

Troponin I and Echocardiography in Cardiovascular Disease: A Correlation Study

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Abstract— The present study aim was the correlation between cardiac troponin I and echocardiography in cardiovascular diseases. The main objectives of the study were Review the symptoms of cardiac patients. Identify the troponin levels and the number of affected subjects. Examination of diagnostic parameters using 2D and 4D echocardiography techniques. To find out the action of combining the two parameters for early detection and risk management. Methodology include A prospective observational study was conducted at Santhosh Cardiac Center, a primary care setup in Hanamkonda. The patients visiting the inpatient department of Cardiology were reviewed, and patients diagnosed with cardiovascular diseases that include Myocardial infarction, coronary artery disease, cardiac arrest, carotid artery disease, rheumatic heart disease, and arrhythmia, were enrolled in the study. Performed a prospective study on the combined effect of diagnostic parameters in cardio disease patients in the study; the major outcome was that the use of these tools can provide precise management of the patients. In conclusion, among the 150 patients studied, a higher percentage of males (52%) than females (48%) were observed. Testing for troponin I revealed that 36.6% of males and 32.6% of females underwent the procedure. Electrocardiogram assessments were performed using both 2D ECHO and 4D ECHO, with 16% of males and 14.66% of females receiving 2D ECHO examinations. The primary symptoms reported included chest pain, shortness of breath (SOB), and epigastric pain, with males showing a greater prevalence and impact from these conditions. This suggests that males may be more significantly affected by the conditions leading to these symptoms compared to females.

Keywords— Troponin I, echocardiography, cardiovascular diseases, 2D ECHO and 4D ECHO.

I. INTRODUCTION

Cardiovascular diseases (CVDs) remain the leading cause of global mortality and morbidity, accounting for an estimated 17.9 million deaths annually [1]. Among these, acute coronary syndromes (ACS), including ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI), present the most immediate threat to patient survival and require rapid diagnostic and therapeutic triage. Efficient clinical management of these conditions relies on two fundamental pillars: the biochemical detection of myocardial cellular injury and the structural evaluation of cardiac functional capacity.

In contemporary cardiology, cardiac-specific Troponin I (CTNI) serves as the gold-standard biomarker for diagnosing myocardial necrosis [1, 3]. Following ischemic or mechanical insult to the cardiomyocytes, structural cellular membrane disruption occurs, prompting a predictable and rapid release of CTNI into the systemic circulation [1]. The advent of high-sensitivity cardiac troponin (HS-CTNI) assays has further enhanced diagnostic precision, allowing for the detection of minute concentrations of myocardial injury [2]. However, while serum CTNI levels provide highly sensitive and specific proof of cellular death, they function as a blind biochemical metric; they cannot locate the specific anatomical site of the lesion, quantify mechanical pump efficiency, or visualize real-time structural deformities.

To complement these biochemical data, two-dimensional (2D) Echocardiography is utilized as the primary, non-invasive imaging modality at the bedside. Echocardiography provides critical macro-structural insights, most notably the Left Ventricular Ejection Fraction (LVEF) to evaluate overall systolic pump capability, and Regional Wall Motion Abnormalities (RWMA) to map localized tissue hypokinesia

[2, 4]. Despite its utility, macroscopic structural defects or changes in ventricular geometry may take time to manifest visually on an echocardiogram, or they may be transiently masked during the hyper-acute, golden window of a vascular event [2].

Consequently, relying on an isolated diagnostic channel often fails to capture the full, heterogeneous scope of myocardial trauma. While Troponin I gauges microscopic, cellular-level necrosis, Echocardiography maps macroscopic, organ-level dysfunction. Investigating the direct co-relation between these two distinct diagnostic modalities addresses a critical clinical gap. A clear understanding of how peak serum concentration thresholds of Troponin I translate into immediate and late-stage LVEF declines or geometric remodeling can significantly optimize patient risk stratification [3, 5]. For instance, a discordant phenotype—such as elevated troponin in the presence of a normal echocardiogram—frequently flags early-stage microvascular disease or chronic renal strain, signaling a need for altered triage protocols [4, 5].

While previous literature has established the independent prognostic values of both biomarkers and imaging, there remains a need to investigate the precise statistical and temporal synchronization between peak CTNI concentrations and specific echocardiographic parameters like LVEF, RWMA, and diastolic filling pressures

1. The Role of Cardiac Troponin I (CTNI)

Cardiac-specific Troponin I (CTNI) is a gold-standard regulatory protein found exclusively in the myocardium. Following ischemic or mechanical cardiomyocyte insult, structural cellular damage ruptures cell membranes. This prompts a predictable, rapid release of CTNI into the bloodstream. While high-sensitivity assays (HS-CTNI) are

exceptionally accurate for confirming myocardial injury, they cannot verify the exact physical location or identify macrostructural abnormalities caused by the insult. [6,7]

2. The Role of 2D Echocardiography

Two-Dimensional Echocardiography serves as the primary, non-invasive imaging baseline to observe the heart in motion. It quantifies: [8]

Left Ventricular Ejection Fraction (LVEF) to assess overall systolic pump capability.

Regional Wall Motion Abnormalities (RWMA) to narrow down regional tissue hypokinesis. [9]

However, macroscopic structural defects on an echo may take time to manifest, or they may be obscured during the hyper-acute window of a vascular event.

3. The Rationale for Co-relation

Studying the direct correlation between these two distinct diagnostic modalities addresses a critical clinical gap. While Troponin I gauges cellular-level death, Echocardiography maps organ-level dysfunction.

Investigating how specific peak concentration values of Troponin I correspond to immediate and late-stage LVEF declines helps clinical teams answer key prognostic questions. This study builds a bridge between biochemical injury markers and physical ventricular geometry to establish a highly predictive matrix for patient survival, post-infarct remodelling, and microvascular failure

II. METHODOLOGY

Study site: The proposed study was conducted in the outpatient wards of the cardiology department at Santhosh Cardiac Center.

Santhosh Cardiac Center is a secondary care hospital located in Hanamkonda. This patient-focused hospital includes a pharmacy, diagnostic investigations, and doctor consultations.

Study design: Prospective study.

Study period: 6 months.

Sample size: 150 patients.

Study population: patients included are those with a diagnosed troponin I test, visual parameters [2D-ECHO and 4D ECHO].

Study criteria:

Inclusion Criteria

- Patients diagnosed with MOST occurring symptoms Of Cardiac Problems, Cardiac Troponin I, Visual Testing Parameters, AND Treatment.
- Patients with age >18 years.
- Patients with rising levels of cardiac troponin I.
- Patients presenting with discomfort in the chest, sobbing, and epigastric pain.
- Patients who are being monitored for stable treatments.

Exclusion Criteria

- Non-cardiac causes of elevated troponin (e.g., kidney failure, sepsis, trauma).
- Pregnant women may be affected by exposure to 2D radiation, depending on the nature of the exposure and the specific study being referenced.]

- Inability to provide informed consent.
- Serious health issues or terminal illnesses that might impact treatment or results.

III. RESULTS AND DISCUSSION

During the study period [6 months], 150 patients were enrolled according to the inclusion and exclusion criteria.

TABLE 1: Distribution of Subjects Based on Gender

Gender	Number Of Patients	Percentage (%)
Males	78	52
Females	72	48
Total	150	100

The table 1 indicates that, among 150 patients, the prevalence of cardiac diagnostic parameters is significantly higher in males (78 patients, 52%) than in females (72 patients, 48%).

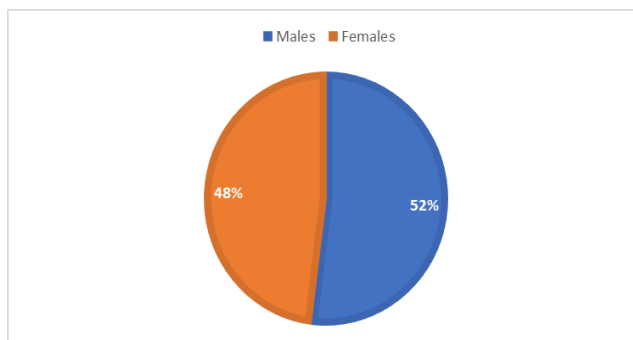


Figure 1: Table: Distribution of Subjects Based on Gender

TABLE 2: Distribution of Patients According to Age Group

Age groups	Number of patients	Percentage (%)
10-20	1	0.66
21-30	6	4
31-40	15	10
41-50	35	23.3
51-60	53	35.3
61-70	29	19.3
71-80	10	6.6

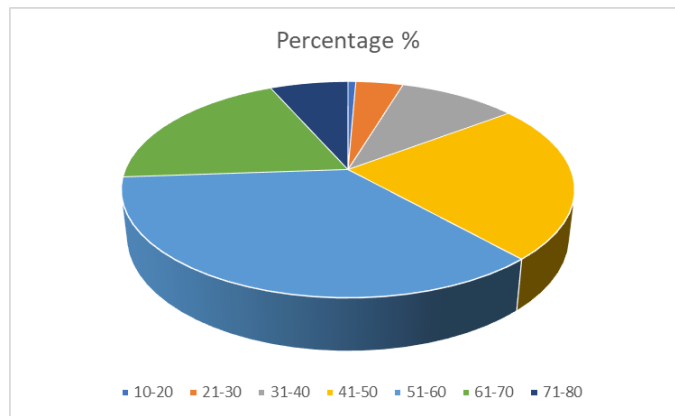


Figure 2: Distribution of Patients According to Age Group

The table above presents the age distribution of all patients involved in the clinical study. Out of the 150 subjects, the largest group was in the age range of 51-60, while the smallest

numbers were observed in the age groups of 10-20, 21-30, and 71-80.

TABLE 3: Distribution of common symptoms

Symptoms	Number of patients	Percentage (%)
SOB	52	34.6
Palpitation	36	24
Epigastric Pain	20	13.3

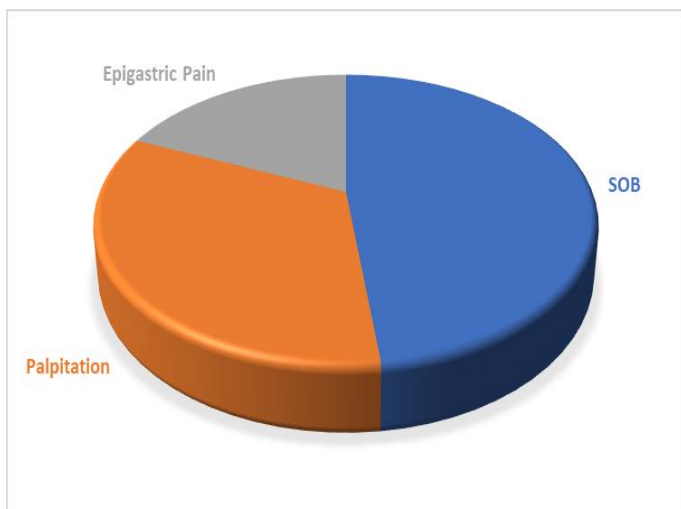


Figure 3: Distribution of common symptoms

The table 3 above indicates that, among 150 patients, the most common symptoms are shortness of breath (SOB), palpitations, and epigastric pain. Specifically, 52 patients (34.6%) are experiencing shortness of breath, 36 patients (24%) are suffering from palpitations, and 20 patients (13.3%) have epigastric pain, which is the least common symptom reported.

TABLE 4: Distribution of Common Symptoms by Gender

Gender	SOB	Palpitation	Epigastric Pain
Males	28	17	9
Females	24	19	11

The table 4 above shows the gender-wise distribution of symptoms: males experienced shortness of breath (28), palpitations (17), and epigastric pain (9); females reported shortness of breath (24), palpitations (19), and epigastric pain (11). Among the 150 patients, females are more affected than males.

TABLE 5: Distribution of Troponin I In Cardiac Patients

Gender	Number of Patients	Percentage (%)
Male	55	36.6
Female	49	32.6

The table 5 shows that among 150 patients, 55 males (36.6%) and 49 females (32.6%) are diagnosed with TROP-I, indicating that males are more prone than females.

The table 6 above indicates that among 150 patients, troponin I levels above 40 were found in 10.6% [16 patients], and below 40 were found in 6.66% [10 patients]

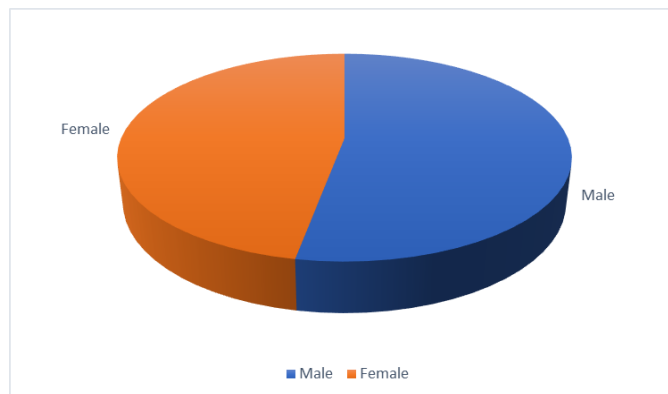


Figure 4: Distribution of Troponin I In Cardiac Patients

TABLE 6: Distribution of Average Troponin Levels in Cardiac Patients

Levels	Number of Patients	Percentage (%)
Above 40ng/L	10	6.66
Below 40ng/l	16	10.6

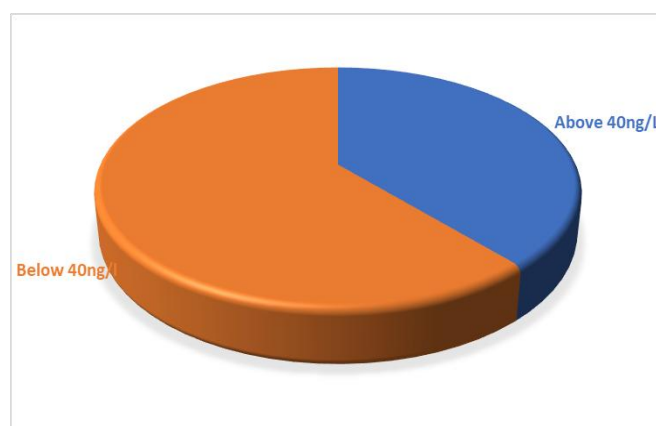


Figure 5: Distribution of Average Troponin Levels in Cardiac Patients

TABLE 7: Distribution of 2d echo by gender

Gender	Number of patients	Percentage (%)
Female	24	16
Male	22	14.66

The above table 7 indicates among 150 patients 2D ECHO diagnosed in females [24-16%]and males [22-14.66%].

TABLE 8: Distribution of 4d Echo by Gender

Gender	Number of Patients	Percentage (%)
Female	42	28
Male	58	38.66

The table 8 shows that among 150 patients, 4D ECHO was diagnosed in 42 females (28%) and 58 males (38.66%).

IV. DISCUSSION

The above graphs briefly discussed the percentage of people with distribution according to gender, age-wise distribution, symptoms-based, troponin I level, and echocardiography, which includes 2D echo and 4D echo parameters. It shows the different parameters that might show the percentage gradients of the cases. And briefly know the activity of the patients in the practical test. The laboratory test might show the action of the test and describe the whole

patient's graphical representation which might be revealed and explained. it might be prepared and sequentially distributed in table form. There are many parameters to detect the patient's history monitor the levels and treat the patients with the required treatment.

Among 150 patients [52%] are males and [48%] are females. Between them [36.6%] males and [32.6%] females are tested with the troponin I test. The electrocardiogram visuals were conducted in two forms 2D ECHO and 4DECHO. The 2D ECHO was conducted on [16%] males and [14.66] females at a wide range of 2D and 4D Images. The major symptoms of the subjects are gradually suffering from chest pain, SOB, and epigastric pain, were considered. among them, males are more affected and tested.

V. CONCLUSION

In the process of finding the relationship between troponin and echocardiography concluded that the diagnostic mechanism has a correlation between them. When the patient's lifestyle is abnormal, the most common symptoms that appear repeatedly. Whether the troponin I serves as a highly sensitive marker for myocardial injury, echocardiography provides both structural and functional aspects of cardiac damage. The combined utility of the diagnostic parameters can enhance the accuracy of early detection, finding risks, and management of cardiac diseases.

Through this, our findings are to emphasize the nature of these parameters, mainly in the phase of acute and chronic conditions. In this condition, a single diagnostic mobility was not sufficient to approach the treatment phase. Some of the challenges in variability in troponin values and imaging techniques of the heart can give Important consideration of treatment to the clinicians.

According to our findings, future research should be focused on obtaining combined diagnostic protocols, advanced imaging techniques, and improving the troponin assays to serve as accurate cardiac risk assessment. The end of the findings proved that synergistic use of these troponins and

imaging techniques might increase the findings of the condition of the patient and provide a brief essay on the patient's condition, which can be treated precisely by the clinicians.

REFERENCES

1. Mahajan VS, Jarolim P. Cardiac troponins. *J Am Coll Cardiol.* 2011;58(22):2257-2271.
2. Prasad A, Kumar R, Singh S, et al. Correlation of standard ECG with 2D-echo and serum troponin I in locating the site of myocardial infarction and its extent: An observational study. *J Clin Diagn Res.* 2022;16(7): BC01-BC05.
3. Sultana S, Rahman M, Islam M, et al. Correlation of troponin-I level with left ventricular systolic dysfunction in NSTEMI. *Int J Res Med Sci.* 2019;7(3):612-616.
4. Darki A, Schneck MJ, Silver B, et al. Correlation of elevated troponin and echocardiography in acute ischemic stroke. *J Stroke Cerebrovasc Dis.* 2013;22(7): e181-e184
5. Jordan MR. Troponin biomarkers: the benefits of echocardiography in a presumed diagnosis of NSTEMI. *Br J Cardiol.* 2014;21(4):158-161. doi:10.5837/bjc.2014.032
6. AbuBaha M, Aldwaik S, Awashra A, Milhem F, Zahran A, Hamshary H, Fuqha H, Bdair M, Abubaha B, Saife S, Shubietah A. Troponins and echocardiography: role in detecting myocardial injury in burn patients. *Ther Adv Cardiovasc Dis.* 2026 Jan-Dec; 20:17539447251414564.
7. Adamson PD, Hunter A, Madsen DM, Shah ASV, McAllister DA, Pawade TA, Williams MC, Berry C, Boon NA, Flather M, Forbes J, McLean S, Roditi G, Timmis AD, van Beek EJR, Dweck MR, Mickley H, Mills NL, Newby DE. High-Sensitivity Cardiac Troponin I and the Diagnosis of Coronary Artery Disease in Patients with Suspected Angina Pectoris. *Circ Cardiovasc Qual Outcomes.* 2018 Feb;11(2): e004227.]
8. Reddy, AC & Pandiyan, TR & Rao, Srinivasa & Reddy, YJ & Dhananjaya, PE. (2022). Correlation of Standard ECG with 2D-Echo and Serum Troponin I in Locating the Site of Myocardial Infarction and its Extent an Observational Study. *Journal of clinical and diagnostic research.* 10.7860/JCDR/2022/53075.16071.
9. Khan, M. H., Islam, M. M. N., Islam, M. S., Khan, K. N., Chowdhury, S., & Rahman, R. (2019). Correlation of troponin-I level with left ventricular systolic dysfunction after first attack of non-ST segment elevation myocardial infarction. *International Journal of Research in Medical Sciences,* 7(5), 1392–1398.