Original Article

# Correlation of Elevated Cardiac Troponin T Level with Severity and In-Hospital Outcomes in Patients with Acute Ischemic Stroke

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## Abstract

**Background:** Although elevated cardiac troponin T (cTnT) is a specific marker of acute coronary syndrome, its increment in patients with acute ischemic stroke is not clear. The aim of this study is to identify the relationship between high cTnT levels and stroke severity as well as in-hospital outcomes. **Materials and Methods:** This observational, cross-sectional study was conducted on 100 patients with acute ischemic stroke in Rizgary teaching hospital from January 2016 to January 2017. Patients were divided into two groups: Group 1 patients ($n = 61$) with normal cTnT level and Group 2 patients ($n = 39$) with elevated cTnT level. The relationships between cTnT levels and stroke severity as well as in-hospital outcomes were assessed and compared between the two groups. **Results**: In this study, cTnT was raised in 39 patients (39%). Patients with elevated cTnT levels were mainly males, had a significantly higher prevalence of hypertension and diabetes mellitus than the normal cTnT group ($P < 0.001$, for all). Systolic blood pressure and total cholesterol were significantly higher ($P < 0.008$ and $< 0.001$, respectively) in Group II patients than in Group I. In addition, Group II patients had more severe stroke and longer length of stay in hospital than in Group I patients, and the differences were statistically significant ($P < 0.001$, for all). The incidence of aspiration pneumonia, seizures, hemorrhagic transformation of ischemic stroke, and death was significantly higher ($P < 0.001$, for all) in Group II patients than in Group I patients. **Conclusion:** Elevated serum cTnT level at hospital admission is highly correlated with severity and poor in-hospital outcomes in patients with acute ischemic stroke.

**Keywords:** Acute ischemic stroke, cardiac troponin T, in-hospital outcomes

## Introduction

Stroke is a common cause of mortality and morbidity worldwide.[1] The correlation between stroke and heart disease is established in many studies.[2] Embolism due to cardiac disease accounts for 15%–20% of all strokes; and after a stroke, patients are at high risk of developing many adverse cardiac outcomes.[3] Cardiac Troponin T (cTnT) is highly sensitive and specific marker of cardiac damage.[4] Several studies have noticed that elevated levels of cTnT are increased in 10%–34% of patients with acute ischemic stroke.[5] Although the exact cause of troponin rise in acute ischemic stroke is not clear, it is suggested that the reason for this cardiac change resulted from excessive sympathetic nervous activity secondary to insular cortical damage.[6] Some studies have reported an association between an elevated troponin level with both mortality and poor outcomes in acute ischemic stroke.[7] Again, the clinical significance of such association is not clear. To date and up to our knowledge, there is no previous study done regarding the same subject in Erbil city. The objectives of this study are to (1) assess the correlation between elevated serum cTnT levels and stroke severity and (2) to determine the effect of elevated serum cTnT on in-hospital outcomes in a group of patients with acute ischemic stroke.

## Materials and Methods

This observational, cross-sectional study was conducted in the department of neurology at Rizgary teaching hospital in Erbil city, Iraq, between January 2016 and January 2017. From a

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total of 130 patients with a diagnosis of acute ischemic stroke participated in the study, 20 patients were excluded (previous history of stroke or ischemic heart disease) from the study. For the remaining 110 patients with inclusion criteria, 68 patients had normal cTnT levels and 42 patients with elevated cTnT levels. There were missing data for 10 patients (seven patients with normal cTnT levels and three patients with elevated cTnT levels). The total number of patients enrolled in the study was 100 (61 patients with normal cTnT levels and 39 patients with elevated cTnT levels) as shown in Figure 1.

According to serum cTnT level, the patients were classified into two groups; Group I (patients with normal cTnT level, $n = 61$), and Group II (patients with elevated cTnT level, $n = 39$).

The inclusion criteria were patients with (1) acute ischemic stroke confirmed by either computed tomography (CT) scan or magnetic resonance imaging (MRI) of the brain within 24 h of stroke onset and (2) measurement of serum cTnT level (normal value: 0.0–0.3 ng/ml)[8] within 24-h of stroke onset, to patients with age ≥18 years and of both genders. All patients with acute ischemic stroke were evaluated by an experienced neurologist to confirm the diagnosis.

The exclusion criteria were patients with recent ischemic heart disease (acute coronary syndrome [ACS] according to American College of Cardiology/American Heart Association) within 2 weeks before stroke onset, recent coronary angioplasty or coronary bypass surgery, and other heart diseases or conditions that might increase serum cTnT level, such as congestive heart failure, valvular heart disease, end-stage renal disease, acute pulmonary embolism, chest trauma, rhabdomyolysis, and chemotherapy. All patients with elevated cTnT levels were evaluated by an experienced cardiologist to exclude ACS. Patients with intracerebral or subarachnoid hemorrhage were ruled out by brain CT scan at the time of admission. All patients were assessed by a detailed history, physical examination, CT scan or MRI of the brain, electrocardiography, echocardiographic evaluation, and other investigational tools. Blood samples were drawn to measure the serum cTnT level and other hematological parameters for each patient. The cutoff value for elevated serum cTnT was more than 0.3 ng/ml. The severity of the stroke was evaluated according to the National Institute of Health Stroke Scale.[9] A score of 1–4 is considered minor stroke, 5–15 is moderate stroke, 16–20 is moderately severe, and more than 21 is severe stroke. In-hospital outcomes such as aspiration pneumonia, seizures, hemorrhagic transformation of ischemic stroke, and death were evaluated in both groups.

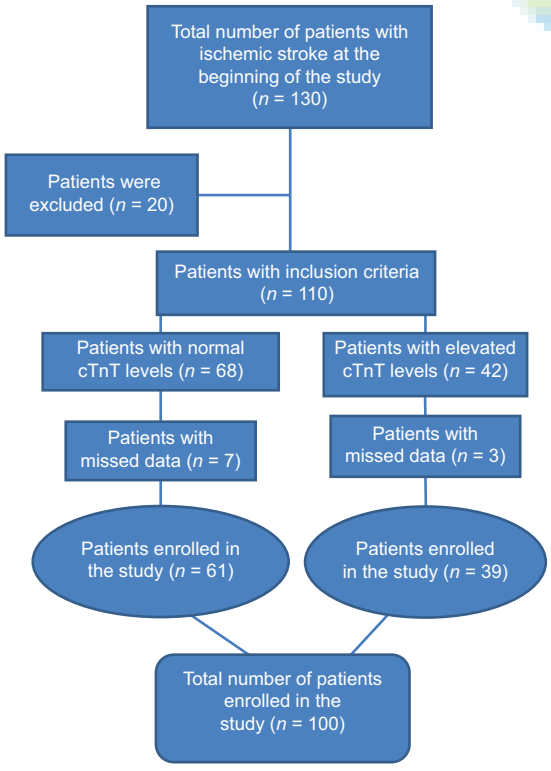


**Figure 1:** Flowchart of participants included in the study

The data were collected by interviewing the patients using a questionnaire designed by the researchers. The questionnaire included information about sociodemographic data (such as age and gender) and risk factors (such as hypertension and diabetes mellitus).

### Ethical considerations

The study protocol was approved by the Ethics Committee of the College of Medicine, Hawler Medical University. This study was conducted using an informed verbal consent from the patients before participation in the study. The purpose of the study was carefully explained to each patient.

### Statistical analysis of data

Data were analyzed using the statistical package for social sciences (SPSS, version 19). Student's *t*-test for two independent samples was used to compare means. Correlation coefficient (r) was obtained to demonstrate the correlations between variables. "*P*" ≤ 0.05 was considered as statistically significant.

## Results

A total of 100 patients with acute ischemic stroke were enrolled in this study. Serum cTnT was elevated in 39 patients (39%). The patients were classified into two groups according to serum cTnT levels: Group I (patients with normal cTnT level [0.0–0.3 ng/ml], $n = 61$) and Group II (patients with elevated cTnT level [ 0.3 ng/ml], $n = 39$). Basic and clinical characteristics were compared between the two groups as shown in Table 1. The patients with elevated cTnT levels were mainly males, had a higher prevalence of hypertension and diabetes mellitus than the normal cTnT group, and the differences were statistically significant ($P < 0.001$, for all). Systolic blood pressure and total cholesterol were significantly higher ($P < 0.008$ and $< 0.001$, respectively) in Group II patients than in Group I. In addition, Group II patients had more severe stroke and longer length of stay in hospital than in Group I patients, and the differences were statistically significant ($P < 0.001$, for all).

**Table 1: Basic and clinical characteristics of patients with normal and elevated serum cardiac troponin T**

| Variables | Group I Normal cTnT (0.0-0.3 ng/ml) ($n$=61) | | Group II Elevated cTnT (>0.3 ng/ml) ($n$=39) | | $P$ |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Age (years) | 66.1 | 11.66 | 65 | 10.8 | 0.6 |
| Male (%) | 47.5 | | 58.9 | | <0.001 |
| Hypertension (%) | 65.5 | | 74.3 | | <0.001 |
| Diabetes (%) | 32.7 | | 53.8 | | <0.001 |
| SBP (mmHg) | 152.2 | 24.8 | 165.5 | 22.8 | 0.008 |
| Diastolic BP (mmHg) | 87 | 13.1 | 91.9 | 12.8 | 0.07 |
| Cholesterol (mg/dl) | 178.5 | 52.1 | 187.6 | 31.4 | 0.001 |
| TG (mg/dl) | 122.9 | 67.42 | 136.9 | 78.2 | 0.36 |
| LDL (mg/dl) | 102.4 | 29.1 | 106.4 | 32.1 | 0.4 |
| HDL (mg/dl) | 39.6 | 12.4 | 35.5 | 9.3 | 0.06 |
| BU (mg/dl) | 42.7 | 15.9 | 44.5 | 22.1 | 0.6 |
| SC (mg/dl) | 1 | 0.31 | 1 | 0.44 | 0.48 |
| cTnT (ng/ml) | 0.1 | 0.03 | 49.9 | 144.8 | <0.001 |
| NIHSS | 4 | 3.5 | 9.7 | 5.3 | <0.001 |
| Length of stay (days) | 5 | 2.3 | 7.4 | 3.7 | <0.001 |

SBP: Systolic blood pressure, BP: Blood pressure, TG: Triglycerides, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, cTnT: Cardiac troponin T, NIHSS: National Institute of Health Stroke Scale, SC: Serum creatinine, BU: Blood urea

Table 2 shows the incidence of in-hospital outcomes in both studied groups. The incidence of aspiration pneumonia, seizures, hemorrhagic transformation of ischemic stroke, and death was significantly higher ($P < 0.001$, for all) in Group II patients than in Group I patients.

**Table 2: Incidence of in-hospital outcomes in both studied groups**

| Variables | Group I Normal cTnT (0.0-0.3 ng/ml) ($n$=61), $n$ (%) | Group II Elevated cTnT (>0.3 ng/ml) ($n$=39), $n$ (%) | $P$ |
|---|---|---|---|
| Aspiration pneumonia | 5 (8.1) | 5 (12.8) | <0.001 |
| Seizures | 0 (0) | 2 (5.1) | <0.001 |
| Hemorrhagic transformation | 0 (0) | 2 (5.1) | <0.001 |
| Death | 3 (4.9) | 6 (15.3) | <0.001 |

cTnT: Cardiac troponin T

## Discussion

In the current study, high serum cTnT level was detected in 39% of patients with acute ischemic stroke and was associated with severity and poor in-hospital outcomes. The prevalence of elevated cTnT level in acute ischemic stroke varies from study to study but has been reported to be as high as 34%.[5] In consistence with the present study, other studies have confirmed the presence of high troponin levels in ischemic stroke.[5,10-12] The relationship between cerebrovascular and cardiovascular disease is a little bit complex, and the cause of troponin increment is still poorly understood. Scheitz *et al*. suggest associated ischemic or nonischemic myocardial injury.[13]

It has been suggested that the myocardial damage observed in acute stroke insult is due to myocyte damage (myocytolysis) due to the activation of sympathoadrenal system that may be linked to insular damage.[11] Epinephrine and cortisol concentrations are elevated after a stroke and higher levels have been reported in association with myocardial damage.[5] The brain–heart connection was described previously by Levy.[14] He mentioned that changes in central nervous system metabolism can affect cardiac function. Acute ischemic strokes can induce diffuse myocardial damage characterized by microislands of necrosis and subendocardial hemorrhage.[14]

In concordance with the present study, increased mortality has been predicted by elevated troponin levels in multiple studies.[7,15,16] Stroke can induce a considerable stress on the patient's heart causing troponin to be elevated and this might be an indication of a lower cardiac tolerance caused by the acute stroke.[17,18] This might explain the correlation of elevated serum cTnT with both the severity and poor in-hospital outcomes found in this study, and for this reason, physicians in charge of stroke unit should be more careful when dealing with these patients.

There is controversy whether troponin should be routinely checked in patients with acute stroke. Recent UK acute stroke guidelines from the National Institute of Clinical Excellence,[19] and the Scottish Intercollegiate Guidelines Network[20] do not recommend the routine checking of cardiac enzymes. However, the American Stroke Association[21] does recommend this.

## Conclusion

Elevated serum cTnT levels in the absence of clinical evidence of recent coronary artery disease were associated with stroke severity, longer in-hospital stay, and poor in-hospital outcomes.

## Recommendations

1. A large, prospective study with assessment of both short- and long-term clinical outcomes is needed in future studies to clarify the clinical implications of high serum cTnT levels in acute ischemic stroke
2. We suggest that doctors in neurology unit would better consider adding a serum cTnT level to their routine testing when admitting patients with acute ischemic stroke.

## Limitations

Our study has few limitations. First, our sample study was low. A larger study population is needed in future. Second, we depend on single baseline blood sample in detecting cTnT level. Repeated assays could provide additional information on the evolution of myocardial damage.

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## Conflicts of interest

There are no conflicts of interest.

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