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Determine myocardial injury by using qualitative cardiac troponin T in critically ill children at tertiary care centre

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ABSTRACT

Background- Early recognition of myocardial dysfunction may help in the management for quick and improved outcome. Experimental models of myocardial injury have shown significant rise in cardiac troponins (cTns) and creatine phosphokinase-MB (CPK-MB).

Material and Methods- Cardiac trop T and ck-mb is recorded in 100 children with in 24 hrs of admission in picu who are critically ill excluding cardiac cases.

Result- Cardiac troponin T has been used to assess prevalence of myocardial injury in critically ill children. Myocardial injury has been associated with increased mortality. The present study was observational study conducted in Paediatric Intensive care unit of tertiary care centre, Dr. Susheela Tiwari Government Hospital, Haldwani to determine myocardial injury by using qualitative cardiac troponin T in critically ill children. In the present study, the mean CK-MB in Troponin T positive cases was 97.32±65.24 and Troponin T negative cases was 58.11±52.05. This was found to be statistically significant ($P<0.0001$).

Conclusion- The present study shows the role of cardiac troponin T in critically ill children to determine myocardial injury. We assessed the correlation between qualitative Troponin T and PELOD score and also the mortality. The correlation of CK-MB and Troponin T was studied and found to be highly significant and related to prognosis, severity, and further management.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 06, 2023

Further studies with larger sample size are required to validate the findings of the present study.

Keywords: Cardiac troponin T and ck-mb, PELOD score

INTRODUCTION

Myocardial dysfunction is conventionally assessed by echocardiography. Its limited availability at bedside in resource-limited facilities, especially in pediatric services, is a cause of concern. An affordable, sensitive, and specific biomarker of myocardial dysfunction is the need of the hour. Early recognition of myocardial dysfunction may help in the management for quick and improved outcome. Experimental models of myocardial injury have shown significant rise in cardiac troponins (cTns) and creatine phosphokinase-MB (CPK-MB).[1, 2]

The troponin complex regulates the contraction of striated muscles and consists of three subunits (troponin C, troponin T, and troponin I). Troponin C is a 18 ku protein that binds to calcium ions. Troponin T is a 37 ku protein that binds to tropomyosin, thereby attaching the troponin complex to the thin filament. Troponin I is a 24 ku protein that binds to actin and decreases troponin C affinity for calcium, thus inhibiting actin–myosin interactions.[3]

Troponin T and troponin I are present in cardiac and skeletal muscles, but are encoded by different genes in the two types of muscle, yielding proteins that are immunologically distinct. Assays that are based on high-affinity antibodies and are specific for cardiac troponin T (cTnT) and cardiac troponin I (cTnI) are available. Because the amino acid sequence of cardiac troponin C and skeletal troponin C is identical, no such assays have been developed for the troponin C component.[4]

The majority of cardiac troponin (cTn) is bound to myofilaments, and the remainder is free in the cytosol which accounts for 3%–8% of the total amount.[5] After disruption of the sarcolemmal membrane of the cardiomyocyte, troponin from the cytoplasmic pool is initially released, followed by a more protracted release from quantities bound to deteriorating myofilaments. In peripheral blood, cTnT begins to rise within three to four hours after the onset of myocardial injury and remains increased for 10–14 days.[6]

CK-MB is an isoenzyme of creatine kinase. Creatine kinase dephosphorylates creatine phosphate to creatine, providing the energy required for ATP regeneration. In 1966, creatine kinase isoenzymes were identified in various tissues. The isoenzymes of CK are dimers of either type B or type M polypeptide chains, BB isoenzymes are found in the central nervous system, MM isoenzyme is a principal component in adult skeletal muscles. The myocardium has 15% CK-MB

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isoenzyme and 85% CK-MM. Skeletal muscles contain about 1% to 3% of CK-MB.[7]

The main objective of the pediatric intensive care unit (PICU) is to prevent mortality by intensively monitoring and treating critically ill children who are considered at high risk of mortality. The capability to estimate patient risk of death is extremely important because these estimates would be useful in achieving many different goals, such as assessing prognosis, intensive care unit (ICU) performance, ICU resource utilization, evaluating therapies by comparative analyses in quality assessment controlling, and matching severity of illness in clinical studies. The lack of consistency, reliability, and accuracy in physician's subjective opinions concerning patient status necessitates quantitative clinical scores. The scoring systems were developed in response to increasing emphasis on the evaluation and monitoring of health services.[8]

The descriptive score widely used to assess multiple organ dysfunction syndrome (MODS) is the Pediatric Logistic Organ Dysfunction score (PELOD). In 1999, PELOD score was developed using the most abnormal value of each variable during the entire PICU stay and was validated in 2003. It is by far the most frequently used score aiming to describe the severity of cases of MODS. Because of changes over time in case mix and clinical practice, the performance of this score deteriorated, and there was a need to re-calibrate it. Even though PELOD is quantitative, it is discontinuous, and which may cause problems when doing some statistical analyses. There is paucity of data concerning myocardial injury in PICUs in our country. So, the aim of this study was to evaluate myocardial injury in critically ill children by using qualitative cardiac troponin T. We determined correlation between qualitative Troponin T and PELOD score in critically ill children. We assessed correlation of CK-MB and Troponin T as marker for myocarditis.

MATERIAL & METHODS

- **Study Design**: Observational study.
- **Study Population**: >1 month to 15 years.
- **Place of study**: Paediatric Intensive care unit of tertiary care centre (Dr. Susheela Tiwari Government Hospital, Haldwani).
- **Sample Size**: 100 children getting admitted in PICU of Dr. Sushila Tiwari hospital who fulfilled the inclusion criteria were included
- **Study Period**: January 2021 to September 2022

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 06, 2023

Inclusion criteria:

- Acute critically ill children
- >1 month to 15 years

Exclusion Criteria

- Children with congenital heart disease
- Those who have recently undergone major surgery
- Burn patients
- Not willing to give consent
- Paediatric logistic organ dysfunction (PELOD) score was filled in all children admitted in PICU at time of admission.
- Complete blood count (hemoglobin, total leucocyte count, platelet counts), CRP, KFT, LFT, arterial blood gas analysis, electrolytes (sodium, potassium), serum calcium was done at time of admission.
- On admission along with the above laboratory parameters qualitative troponin T and CPK-MB were done in critically ill children.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for windows, Version 25.0 Armonk, NY: IBM Corp. Results on Mean±SD and categorical as frequency (Percentage). Inferential statistics like Chi-square test/Fischer Exact test, Independent t test was applied. The significance of level adopted was 5%.

RESULT

The present study was observational study conducted in Paediatric Intensive care unit of tertiary care centre, Dr. Susheela Tiwari Government Hospital, Haldwani to determine myocardial injury by using qualitative cardiac troponin T in critically ill children.

Majority of participants (29%) were 11 to 15 years of age, followed by 27% in age group 6 to 10 years, followed by 22% in age group 1 to 5 years and 22% in age group less than 1 years.

The present study showed male predominance. There were 54.0% males and 46.0% females in the present study.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 06, 2023

Gastro-intestinal, respiratory and Central nervous involvement was reported in 30.0%,44% and 25% respectively.Skeletal system was involved in 1.0% participants.

Table 1: Distribution of study participants based on diagnosis

Diagnosis	Number	Percentage
ARDS	6	6.0%
Bronchiolitis	6	6.0%
Cerebral malaria	1	1.0%
Encephalitis	13	13.0%
Enteric fever	6	6.0%
GBS	3	3.0%
Hepatic encephalopathy	1	1.0%
Meningitis	7	7.0%
Meningoencephalitis	1	1.0%
Pneumonia	26	26.0%
Scrub typhus	22	22.0%
Seizure	1	1.0%
Septic arthritis	1	1.0%
Severe Pneumonia	6	6.0%
TOTAL	100	100%

The above table depicts distribution of study participants based on diagnosis.

Majority of participants were diagnosed with pneumonia (26%), followed by scrub typhus (22%).

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 06, 2023

Table 2: Distribution of study participants based on troponin T

Troponin t	Case		Control	
	Number	Percentage	Number	Percentage
Positive	25	25.0%	0	0%
Negative	75	75.0%	40	100%
TOTAL	100	100.0%	40	100%

In the case group,25.0% participants showed positive Troponin T and remaining 75.0% showed negative Troponin T. Troponin T positivity was not reported in the control group. On statistical analysis, this was found to be highly significant ($p<0.0001$).

Table 3: Association of troponin t with PELOD score

Troponin T	Mean pelod score
Negative (N=75)	8.52±4.76
Positive (N=25)	7.76±3.71

The mean PELOD score in Troponin T positive cases was 8.52±4.76 and Troponin T negative cases was 7.76±3.71. This was not found to be statistically significant ($P= 0.411$, $P>0.05$).

Table 4: Association of troponin T with CK-MB

Troponin T	Mean CK-MB
Negative (N=75)	97.32±65.24
Positive (N=25)	58.11±52.05

The mean CK-MB in Troponin T positive cases was 97.32±65.24 and Troponin T negative cases was 58.11±52.05. This was found to be statistically significant ($P<0.001$) and CK-MB is directly proportional to increase in trop T and is indicator of severity of disease and further outcome.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 06, 2023

Table 5: Association of troponin T with mortality

Troponin T	Survivors		Dead	
	Number	Percentage	Number	Percentage
Positive (N=25)	22	88.0%	3	12.0%
Negative (N=75)	66	88.0%	9	12.0%
TOTAL	88	88.0%	12	12%

The association of Troponin T with mortality was not found to be statistically significant (P= 0.658, P>0.05).

DISCUSSION

Cardiac troponin T has been used to assess prevalence of myocardial injury in critically ill children. Myocardial injury has been associated with increased mortality. The present study was observational study conducted in Paediatric Intensive care unit of tertiary care centre, Dr. Susheela Tiwari Government Hospital, Haldwani to determine myocardial injury by using qualitative cardiac troponin T in critically ill children.

In Clark SJ et al[18] they observed that admissions to paediatric intensive care had significantly raised cTnT levels compared to controls and this elevation persisted for at least 24 hours. There was a significant correlation between the cTnT levels and the disease severity score. In the present study, 29% participants were between 6 to 10 years of age, with majority being 54.0% males. We observed that in the case group, 25 % participants showed positive Troponin T and remaining 75 % showed negative Troponin T. Troponin T positivity was not reported in the control group. TropT on statistical analysis, this was found to be highly significant ($p<0.0001$).

The Pediatric Logistic Organ Dysfunction (PELOD) score quantifies organ dysfunction precisely and can be used as indicators of the severity of illness throughout the clinical course. PELOD score more than 15 is found to be significant and associated with multi organ failure. It can also be used as baseline and measure outcome in clinical studies conducted in ICU and pediatric ICUs (PICUs).[27]The mean PELOD score in Troponin T positive cases was 8.52 ± 4.76 and

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 06, 2023

Troponin T negative cases was 7.76±3.71. However, this was not found to be statistically significant (P= 0.411, P>0.05) in this study.

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In the present study, the mean CK-MB in Troponin T positive cases was 97.32±65.24 and Troponin T negative cases was 58.11±52.05. This was found to be statistically significant (P<0.0001). Baranwal AK et al[23]also concluded by their study that CPK-MB could be a potential monitoring tool for septic cardiomyopathy in resource-limited settings. In their study, the SSSs (Septic Shock Survivors) had higher CPK-MB and PeLOD score on day 1 compared to the NSS (Non-septic shock) children.

In the present study, the association of Troponin T with mortality was not found to be statistically significant (P= 0.658, P>0.05). This was contrary to findings of Hassan B et al[20] who conducted a quantitative study and observed a highly significant difference between levels of cTnT in cases who died and those who survived, being higher in non-survivors.

CONCLUSION

The present study shows the role of cardiac troponin T in critically ill children to determine myocardial injury. We assessed the correlation between qualitative Troponin T and PELOD score and also the mortality. The correlation of CK-MB and Troponin T was studied and found to be highly significant and related to prognosis, severity and further management. Further studies with larger sample size are required to validate the findings of the present study.

Cardiac markers like LDH, Troponin I were not included in the present study. Studies with large cohort study and specific age group are required. Measurement of troponin levels at regular interval is required. Patient must be monitored for more than 24 hr. for troponin T and CK-MB rise and decline to draw a conclusion.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 06, 2023

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ISSN:0975 -3583,0976-2833 VOL14, ISSUE 06, 2023

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