College and Maharaja Yashwantrao Hospital, Indore, Madhya Pradesh, India. **Mobile:** +91-9926278399. **E-mail:** dr.anjalibharani@gmail.com

of pediatrics M.Y.H. and CNBC Hospital, Indore after ethics committee approval.

Inclusion criteria

Neonates (Gestational age more than 37 weeks) identified to have severe birth asphyxia and hypoxic-ischemic encephalopathy (HIE) III by Levene's grading.

Features	Severe HIE grade
Consciousness	Comatose
Tone	Severe hypotonia
Seizures	Prolonged
Sucking/Respiration	Unable to sustain spontaneous respiration

Exclusion criteria

Congenital malformations like congenital heart disease.

Study process

Before starting the study, written informed consent was taken from the parents. Neonates fulfilling all inclusion criteria were enrolled for the study and Levene's grading was done. All relevant maternal risk factors were noted and entered in pro forma. General and systemic examination of enrolled neonates was done. A 12-lead ECG and chest X-ray were done within 24 h. Serum Creatine phosphokinase myocardial band (CPKMB) levels were sent at 24-h age. Echocardiography was done to evaluate cardiac contractility and the presence of persistent pulmonary hypertension within 48 h of birth. Elevated serum CPKMB level was used as criteria to diagnose myocardial dysfunction in newborns with severe birth asphyxia. All patients were managed as per unit protocol. All enrolled neonates were followed till their hospital stay (death/discharge) to assess the outcome of severe birth asphyxia in these patients.

Statistical analysis

Data were entered into a Microsoft Excel spread sheet and analyzed using open source software. For nominal data, frequencies and percentages were computed. Statistical methods such as frequencies, descriptive, crosstabs, and Chi-square were used to analyze the data.

RESULTS

In the present study, babies with severe birth asphyxia fulfilling the inclusion criteria were included. A total of 150 neonates with evidence of severe birth asphyxia were enrolled and studied. There were 25.33% females and 74.67% males. In our study, male-to-female ratio was found to be 3:1. Majority of mothers (80.6%) were multigravida.

Basic characteristics among the study neonates showed that antenatal complications were found in 85.33%, like meconium-stained liquor (73.33%), eclampsia (10%), pre-eclampsia (12%), gestational diabetes mellitus (15%), obstructed labor (16%), oligohydramnios (23%), placenta previa (10%), and antepartum hemorrhage (7%). We found that signs of respiratory distress in the form of chest indrawing were present in 73.33% of patients. Signs of circulatory failure in the form of prolonged capillary refill time (CRT) were seen in 83.33%, and central cyanosis was seen in 60.66%. Meconium staining of the cord was present in 76.66% of cases, and 72.66% of babies were pale (Table 1).

Table 1: Demographic and clinical characteristics of patients

Parameter	n	%
Amniotic fluid		
Stained	110	73.33
Clear	40	26.66
Mode of delivery		
Vaginal route	98	65.30
Emergency LSCS	52	34.70
Antenatal complications		
Present	128	85.33
Absent	22	14.66
Type of delivery		
Post term	7	4.70
Term	143	95.30
Chest indrawing		
Present	110	73.33
Absent	40	26.66
CRT>3 s		
Yes	125	83.33
No	25	16.66
Meconium-stained cord		
Yes	115	76.6
No	35	23.33
Apnea		
Yes	25	16.7
No	125	83.3
Cyanosis		
Central	91	60.66
Peripheral	59	39.33
Color		
Pale	109	72.66
Pink	41	27.33

CRT: Capillary refill time

Analysis of echocardiography showed that tricuspid regurgitation was present in 58% and the ejection fraction was reduced in 53.3%. CPKMB was deranged in a very high number of patients (93.33%) in comparison to echocardiography, in which the ejection fraction was reduced in 53.33%. Hence, it can be suggested that serum CPKMB levels rise early before ejection fraction is reduced and hence is more sensitive to pick up cardiac dysfunction. ECG abnormality was seen in a very small number of patients (Table 2).

There was a statistically significant association between CPKMB, ejection fraction, and the outcome ($P<0.05$),

while there was no significant association between ECG abnormality and the outcome (P>0.05). Hence, it can be concluded that CPKMB and ejection fraction are better predictors of mortality (Table 3).

DISCUSSION

In our study, out of 150 cases, we found the male-to-female ratio to be 3:1, which was consistent with the study conducted by Reddy et al., where there was a preponderance of the male gender in cases of birth asphyxia.[4] Most of the mothers were multigravida 80.6% (n=121) and 19.3% (n=29) were primigravida. Out of the total, 65.3% (n=98) were born by vaginal route, and 34.7% (n=52) were born through emergency LSCS. But studies from Reddy et al., and Khreisat and Habahbeh have shown a higher incidence of emergency LSCS in cases of asphyxia than in the control group.[4,5] Antenatal complications were present in 85.3% (n=128). This can be explained by the fact that we had a greater number of referred cases, and mothers came in the advanced stages of labor. In our study, amniotic fluid staining was present in 73.33% (n=110), which can be explained by the passage of meconium in utero due to acute or chronic hypoxia and/or infection. Fetal distress was found to be present in 72.70% (n=109); the reason may be that mothers from the peripheries came with delayed presentation.

Table 2: CPKMB, echocardiography and ECG findings

Parameter	n	Percent
CPKMB		
Elevated	140	93.33
Normal	10	6.66
Tricuspid regurgitation		
Present	87	58
Absent	63	42
Ejection fraction		
Reduced	80	53
Normal	70	47
PR interval		
Shorter	13	9
Prolonged	4	3
Normal	133	89
QTc Interval		
Prolonged	23	15
Normal	127	85
ST segment		
Depression	15	10
Elevation	4	3
Normal	131	87
T waves		
Flattening	12	8
Inversion	3	2
Normal	135	90

Analysis of clinical features revealed that out of 150 patients, respiratory distress was present in 73.33% (110) and central cyanosis was present in 60.66% (n=91). Features of circulatory failure in the form of prolonged CRT were seen in 83.33% (n=125) of the cases. 72.66% (n=109) of the cases were pale. Goel et al., also reported to an almost similar incidence of prolonged CRT of 75% and respiratory distress in 70% of severe birth asphyxia.[6] The echo changes expected to occur in asphyxia are a depressed ventricular ejection fraction and tricuspid regurgitation. In the present study, we found tricuspid regurgitation was present in 58% (n=87) cases and a reduction in ejection fraction was observed in 53.3% (n=80) cases.

In our study, we tested the levels of CPKMB in serum at 24 h, and we found that 93.3% (n=140) had raised CPKMB levels. Shadique and Sailavasan; Saira et al., and Mandal et al., support our findings.[7] The enzyme levels showed a significant rise with severe birth asphyxia, which indicates significant myocardial ischemia in cases of severe birth asphyxia. ECG abnormalities were seen in almost 2-15% of cases in our study, which is lower than the study done by Rajakumar et al., (73.33%) and Agrwal et al., (76.77%).[8,9] Myocardial changes in birth asphyxia have similarly been described by Bhasin and Kohli, Kumar and Arasan, and; Merchant et al.[10-12]

Out of the total 150 cases, 72 died, and levels of CPKMB were elevated in 70 cases, which can be considered an early sensitive marker of mortality in severe birth asphyxia.

Limitations of the study

There was no control group in the study. Serial Troponin-T levels and Serial Echocardiogram, Serial ECG could not be done. Comparison with other cardiac bio-markers such as LDH and Troponin-I was not done. Autopsy was not done on non-survivors as parents refused to give consent.

Table 3: Outcome of babies with normal and abnormal CPKMB, ECG, and echocardiography findings

Outcome	CPKMB		Ejection fraction		ECG abnormality	
	Increased (140)	Normal (10)	Reduced (80)	Normal (70)	Present (24)	Absent (126)
Death (72)	70	2	62	11	14	69
Discharge (57)	47	10	9	48	10	38
LAMA# (20)	20	00	9	11	00	19
Chi-square value	11.391, df=2		62.124, df=2		4.50, df=2	
P-value	0.003*		0.001*		0.105, NS	

Pearson Chi-square test applied. P<o.o5 was taken as statistically significant. #Leave against medical advice

CONCLUSION

Evaluation of CPKMB levels as a marker of myocardial dysfunction shows promising results. There was an increased incidence of overall mortality in children with cardiac dysfunction. Further studies are necessary to validate these findings.

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Authors' Contributions:
SK- Prepared first draft of manuscript, implementation of study protocol, data collection and analysis and manuscript preparation; **AB-** Concept, design manuscript preparation, editing and revision; **DC-** Design of study and interpretation; **NM-** Review manuscript; **PG-** manuscript preparation and revision.

Work attributed to:
Department of Pediatrics, Mahatma Gandhi Memorial Medical College, Indore, Madhya Pradesh, India.

Orcid ID:
Dr. Shivangi Kachhwaha - https://orcid.org/0000-0002-9290-3172
Dr. Anjali Bharani - https://orcid.org/0000-0002-8071-1368
Dr. Dharmanshu Chaube - https://orcid.org/0000-0001-5386-2358
Dr. Nirbhay Mehta - https://orcid.org/0000-0003-4824-4680
Dr. Puneet Goyal - https://orcid.org/0000-0001-8734-3804

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