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# Comparison between ante-mortem and post-mortem Troponin T

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**Abstract:** *Introduction.* Sudden cardiac death due to acute myocardial infarction (AMI) comprises a significant proportion of autopsy cases. Troponin levels act as a specific and sensitive indicator of myocardial infarction in the living.

*Methods.* This retrospective study of post-mortem and antemortem cases (n= 154) in the year of 2016 at Hospital Kuala Lumpur. Blood Troponin T was analyzed from these cases.

*Results and Discussion.* Average troponin T values for non-cardiac related death cases (5.322 ng/mL) were higher than cardiac-related death (4.916 ng/mL) with no significant difference between them although Trop T values were highly sensitive to myocardial infarction (MI) with limited specificity. There was also no correlation between post-mortem Trop T levels to the cardiac-related cause of death. The minimum Trop T value amongst the MI post-mortem cases was 0.390 ng/mL. Post-mortem troponin T values were affected by multiple factors which includes post-mortem interval and the severity of myocardial damage at the time of death. We also have analyzed 4 ante-mortem samples and compared it to post-mortem Troponin T. All four samples showed marked disproportionate rise.

*Conclusion.* Post-mortem troponin T has limited value in establishing the cardiac-related cause of death.

**Key Words:** Troponin T, cardiac death, post-mortem, myocardial infarction.

## INTRODUCTION

Cardiac related deaths are becoming increasing in trends and especially in males. Ischaemic heart disease were the principal cause of death in 2016 accounting 13.2% of all deaths in Malaysia[1]. Acute myocardial infarction (AMI) is a serious and potentially lethal manifestation of coronary artery disease, affecting more than 7 million people worldwide each year and proved to be a cause of sudden death [2]. Sudden cardiac death due to an acute myocardial infarction (AMI) comprises a significant proportion of autopsy cases. In clinical practice, AMI is diagnosed with the aid of the electrocardiogram and serum biochemical markers specific in the detection of myocardial damage [3].

Troponin T and troponin I, in particular, have been extensively studied and proof of sensitivity and specificity in detecting AMI in the living is well established. Troponin is a complex of three regulatory proteins (Troponin C, I and T) that is integral to muscle contraction in skeletal and cardiac muscle. It is a component of thin filaments along with actin and tropomyosin and is the protein to which calcium binds to accomplish regulation of contraction and relaxation of the cardiac muscle. During myocardial injury, as seen in AMI, troponin is released from the injured myocyte into the circulation which can be detected biochemically. The potential role of troponin in the diagnosis of AMI at post-mortem is not well understood. In this study, we evaluate the sensitivity and specificity of Troponin T as a diagnostic tool in the detection of AMI at autopsy [3].

In the living, a simple reliable biochemical assay for cardiac troponins is used in the diagnosis of acute myocardial ischemia along with electrocardiogram

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changes. Several studies have investigated the use of cardiac troponins in post-mortem subjects as a means to distinguish between a cardiac and a non-cardiac cause of death. All of these studies, however, rely upon assigning subjects to "cardiac" or "non-cardiac" death on the basis of a post-mortem examination [4].

## METHODS

This was a retrospective study of all post-mortem cases with blood samples sent for Troponin T investigation in the year 2016. The data were retrieved from Forensic Medicine Information System (FMIS). Sudden death cases were further categorized into cardiac-related death and non-cardiac related death. Cardiac-related death was divided into four categories including myocardial infarction (MI), ischemic heart disease (IHD), coronary artery-related disease (CA) and another heart-related disease (HD). Non-cardiac related death was labeled as others (O). Other heart-related disease includes valvular heart disease, infective endocarditis, and hypertensive heart disease. The interval of post-mortem conducted was computed from the time since death or time of body receiving whichever was earlier. Troponin T results were retrieved retrospectively from the Laboratory Information System (LIS). Statistical test which includes Chi-square test, Mann-Whitney test, Two-way ANOVA and Spearman Correlation test was used to analyse the results. The prevalence and relatedness using statistical analysis were computed.

## RESULTS AND DISCUSSION

A total of 138 from 154 post-mortem cases were analysed because the remaining samples were lysed. Cardiac-related cases were identified in 90 cases (65.2%) and 48 cases (34.8%) were certified with non-cardiac related death (Table 1). The mean value of troponin T was highest in MI cases (5.065ng/mL), followed by IHD cases (4.936ng/mL), CA cases (4.895ng/mL) and HD cases (4.682ng/mL). However, the mean value for troponin T for non-cardiac related death (O) superseded all the cardiac-related death categories with 5.322 ng/mL (Fig. 1). There were no significant differences in troponin T values between the non-cardiac related death and cardiac-related death. This is consistent with Davies *et al.* (2005). It was also true within the cardiac-related death categories (Table 2). The troponin T values could be relatively high sensitivity to MI cases but the specificity was limited due to other heart-related diseases (HD) also presented with high upper bound 95% confidence interval of Trop T values.

These average value for post-mortem troponin T in cases of coronary artery disease and ischaemic heart disease is 6.128 ng/mL and 57.14% of them recorded more than 10 ng/mL. As inference made based on Spearman Correlation ($p = 0.382$, $p > 0.05$), there was no correlation between post-mortem Trop T levels to the cardiac-related cause of deaths. The minimum Trop T values amongst MI post-mortem cases was obtained more than 0.390 ng/mL. This value was not much different from Bheeshma *et al.* (2015) which was at 0.3 ng/mL.

From the 138 cases, there were four cases where we managed to compare the antemortem and post-mortem troponin T (Table 5). These cases received active management for ischemic heart disease and myocardial infarction. All the cases were resuscitated. In case 1, the troponin T level of one of the patients was 0.007 ng/mL on 20/5/2016 10.32 AM and the patient subsequently pronounced dead at 2.35 PM after 4 hours. Post-mortem was performed on the patient at 6.00 PM. The Trop T was raised to 1.04 ng/mL, 3 ½ hours after his death. The case was certified as coronary artery disease (CA) based on post-mortem and histological findings. In case 3, the patient was admitted on 28 Oct 2016 at 1.05 AM. The initial Trop T level was < 0.003 ng/mL. The Trop T raised to 0.738 ng/mL after 4 ½ hours at 5.44 AM and the patient subsequently pronounced dead at 10.10 AM. A post-mortem was performed on the patient at 5.00 PM. The Trop T was showed 12.5 times raise to 9.2 ng/mL after 5 hours of post-mortem interval. This case was certified as Ischemic Heart Disease (IHD) based on post-mortem examination including histological examination. In case 1 and 3, the troponin T value had shown a disproportionate rise. Case 1 showed an increase of 8.462 ng/mL while case 3 rose additional 1.033 ng/mL. This has clearly deviated from the graph displayed in Figure 2. Case 3 should take longer periods or at least 8 hours for the changes of Trop T values obtained in post-mortem. Case 4 has clearly shown that there was post-mortem contribution in Trop T value because Trop T was relatively low at 37 minutes prior to death, however, it was detected at 10 ng/mL after 25 hours using the post-mortem samples.

There was definitely a significant difference

**Table 1.** Descriptive table of trop t values for post-mortem cases in 2016

| | N | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | | Min | Max |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound | | |
| O | 48 | 5.3221 | 4.39496 | .63436 | 4.0459 | 6.5983 | .04 | 10.00 |
| MI | 8 | 5.0650 | 4.49790 | 1.59025 | 1.3047 | 8.8253 | .39 | 10.00 |
| IHD | 45 | 4.9361 | 4.19867 | .62590 | 3.6747 | 6.1976 | .02 | 10.00 |
| CA | 31 | 4.8949 | 4.27361 | .76756 | 3.3273 | 6.4624 | .01 | 10.00 |
| HD | 6 | 4.6815 | 4.74652 | 1.93776 | -.2997 | 9.6627 | .05 | 10.00 |
| Total | 138 | 5.0575 | 4.26441 | .36301 | 4.3397 | 5.7753 | .01 | 10.00 |

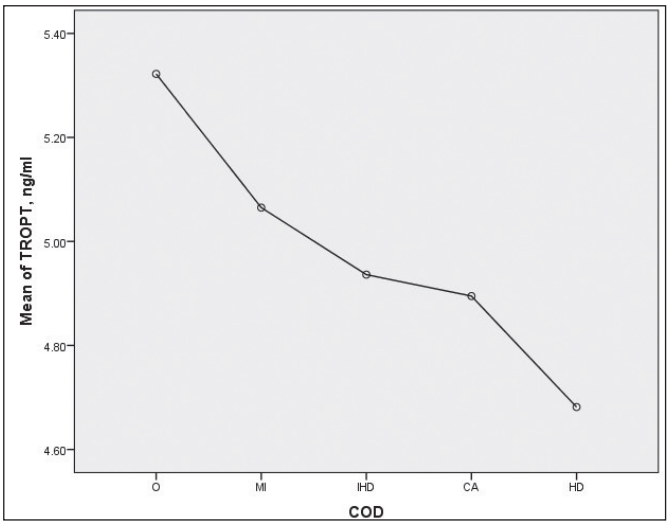


**Figure 1.** Means of Trop T values for cardiac and non-cardiac death cases.

**Table 2.** Chi-Square Statistic Analysis of Trop T values between COD Groups

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 339.302[a] | 312 | .138 |
| Likelihood Ratio | 230.767 | 312 | 1.000 |
| Linear-by-Linear Association | .296 | 1 | .587 |
| N of Valid Cases | 138 | | |

a. 392 cells (99.2%) have expected count less than 5. The minimum expected count is .04.

**Table 3.** Mann-Whitney test and Two-way ANOVA Test

| Test Statistics[a] | |
|---|---|
| | TROPT |
| Mann-Whitney U | 991.000 |
| Wilcoxon W | 5647.000 |
| Z | -4.828 |
| Asymp. Sig. (2-tailed) | .000 |

a. Grouping Variable: Interval.

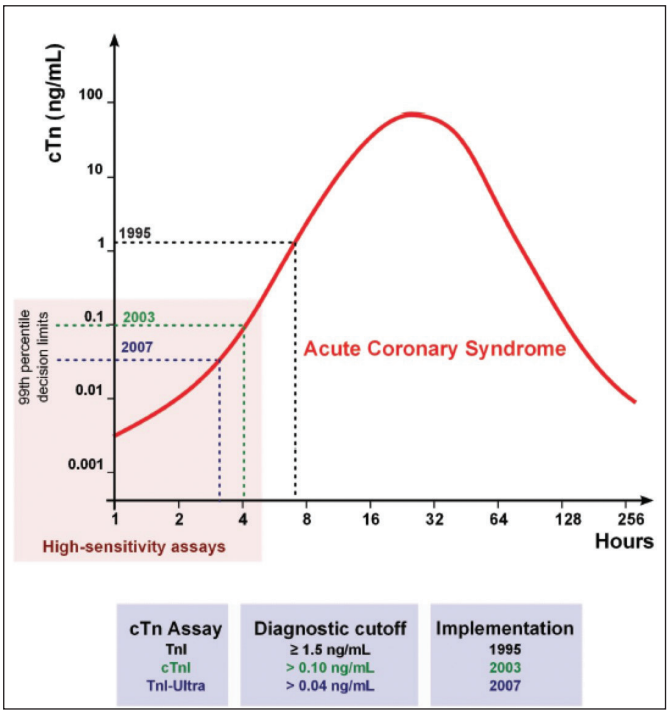


**Figure 2.** Means of Trop T values for cardiac and non-cardiac death cases.

between ante-mortem and post-mortem because of the raising Trop T values until the point of death pronounced. Multiple factors that can attribute to an elevated troponin T results after death including the interval from the time of death to the time of postmortem and depend on the severity of myocardial damage at the time of death [4, 5].

Post-mortem interval influences the value of troponin T. This was supported by the findings from this study using the post-mortem cases as shown in Tables 3 and 4, by dividing the post-mortem performing interval into < 12 hours (3.947 ± 4.078 ng/mL) and 12 – 48 hours (7.597 ± 3.568 ng/mL). As shown in Table 4, there was a significant difference between the two intervals, $p < 0.001$.

**Table 4.** Two-way ANOVA of the interval and COD variables for post-mortem cases

| Tests of Between-Subjects Effects | | | | | |
|---|---|---|---|---|---|
| Dependent Variable: TROPT | | | | | |
| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. |
| Corrected Model | 464.685[a] | 9 | 51.632 | 3.261 | .001 |
| Intercept | 1701.182 | 1 | 1701.182 | 107.442 | .000 |
| COD | 12.739 | 4 | 3.185 | .201 | .937 |
| Interval | 139.939 | 1 | 139.939 | 8.838 | .004 |
| COD * Interval | 65.925 | 4 | 16.481 | 1.041 | .389 |
| Error | 2026.688 | 128 | 15.834 | | |
| Total | 6021.200 | 138 | | | |
| Corrected Total | 2491.374 | 137 | | | |

a. R Squared = .187 (Adjusted R Squared = .129)

**Table 5.** Ante-mortem and post-mortem Trop T comparison with analysis of intervals

| No | Ante-mortem Trop T Level | Interval of ante-mortem till death | Interval of death till post-mortem | Post-mortem Trop T Level | COD |
|---|---|---|---|---|---|
| 1 | 0.738 ng/mL | 4 hours 26 mins | 4 hours 50 mins | 9.200 ng/mL | IHD |
| 2 | 0.914 ng/mL | 19 hours 22 mins | 10 hours 27 mins | 3.440 ng/mL | CA |
| 3 | 0.007 ng/mL | 4 hours 3 mins | 3 hours 25 mins | 1.040 ng/mL | CA |
| 4 | 0.021 ng/mL | 37 mins | 25 hours 2 mins | 10.000 ng/mL | MI |

The effect of post-mortem performing interval was also statistically significant $p < 0.001$ but no significant effect on the cause of death. The troponin T value based on the post-mortem performing interval was also significantly different between non-cardiac related death and cardiac-related death as well as within the four categories of cardiac-related death. Trop T value for cardiac-related death cases was 4.23 ng/mL and 6.82 ng/mL in average for the < 12 hours and 12 – 48 hours post-mortem performing interval.

## CONCLUSION

The mean value for post-mortem troponin T in non-cardiac related death cases (5.322 ng/mL) were higher than cardiac-related death (4.916 ng/mL) and there was no significant difference between them although troponin T values were highly sensitive to myocardial infarction but limited specificity. There was also no correlation between post-mortem troponin T levels to the cardiac-related cause of death using post-mortem cases. 0.390 ng/mL. There were multiple factors that can attribute to an elevated troponin T results after death and depend on the severity of myocardial damage at the time of death. As such, post-mortem Trop T level could probably not be used to reflect the ante-mortem Trop T level to diagnose myocardial infarction. In addition, the effect of post-mortem performing interval was statistically significant between the interval of lesser than 12 hours and 12 – 48 hours.

**Conflict of interest.** The authors declare that there is no conflict of interest.

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