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Determinants of Levels of Cardiac Troponin I in Post-Mortem Blood Sample in Sudden Cardiac Death–An Autopsy Based Study

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ABSTRACT

Cardiac Troponin I (cTnI) is a very sensitive biochemical marker for the diagnosis of myocardial infarction (MI) in Sudden Cardiac Death (SCD). cTnI has nearly absolute myocardial tissue specificity, thereby reflecting even microscopic zones of myocardial necrosis. The aim of this study is to find out the gross and microscopic changes in heart and determinants of elevated levels of cTnI in cases of SCD. This cross sectional study was conducted in 50 cases of SCD brought for medicolegal autopsy at Government Medical College, Thiruvananthapuram. Heart was examined for gross and microscopic changes and blood level of cTnI. The mean value of cTnI was 3.4 (sd – 7.8) ng/dl. Age (>50 years), male sex, BMI (>25), previous history of CAD, family history, diabetes mellitus and hypertension were the determinants of level of cTnI in the postmortem blood. Common morphological findings observed in heart were haemorrhage, hypereosinophilia and oedema. From this study it can be concluded that cTnI assay can be used as a valuable supportive measure for postmortem diagnosis of SCD.

Keywords: *Sudden Cardiac Death (SCD); Cardiac Troponin I (cTnI); myocardial infarction (MI); determinants; postmortem diagnosis*

INTRODUCTION

According to Hurst, sudden cardiac death (SCD) in a person is the unexpected natural death in a person, due to cardiac causes, within a short period of time from the onset of symptoms without any prior fatal disease[1]. Acute myocardial ischaemia due to Coronary Artery Disease (CAD) accounts for 45 to 90% of all sudden natural deaths according to various authors[2]. Post-mortem demonstration of ischaemic heart disease is based on conventional gross and histological changes. Gross changes occur 8 hours after coronary occlusion. No macroscopic changes will be evident by classical method for at least 8 hours or much longer[3]. Cardiac Troponin I (cTnI) is a very sensitive biochemical marker for the diagnosis of myocardial infarction (MI). Cardiac troponin I has nearly absolute myocardial tissue specificity, thereby reflecting even microscopic zones of myocardial necrosis[4]. cTn I was found to be power aid in diagnosis of myocardial damage[5].

The main aim of this study is to find out the gross and microscopic changes in heart and determinants of elevated levels of cardiac troponin I in cases of sudden cardiac death

MATERIAL AND METHOD

This cross sectional study was conducted in the Department of Forensic Medicine, Government Medical College Thiruvananthapuram for a period of one year after getting Institutional Ethics Committee Clearance. A sample size of 50 cases of SCD due to CAD was studied. Unknown cases, decomposed bodies and those with other causes of death were excluded from the study. Cases were selected after scrutinizing the inquest reports. Informed written consent was obtained from the available near relative. Preliminary details were collected from the available relative and the police. During autopsy,

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a sample of 5ml of blood collected from neck veins for analysis of level of cTn I. All organs including heart were examined in detail for gross pathological changes. Bits of tissues from heart were subjected to hisopathological examination using haematoxylin and eosin staining. cTnI was analysed by High Sensitivity assay at Advanced Research Laboratory (ACR Lab), Government Medical College Thiruvananthapuram. All data were entered in proforma and MS Excel Spread sheet.

Statistical analysis was done using soft ware, Statistical Package for Social Sciences (SPSS) Version 16.0. The descriptive data was represented; qualitative variables as frequencies and percentage and continuous variables as mean and standard deviation (sd). Categorical variables were made into binary variables and comparison was done using't' test. Correlation between variables was done by Pearson correlation.

OBSERVATIONS

Results are as follows

Table 1: showing characteristics of the study population (N = 50)

Variable	Mean	sd	Min.	Max.	25th percentile	Median	75th percentile
Age	52.2	12.8	23.0	83.0	44.5	53.5	61.0
Body Mass Index (BMI)	24.0	3.6	16.4	36.3	21.5	24.5	26.1
PM interval	14.8	5.6	4.0	23.0	10.0	16.5	18.5
Trop I	3.4	7.8	0.8	56.6	1.5	2.1	3.2

Table 2: showing Microscopic appearance of heart (N = 50)

Characteristics	Frequency	Percentage
Wavyness of fibres	27	54
hyper eosinophilia	43	86
haemorrhage	44	88
oedema	42	84
Necrosis	19	38
Vascular proliferation	12	24
Inflammatory cell infiltration	22	44
Fibrosis	32	64

Table 3: Showing correlation of Trop I level with independent variables (N = 50)

Variable		N	Troponin I		t	p
			mean	sd		
Age	<50	18	1.78	0.79	-.126	0.003
	≥50	32	2.83	1.29		
BMI	Normal	30	1.75	0.67	6.845	<0.001
	Abnormal	20	3.51	1.14		
Gender	Male	30	2.74	1.23	2.064	0.044
	Female	20	2.02	1.14		
Previous h/o CAD	No	22	1.95	0.70	2.679	0.010
	Yes	28	2.84	1.43		

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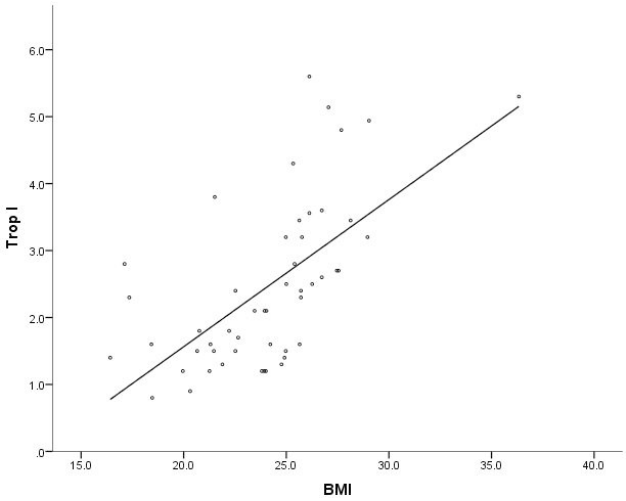
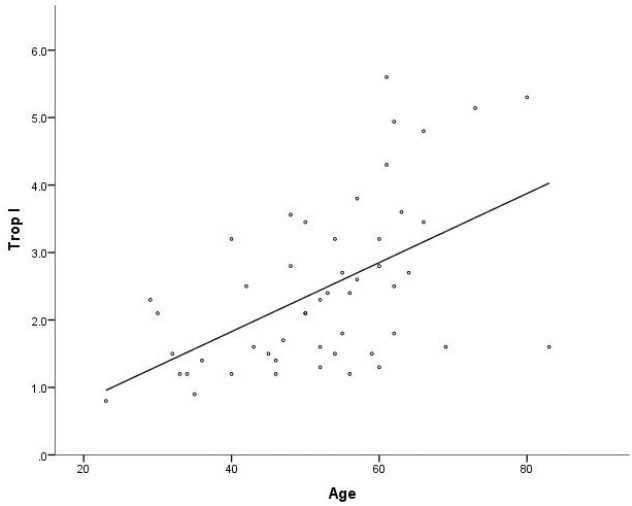
Family history	No	39	2.24	1.01	2.451	0.018
	Yes	11	3.22	1.67		
Smoking	No	25	2.54	1.34	0.504	0.617
	Yes	25	2.36	1.15		
Alcoholism	No	17	2.66	1.39	0.852	0.398
	Yes	33	2.35	1.16		
Diabetes Mellitus	No	29	2.05	1.10	2.924	0.005
	Yes	21	3.01	1.21		
Hypertension	No	25	1.98	0.87	2.899	0.006
	Yes	25	2.93	1.38		



Pearson correlation- r= 0.633 p< 0.001

Figure 1: Showing the relationship of Troponin I with BMI



Pearson correlation- r = 0.53, p.001

Figure 2: Showing the relationship of Troponin I with Age

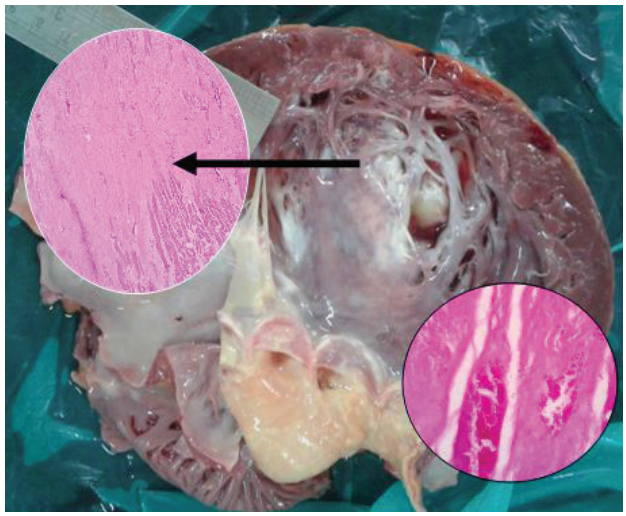


Figure 3: Showing gross appearance of fibrosis and its microscopic appearance (insight upper left H&E100 x and haemorrhage (insight lower right H&E 400x))

DISCUSSION

In the present study the mean age at death of SCD was 52.2 years (sd- 12.8) which is in agreement with previous study showing mean age 47 years (sd - 13)[6]. There is male predominance similar to many other studies[6,7]. The average postmortem interval was 14.8 hours (sd - 5.6); so that decomposition changes has not started and so no changes in level of troponin could have occurred due to decomposition. The average Body Mass Index (BMI) was 24.0 (sd- 3.6). It indicates that majority of persons died of SCD is having BMI within normal limits.

Microscopic findings: Common microscopic findings in heart in SCD were similar to observation made by Fishbein and slightly higher from observations of Martinez. The findings were haemorrhage (88%), hyper

eosinophilia (86%), oedema (84%) and waviness of fibres (54%). In the study by Fishbein etal[3] the findings were haemorrhage (71%), hyper eosinophilia (10%), oedema (10%) and waviness of fibres (94%) and Martinez et al[8] observed haemorrhage (18%) and oedema (78%). The most common observation in Fishbein etal[3] study was vascular proliferation (100%) whereas in our study that observation was 24%. Fibrosis was observed as indicator of old Myocardial Infarction and observation varies from 40% to 80% in different studies[9,10]. In the present study it was 32 (64%)

Level of Troponin I: The mean level of Trop I was found to be 3.4 ng/dl (sd – 7.8) in the present study. This value is diagnostic of Myocardial Infarction. This finding is in well agreement with various other postmortem studies. Because cardiac Troponin I is not normally found in blood, any detectable amount is considered as indicative of MI. In the meta analysis by Sethi A etal[11], the researchers found out a pooled cut off value of High sensitivity Trop I as 0.867 (95% CI: 0.845 – 0.887, χ^2 = 43.46, p<0.001). In a study Patel PR etal[12] concluded that cardiac Trop I level > 0.04 ng/ml was considered as positive test and 93.75% cases of SCD gave positive test and none of cases of Noncardiac death gave positive test. Whereas Martinez etal[8] in his study observed serum mean value of Trop I 11.8ng/ml (sd – 23.6). Many authors also suggested CardiacTrop I assay in postmortem blood as a diagnostic tool of SCD[5,13,14]. Sharma etal[14] observed in his study, trop I value indicative of myocardial damage ranges from 0.1 to 2 µg/ml. In another study by Bossard etal[15] observed a median value of 0.68 (interquartile range 0.43 to 1.18) ng/ ml. A similar observation was made in the present study with a median value of 2.1 (interquartile range 1.5 to 3.2) ng/ ml

Determinants of Postmortem blood level of Trop I: Univariate analysis of various independent variables upon the level of Trop I could identify certain determinants of the level of Trop I in postmortem blood sample. Among general factors Age (>50 years), Male sex, BMI (>25), Previous history of CAD, Family history, Diabetes Mellitus and hypertension are found to be the determinants and causes elevated levels of trop I in post mortem blood sample. Various studies had observed male gender, age as determinants[15-17]. BMI and age showed positive correlation with the level of Trop I with high significance (p<0.001) as shown in charts.

CONCLUSION

Cardiac Troponin I assay can be used as a valuable supportive measure for postmortem diagnosis of SCD. Common morphological findings observed in heart were haemorrhage, hypereosinophilia and oedema. The mean tropinin I value in postmortem blood sample was found to be 3.4 (sd- 7.8) ng/dl. Age (>50 years), male sex, BMI (>25), previous history of CAD, family history, diabetes mellitus and hypertension were the determinants of level of Troponin I in the postmortem blood. The smaller sample size and the difficulty to get previous history and personal habits are the limits of this study.

Conflict of Interest: None to declare

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Ethical Clearance: The study started only after receipt of Institutional Ethics Committee, Government Medical College, Thiruvananthapuram.

REFERENCES

1. Hurst. The Heart. In: Hurst's the heart. 9th ed. new york: mc Grew hills; 1995.
2. Dolinak D, Matshes E, Lew E. Principles and practice of Forensic Pathology. In: forensic pathology. london: Elsevier; 2005. p. 72–5.
3. Fishbein, Michael C, Maclean DMP. The Histopathologic Evolution of Myocardial Infarction - ScienceDirect. Chest. 1978;73(6):843–9.
4. Sapouna R, Gourgiotis D, Athanaselis S, Papadodima S, Spiliopoulou C. Diagnostic Value of Cardiac Troponin I in Postmortem Diagnosis of Myocardial Infarction. Am J Forensic Med Pathol. 2013;34(2):139–41.
5. Aissaoui, Abir & Nidhal, Haj Salem & Zaqout, A & Boughattas, M & Belhaj, M & Mosrati, M.A. & Chadly A. Cardiac troponin I and the post-mortem diagnosis of myocardial damage. j.ancard. 62. 10.101.
6. Salini R, Meena K S. Cardiac causes of sudden natural death in adults autopsied in a tertiary level hospital within one year period- a cross sectional study. Medicolegal Update. 2018;18(2):81–5.

7. zhi-jie-zheng, Janet B, croft WHG. Sudden cardiac death in United States. 2001;104:2158–64.

8. Martínez Díaz F, Rodríguez M, Pérez-Cárceles J. Noguera AL. Biochemical analysis and immunohistochemical determination of cardiac troponin for the postmortem diagnosis of myocardial damage. Histol Histopathol. 2005;20(2):475–81.

9. Lie JT, JL T. Pathology of the myocardium and the conduction system in sudden coronary death. Circulation. 1975;51(6 Suppl III):41–52.

10. Reichenbach DD, Moss NS, Ellen Meyer. Pathology of the heart in sudden cardiac death - American Journal of Cardiology. Am J Cardiol [Internet]. 1977;39(6):865– 872.

11. Ankur Sethi, Anurag Bajaj, Gurveen Malhotra, Rohit R Arora SK. Diagnostic accuracy of sensitive or high-sensitive troponin on presentation for myocardial infarction: a meta-analysis and systematic review. Dove Press J. 2014;(Vascular Health and Risk Management):435–50.

12. Patel PR, Parekh U, Modi K. Troponin : The biomarker in post mortem investigation of ischemic heart. 2013;(January).

13. Nowak A, Nowak S, Chowaniec C, Wojnicz R. Troponin in forensic medicine. Arch Med Sadowej Kryminol [Internet]. 2012;62(2):109–20.

14. Sharma S, ; Jackson P; M. Cardiac troponins. J Clin Pathol. 2004;57(10):1025 to.

15. Bossard M, Thériault S, Aeschbacher S, Schoen T, Kunz S, M VR, et al. Factors independently associated with cardiac troponin I levels in young and healthy adults from the general population . 2018;106(2):2017–8.

16. Afonso L, Bandaru H, Rathod A, Badheka A, Kizilbash MA. Prevalence, Determinants, and Clinical Significance of Cardiac Troponin-I Elevation in Individuals Admitted for a Hypertensive Emergency. 2011;13(8):551–6.

17. Adamson PD, Henderson J, Hunter A, Williams M, Moss AJ, Shah A, et al. Acute and Stable Ischemic Heart Disease. J Am Coll Cardiol. 2018;71(11):A104.