STUDY OF TROPONIN I LEVELS IN EVALUATION OF CARDIOVASCULAR STATUS OF FULL-TERM BIRTH ASPHYXIATED NEONATES

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KEYWORDS

TROPONIN, ASPHYXIATED NEONATES, Perinatal asphyxia

ABSTRACT

Introduction: Birth asphyxia, a prolonged imbalance between oxygen demand and supply, accounts for 24% of neonatal deaths and 11% of fatalities in children under 5. Perinatal asphyxia leads to multiple organ dysfunction, including myocardial involvement, which can affect outcomes. Elevated troponin I levels in asphyxiated newborns are crucial biomarkers for detecting cardiac injury, and this study aims to determine their relationship with hypoxic-ischemic encephalopathy stages. **Aims:** The study explores the link between troponin I levels, cardiovascular status, disease severity, and mortality in asphyxiated full-term neonates, examining the relationship between these factors. **Methodology:** The study, a cross-sectional observational observational study, examined the prevalence of birth asphyxia in inborn neonates at Krishna Hospital, Karad, focusing on factors such as gender, birth weight, delivery mode, neurological involvement, and maternal risk factors. **Results:** The study analyzed the prevalence of ovarian cancer in women and men, with a majority of cases being females. The most common cause was fetal distress. The study found that asphyxiated subjects had higher troponin I values, and a higher percentage of subjects had neurological involvement. The majority of cases experienced convulsions or comatose state. **Discussion:** A study found no significant association between pH values, APGAR score, and cord blood ABG in newborn babies, but found meconium-stained liquor more common in asphyxiated neonates. **Conclusion:** Birth asphyxiated individuals exhibited higher cardiac troponin I levels, linked to increased mortality, cardiovascular, and neurological issues, potentially serving as a biomarker for these parameters.

INTRODUCTION

Birth asphyxia is a significant factor in neonatal mortality, causing a prolonged imbalance between oxygen demand and supply. It accounts for 24% of all neonatal deaths and 11% of fatalities in children under 5. Most deaths occur in the first week, with severe cases causing hypoxic-ischemic encephalopathy (HIE), resulting in severe symptoms. **[1,2]**

Birth asphyxia is influenced by antepartum, intrapartum, and postpartum factors, including maternal age, eclampsia, meconium-stained liquor, fetal distress, and prolonged labor. [3]

The World Health Organization's ICD-10 classification categorizes birth asphyxia into severe (0-3 APGAR score) and mild and moderate (4-5) scores at one minute. [4]
Perinatal asphyxia causes a common problem leading to multiple organ dysfunction, including myocardial involvement, which can affect outcomes. [5] The cardiovascular system is significantly impacted by hypoxia, causing hemodynamic instability and Bradycardia. Asphyxia causes blood pressure drops and ischemia in vital organs. Low heart rate and decreased myocardial contractility reduce ventricular output and stroke volume, leading to impaired myocardial function, as demonstrated by ECG and serum levels of cardiac enzymes. [6]
Troponin I is a crucial cardiac marker in medicine, indicating myocardial ischemia in both adults and children. Typically low in newborns, elevated levels can be detected in heart injuries, indicating perinatal asphyxia. [7]
Cardiac troponin I (cTnI) concentrations in asphyxiated newborns are significant biomarkers for detecting microscopic cardiac injury, making it a valuable diagnostic tool for perinatal asphyxia. [8]
Neonatal hypoxic-ischemic encephalopathy (HIE) can lead to multiorgan injury, with myocardial ischemia potentially contributing. Troponins appear in blood 4-6 hours after asphyxia, peaking 18-24 hours and remaining elevated for up to 21 days. [14]
Issa A, et al.'s study found a direct link between elevated troponin I levels and increased mortality in term babies, emphasizing its prognostic significance. [7]
Shastri et al.'s study found that cardiactroponin I concentrations within 36 hours after birth strongly correlate with hypoxic-ischemic encephalopathy clinical grade and inotropic support duration. [8]
Early cardiac troponin I measurements are crucial for diagnosing cardiovascular status in perinatal asphyxia. However, limited studies exist on cardiac morbidity and survival effects. This study aims to determine troponin I levels in full-term asphyxiated neonates and their relationship with Hypoxic-Ischemic Encephalopathy stages.

AIM AND OBJECTIVES

The study aims to investigate the correlation between troponin I levels, cardiovascular status, disease severity, and mortality in asphyxiated full-term neonates.

Study Objectives:
- Examine Troponin I levels in asphyxiated full-term neonates and healthy controls.
- Evaluate Troponin I levels in cardiovascular status of birth asphyxiated neonates.

• Determine relationships between Troponin I and HIE and mortality.
• Correlate Troponin I level with systemic neurological involvement.

MATERIALS AND METHODS

Study design: Hospital-based cross-sectional observational study

Duration of study:18 months

Place of study: Department-Pediatrics, Krishna Hospital, KVV,KARAD

INCLUSION CRITERIA: The cases included term babies with asphyxia, characterized by failure to breathe at birth, moderate to severe asphyxia, low blood pH, clinical neurologic involvement, and multisystem involvement.

EXCLUSION CRITERIA: The study excludes cases of congenital anomalies and congenital heart disease, with a control group consisting of 60 healthy term newborns and AGA without signs of perinatal asphyxia.

The study required a minimum of 60 cases and 60 controls to accurately represent the prevalence of birth asphyxia in India.
This prospective study included inborn neonates born at Krishna Hospital, Karad, who met inclusion criteria. Data included gender, birth weight, mode of delivery, APGAR, neurological involvement, cardiovascular involvement, maternal risk factors, presence of MSL, and days of hospitalization. Arterial blood gas analysis was performed, and troponin I value was recorded. The data was analyzed using SPSS software, with a p-value <0.001 considered statistically significant.

RESULTS

Table 1: Gender wise comparison of asphyxiated group and controls

Gender	Cases(N=60)	Controls(N=60)
Males	35 (58.33%)	37 (61.66%)
Females	25 (41.66%)	23 (38.33%)

The study found that 58% of cases were females and 41.66% were males, while 61.66% of controls were females and 38.33% were males.

Table 2 presents a comparison of the mode of deliverywise of a sphyxiated group and controls.

Mode Of Delivery	Cases(N=60)	Controls(N=60)
NVD	39 (65%)	46 (76.66%)
LSCS	21 (35%)	14 (23.33%)

In 60 cases, NVD was 39 (65%) and LSCS was 21, while in 60 controls, NVD was 46 (76.66%) and LSCS was 14, resulting in a total of 23.33%.

Table 3: Comparison of baseline characteristics of asphyxiated group and controls.

Characteristic	Cases(N=60)		Controls(N=60)		Unpaired tValue	pValue
	Mean	SD	Mean	SD		
GA(Week)	38.685	0.99	38.6	1.01	0.4655	0.6424
Birth Weight (Kg)	2.867	0.38	3	0.349	1.9967	0.0482
APGAR(1 Min)	2.56	0.738	6.8	0.4	39.1252	<0.0001
APGAR(5 Min)	4.66	0.723	8.81	0.387	63.4433	<0.0001

The mean gestational age (GA) of cases was 38.685 weeks, while the mean birth weight of asphyxiated subjects was 2.867 kg, while the mean APGAR was 4.66.

Table 4 displays the distribution of indication of LSCS in a phyxiated group and controls.

Indication of LSCS	Cases(N=60)	Controls(N=60)
Abruption	3 (5%)	1 (1.6%)
Breech	1 (1.6%)	2 (3.3%)
FetalDistress	6 (10%)	2 (3.3%)
Pre-Eclampsia	3 (5%)	0
Previous LSCS	4 (6.6%)	6 (10%)
PROM	2 (3.3%)	3 (5%)
Eclampsia	2 (3.3%)	0

The most common cause of LSCS in cases is fetal distress, and controls are previous LSCS.

Table 5:Value of Troponin I at 24-48 hours

Troponin I	Cases(N=60)	Controls (N=60)	Unpairedt-Value	pValue
Mean	1.453	0.0315	16.3574	<0.0001
SD	0.673	0.014		

The mean troponin I value of the asphyxiated group was 1.453, while the control group had a value of 0.0315.

Table 6:Value of Troponin I at 5 Days

Troponin I	Cases (N=60)	Controls (N=60)	Unpaired t-Value	pValue
Mean	0.66	0.0141	14.5410	<0.0001
SD	0.344	0.0069		

The average troponin I value of the asphyxiated group was 0.66, while the control group had a value of 0.0141.

Table 7: MSL in Asphyxiated Group(N=60) and Controls(N=60)

MSL	Cases(N=60)	Controls(N=60)
No	29 (48.33%)	50 (83.33%)
Yes	31 (51.66%)	10 (16.66%)

MSL in was present in 31 cases (51.66%), compared to 10 (16.66%) controls.

Table 8: Comparison of Presence of Maternal Risk Factor in Asphyxiated and Control Groups

Maternal Risk Factors	Cases(N=60)	Controls(N=60)
Eclampsia	2 (3.3%)	0
Pre-Eclampsia	3 (5%)	0

Eclampsia was present in 2.3% of cases and pre-eclampsia in 5% of cases, compared to 0 in both categories in the control group.

Table 9: Serum Troponin I values across t ages of disease

Variable	HIE1	HIE2	HIE3
Troponini(ng/ml)	1.128	1.254	2.286

The mean value of Troponini is 1.128, 1.254, and 2.286 at HIES Stage 1, 2, and 3, respectively.

Table10:Relationship between stages of HIE and Mortality

HIE Stage	Outcome at Discharge	
	Survived	Death
1	28 (100%)	0
2	15 (88.2%)	2 (11.8%)
3	3 (20%)	12 (80%)

In HIE Stage 1, all 28 cases (100%) survived, followed by 15 cases (88.2%) and 2 deaths, and only 3 cases (20%) survived, with 12 deaths (80%).

Table 11: Correlation of Troponin I value with Neurological and Cardiovascular Involvement in Asphyxiated subjects

Systemic Involvement	Troponini(0-1 ng/ml)	Troponini(1-2 ng/ml)	Troponini(>2 ng/ml)
Neurological Involvement	5 (8.33%)	6 (10%)	7 (11.66%)
Cardiovascular Involvement	0	0	6 (10%)

The study reveals that 5 subjects have neurological involvement with a Troponin i value between 0-1 ng/ml, 6 have it between 1-2 ng/ml, and 7 have it above 2 ng/ml.

Table12:Correlation of Troponin I value with Outcomes in Asphyxiated subjects

Outcome	Troponini(0-1 ng/ml)	Troponini(1-2 ng/ml)	Troponini(>2 ng/ml)
Survived(46)	18 (39%)	28 (61%)	0
Death(14)	0	3 (21.4%)	11(78.6%)

The study found that subjects with a Troponin i value between 0-1 ng/ml experienced 0 deaths, 3 deaths and 28 survivors, and 11 deaths and 0 survivors in subjects with a higher Troponin i value.

The mean troponin I value in subjects with pulmonary fibrosis ranged from 24-48HOL, with a drop at DOL5, where the mean was 0.66 ng/ml.

Table13:Signs of Cardiovascular Involvement

Sign of Cardiovascular Involvement	Number Of Subjects
Hypotension	5 (83.33%)
Cardiogenic Shock	1 (16.67%)

Six subjects had cardiovascular involvement, with hypertension in five cases (83.33%) and one having cardiogenic shock (16.67%).

Table 14: Signs of Neurological Involvement

Sign of Neurological Involvement	Number Of Subjects
Convulsions	12 (66.66%)
Comatose	6 (33.34%)

Out of 18 subjects with neurological involvement, 12 cases (66.66%) experienced convulsions, while 6 cases (33.34%) were comatose.

DISCUSSION

Perinatal asphyxia is a prevalent neonatal issue, primarily in low-middle-income countries like India. The Apgar score, a rapid tool for assessing newborn clinical condition and resuscitation response, is widely used. [9,10]

The score for immaturity in a preterm infant is subjective and influenced by factors like maternal sedation, congenital malformations, gestational age, and trauma, and a low score cannot predict morbidity or mortality. [9,11]

The study compares pH values, APGAR score, and cord blood ABG in newborn babies with no birth history, APGAR score, and cord blood ABG, and compares asphyxiated and control groups, considering baseline characteristics like birth weight, GA, and gender frequency.

The study involved 120 term newborns, with 60 in the birth asphyxia group and 60 normal newborns. The results showed no significant association between the study groups, correlating well with previous research.

The mean gestational age of term newborns with BA was 38.685 weeks, while normal newborns had 38.6 weeks. No significant statistical association was found between the study groups.

The study compared delivery methods for full-term newborns with birth asphyxia and normal-term newborns, finding that most were normal, with 35% caesarean section, and 23.34% requiring LSCS.

The mean birth weight of asphyxiated newborns and normal newborns was 2.867 kg, with no significant association found among study groups. No statistically significant association was found between the two groups.
The study assessed the APGAR score of full-term newborns with birth asphyxia and term normal newborns at 1 and 5 minutes of life. The mean APGAR score was 2.56, 6.8, and 4.66, similar to Trevisanuto's study.
The study found that meconium-stained liquor (MSL) was more commonly found in asphyxiated neonates (51.66%) than in healthy neonates (16.66%), indicating a higher association with birth asphyxia. [7]
The study reveals a correlation between the severity of HIE and mortality rates in infants. Stage 1 had 100% survival, Stage 2 had 88.2% survival, and Stage 3 had 20% survival. The data shows that mortality rates increase significantly with HIE severity. Stage 1 had a good prognosis, Stage 2 had a lower survival rate, and Stage 3 had a high mortality rate.
The study measured Troponin I at 24 hours of life, with the asphyxiated group having a mean value of 1.453 and the control group having a mean value of 0.0315.
This study uses arterial blood pressure, APGAR scores, and Troponin I values to identify perinatal asphyxia. The mean Troponin I value in the asphyxiated group was 1.453 ng/ml, while in the control group it was 0.0315 ng/ml. The results suggest a significant difference in care requirements for newborns. [12]
Troponin I levels in asphyxiated neonates are elevated, with mean values around 1.3 ng/ml within 48 hours of life, supporting the current study's findings and highlighting the significant statistical difference between asphyxiated infants and controls. [13]

The study found a significant drop in mean Troponin I values in cases and controls over days following birth, with a similar drop observed in Issa et al. The study also revealed signs of cardiovascular involvement in 10% of asphyxiated neonates, including hypotension and cardiac shock, and neurological involvement in 30% of the affected subjects.
Troponin I levels were found to be correlated with neurological and cardiovascular involvement in asphyxiated neonates. Neurological involvement was observed in subjects with levels between 0-1 ng/ml, 1-2 ng/ml, and >2 ng/ml, with severity increasing with higher levels. Cardiavascular involvement, specifically hypotension and cardiogenic shock, was noted in subjects with Troponin I levels >2 ng/ml. The correlation between Troponin I levels and outcomes (survival or death) at discharge was striking, with all subjects with Troponin I levels >2 ng/ml dying. Troponin I could serve as a prognostic indicator, helping clinicians predict outcomes in asphyxiated neonates.

CONCLUSION

Birth asphyxiated subjects showed significantly higher cardiac troponin I levels compared to controls, which were associated with increased mortality, cardiovascular and neurological involvement. Higher troponin I values >2ng/ml could be considered an additional biomarker for these parameters.

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