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Cardiac troponin I level in healthy newborn babies in Ilorin, North-Central Nigeria

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Abstract:

BACKGROUND: Cardiac troponins are reliable markers for the diagnosis of myocardial ischaemia. Cardiac troponin I is a valuable biomarker that has gained popularity across all ages including newborns. However, its usage in our environment in the paediatrics age group is limited probably because few studies have evaluated the normal levels in the healthy children. Hence, we determined the cardiac troponin I level in healthy term newborns.

METHODOLOGY: This was a cross-sectional analytical study that involved 85 healthy term appropriate for gestational age newborns aged 24–72 h of life. The babies had relevant demographic parameters collected in a study pro forma. We determined the cardiac troponin I assay using enzyme-linked immunosorbent assay (Enzyme linked immunosorbent assay method (ELISA)) method.

RESULTS: The median (interquartile range [IQR]) cardiac troponin I level was 0.79 (0.79–1.42) ng/ml. The cardiac troponin I level in male newborns, 1.05 (0.79–1.55) ng/ml, was higher but comparable with female newborns, 0.79 (0.79–1.00) ng/ml, $P = 0.227$. The cardiac troponin I increases with gestational age, $P = 0.049$. There was no relationship between cardiac troponin I level and birth weight, chronological age and mode of delivery ($P > 0.05$ in each).

CONCLUSION: The study demonstrated cardiac troponin I levels in healthy term Nigerian newborns with a significant relationship with gestational age.

Keywords:

Cardiac troponin I, healthy, newborn babies, Nigeria, term

Introduction

Cardiac biomarkers are substances that are released into the blood when the heart is damaged or stressed.[1] The cardiac biomarkers allow for early and improved diagnostic accuracy. They are near-ideal biomarkers because they can be objectively and reliably measured, sensitive, specific for diagnosis and monitoring of response to treatment and useful in prognostication.[1] Among the cardiac biomarkers released in response to acute myocardial injury are cardiac troponins.[1]

Troponin is a regulatory protein complex located on the actin filament of all striated muscle. It is made up of three subunits, namely troponin C, troponin T and troponin I.[2] Cardiac troponins are coded by specific genes and found to be unique to the myocardium.[3,4] Cardiac troponin assay is found to be superior in terms of sensitivity and specificity compared to creatinine kinase (CK-TOTAL, CK-MB) in the identification of myocardial injury.[5] Thus, elevated cardiac troponins are preferred biomarkers for the diagnosis of myocardial infarction.[5,6] Cardiac troponin I has a single isoform specific to the myocardium

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compared with troponin T, although second-generation troponin T assay is equally sensitive as troponin I in the diagnosis of myocardial ischaemia.[7,8] Cardiac troponins are significant markers recommended by the American Heart Association and European Cardiac Society for the diagnosis of myocardial infarction. They are equally significant in the paediatric and neonatal age groups.[6] Troponins are increasingly being used for diagnosis, monitoring and prognostication among children with congenital heart disease, post-cardiac surgery, perinatal asphyxia and other cardiac-related diseases.[9,10] Thus, this study determined the level of serum troponin I among healthy newborns aged 24–72 h of life.

Methodology

This study was a cross-sectional analytical study, conducted in the post-natal wards of the University of Ilorin Teaching Hospital. In the absence of local studies on Nigerian healthy newborns, we used 0.5 to estimate the minimum sample size using Fisher's formula and obtained a sample size of 85. Ethical clearance was obtained from the Hospital Ethics Review Committee. Written informed consent was obtained from parents after a clear explanation of the study objectives.

Inclusion criteria were term appropriate for gestational age (AGA) healthy newborn babies. These babies were recruited between 24 and 72 h of life. Babies with congenital heart disease, major congenital anomalies, history of risk for sepsis and clinical suspicion of sepsis were excluded from the study. All the babies had their anthropometric parameters measured and were classified based on gestational age using Lubchenco chart. Other relevant clinical data were obtained. Two millilitres of blood was collected and transferred into a plain bottle.

Blood sample collected was allowed to clot and fully retract for 2 h at room temperature and then centrifuged at 1000 rpm for 15 min; serum was harvested and stored at −80°C in the Chemical Pathology Laboratory. Cardiac troponin I was subsequently analysed in batches using Caliboteh® Human Troponin I ELISA kit. The ELISA kit is an *in vitro* enzyme-linked immunosorbent assay for the quantitative measurement of cardiac troponin I in the serum. The kit uses the principle of sandwich-based antibodies specific for human troponin I coated on a 96-well microplate. This assay procedure was performed by a chemical pathologist.

Data obtained were entered into a computer and analysed using Statistical Package for the Social Sciences (SPSS) software version 23.0 for Windows (SPSS Inc., Chicago, IL, USA). Mean, median and interquartile range (IQR) were reported as appropriate. Mann–Whitney U test, Kruskal–Wallis test and Spearman's correlation coefficient were used to compute statistical relationships and associations between parameters. A $P < 0.05$ was considered statistically significant.

Results

Eighty-five healthy AGA newborns were recruited between 24 and 72 h of life with mean ± standard deviation (SD) age of 31.47 ± 17.13 h. The newborns comprised 44 (51.8%) females and 41 (48.2%) males. The mean ± SD gestational age was 39.12 ± 1.45 weeks [Table 1]. Majority (71.8%) of the babies were spontaneous vertex delivery. The mean ± SD birth weight was 3.08 ± 0.32 kg as shown in Table 1.

The median (IQR) cardiac troponin I in the healthy newborns was 0.79 (0.79–1.42) ng/ml. Cardiac troponin I levels increased with gestational age. Values were not significantly different between male and females or with birth weight, post-natal age and mode of delivery ($P > 0.05$ in each) [Table 2].

Further, test of association showed no correlation between serum troponin I and selected characteristics of the general population (age, gender, birth weight and mode of delivery), $P > 0.05$ in all. Gestational age was the only parameter with a weak positive correlation as shown in Table 3.

Discussion

Cardiac troponins were documented to have 100% sensitivity and negative predictive value in determining myocardial ischaemia in adult and children compared with creatine kinase and its isoforms.[11] Cardiac troponin I was found to be superior to troponin T in the diagnosis of myocardial injury, despite the specificity of third-generation troponin T assay.[6]

Table 1: General characteristics of the study population

Variable	Mean ± SD
Age at sample collection (h), mean±SD	31.47±17.13
Gestational age (weeks), mean±SD	39.12±1.45
Birth weight (kg), mean±SD	3.08±0.32
Occipitofrontal circumference (cm), mean±SD	34.46±1.45
Length (cm), mean±SD	48.80±2.74
Sex, *n* (%)	
Male	44 (51.8)
Female	41 (48.2)
Mode of delivery, *n* (%)	
Spontaneous vertex	61 (71.8)
Emergency caesarean section	12 (14.1)
Elective caesarean section	10 (11.8)
Assisted vaginal	2 (2.4)

SD: Standard deviation

Table 2: Cardiac troponin I levels across gender, gestational age and post-natal age and birth weight in the study population

Variable	Cardiac troponin I, median (IQR) (pg/ml)	*U*/*K*	*P*
Sex			
Male	1.05 (0.79-1.55)	158.000	0.227
Female	0.79 (0.79-1.00)		
Chronological age (h)			
24-<48	0.79 (0.79-1.50)	78.000	0.056
48-72	0.79 (1.08-1.34)		
Birth weight (g)			
2500-3000	0.79 (0.79-1.21)	183.000	0.498
3001-3999	0.89 (0.79-1.58)		
Mode of delivery			
SVD	0.89 (0.79-1.51)	125.500	0.531
CS	0.79 (0.79-2.89)		
Gestational age group (weeks)			
37-38	0.79 (0.79-1.00)	6.051	0.049
39-40	1.02 (0.79-1.55)		
41-42	1.58 (0.89-2.08)		

U: Mann-Whitney U test, *K*: Kruskal-Wallis test. SVD: Spontaneous vertex delivery, CS: Caesarean section, IQR: Interquartile range

Table 3: Correlation of cardiac troponin I with general characteristic of the population

Variables	Cardiac troponin I	
	r	*P*
Chronological age	0.278	0.079
Sex	−0.191	0.232
Birth weight	0.390	0.808
Mode of delivery	0.099	0.538
Gestational age	0.330	0.035

In the present study, the value of troponin I in the healthy newborns was within the range of values (0.01–1.8) ng/ml obtained for healthy neonates in the literature.[12,13] This is comparable to the median (IQR) of 0.60 (0.20–1.00) ng/ml obtained among Indian healthy neonates using similar methods.[14] The median value in the present study is, however, higher than values of 0.01(0.01 to 0.01) ng/ml and (0.28 ± 0.42) ng/ml obtained by other workers among Serbian and Italian healthy neonates respectively. The values were obtained using fluorescent immunoassay and chemiluminescent immunoassay methods, respectively.[15,16] The current study obtained cardiac troponin I level using enzyme-linked immunoassay (ELISA); this could account for the difference in values across studies. Variation in the serum level of troponin I has been shown by various immunoassay methods with fluorescent and chemiluminescent immunoassay having a lower limit of detection compared with the ELISA method used in the current study.[17] The report of increasing troponin I levels in relation to gestational age in the current study is not in agreement with previous studies that have reported no relationship. The documentation of no relationship between troponin I, gender and mode of delivery in healthy term neonates is consistent with other studies.[18,19] Baum *et al*.[19] demonstrated a significantly higher level of troponin I in caesarean section compared with vaginal delivery at 99 percentile. The present study however did not generate percentile because of its relatively small population compared with 869 healthy newborns in the study by Baum *et al*.[19] The documentation of no association between troponin I, gender, post-natal age and birth weight and mode of delivery could not be compared because previous studies did not correlate troponin I with these parameters.

Due to the variation in the cardiac troponin I levels in the current study compared with other studies and variability across immunoassay methods, it will be attractive to conduct a large population study among African neonates to determine normal troponin I levels in the neonates using different immunoassay methods and generate reference values for each.[14-16,19]

Conclusion

The study demonstrated that cardiac troponin I levels in healthy term Nigerian newborns appeared to fall within reported reference range in the literature with a significant relationship with the gestational age.

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Conflicts of interest
There are no conflicts of interest.

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