Current Trends in Biotechnology and Pharmacy
Vol. 20 (Supplementary Issue 2A), June 2026, ISSN 0973-8916 (Print)., 2230-7303 (Online)
10.5530/ctbp.2026.2s.6

Troponin T and Emergency Echocardiography: A Combined Approach for Early Diagnosis of Cardiac Emergencies

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Abstract

The cardiovascular diseases (CVDs) are the world's leading cause of death and the consequences of a delayed diagnosis are frequently worse the patient conditions. This observational study identified how early detection and risk stratification in cardiac emergencies can be enhanced by diagnosing with combined cardiac Troponin T (TnT) testing with two-dimensional echocardiography (2D Echo). 300 patients with acute cardiac symptoms were assessed over the course of 6 months in a tertiary care hospital in Guntur, India. Within 3 hours of admission, all received standard emergency care along with TnT testing and 2D Echo.

TnT and 2D Echo each demonstrated a greater diagnostic accuracy (82.0% and 81.3%), but when combined together, the result achieved 92.7%, lowering false positives and negatives greatly. While patients with both tests negative had excellent prognoses, those with both tests positive had the worst clinical outcomes compared to only one test, including longer hospital stays, more ICU admissions, more revascularizations, and higher mortality. The complementary nature of these modalities was further supported by the strong correlation found between elevated TnT levels and regional wall motion abnormalities on Echo.

With more intensive therapy in high-risk patients identified by combined diagnostics, treatment patterns mirrored guidelines-based care. Only a small percentage of adverse drug reactions required treatment withdrawal, and most were controllable.

According to our study, combining TnT and 2D Echo in emergency facilitates faster, more precise diagnosis for cardiovascular emergencies, aids in improved triage choices, and directs customized treatment, all of which improve quality of life of patients. Global emergency management of CVDs could be improved by the widespread use of this dual-modality approach.

Keywords: Troponin T (TnT), two-dimensional echocardiography (2D Echo), stratification, cardiac emergencies, prognoses, revascularizations, mortality

Introduction

Now days majority of the deaths are seen in cardiac issues. Cardiovascular diseases (CVD) such as heart failure (HF), myocardial infraction (MI), coronary artery diseases (CAD), arrhythmia, and peripheral artery diseases (PAD) are frequently seen in elder peoples in world wide. According to World Health Organisation (WHO), the prevalence and incidences will increase from (90%) by the year (2050). People's loss their quality of life due to lack of awareness on diagnosis and medications. Primary prevention is necessary to prevent the CVD issues, before getting chronic conditions. In CVD conditions, the numerous symptoms, signs, and cardiac biomarkers are elevated in the blood.[1]In this condition troponin T, Troponin C, and Creatinine kinase myoglobin levels are

Vol. 20 (Supplementary Issue 2A), June 2026, ISSN 0973-8916 (Print)., 2230-7303 (Online)
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usually raised up. Troponin T is a 37 ku protein and present in skeletal muscles and cardiac muscles that binds to tropomyosin, thereby attaching the troponin complex to the thin filament. If the TnT level greater than 0.1 µg/L were considered positive for TnT. The prevalent of cardiac TnT is bound to myofilaments, and the remnants is free in the cytosol which accounts for 3%–8% of the total amount. [2]After interruption of the sarcolemma membrane of the cardiomyocyte, troponin from the cytoplasmic pool is initially free, followed by a more prolonged release from quantities bound to deteriorating myofilaments. In peripheral blood, TnT begins to rise within three to four hours after the onset of myocardial injury and remains increased for 10–14 days.

Another diagnosis test such as Two-dimensional echocardiography (2D echo) is one of the most useful methods due to its availability, usage, cost, easy to perform at bedside. It is the most labouring cardiovascular imaging modality for assessment of cardiovascular disease and is often performed in patients for confirmation or during provisional diagnosis without a history of IHD. It is well established that several echocardiographic measurements provide prevailing predictive information for cardiovascular outcomes, such as occurrence of left ventricular hypertrophy, aortic induration and left ventricular ejection fraction (LVEF). Also, 2D echo is also very useful when it comes to rule out the possibility of other aetiologies of acute chest pain or dyspnoea, such as aortic dissection and pericardial effusion.[3]

Both troponin T and 2D Echo best diagnostic approaches for the early screening of CVD problems from the populations. In present clinical study, we highlighted the sensitivity and specificity of Troponin T and 2D Echo which diagnostic approach ids better for early diagnosis of CVD conditions.

Methodology

Study Site

An observational study was conducted in cardiology department at tertiary care hospital, Guntur, Andhra Pradesh, India. A total 300 participants were enrolled in this study with duration of 6 months. Earlier beginning the study, we were carefully explaining about the study, and pleasing the informed consent form (ICF) from the participants and legal caretaker of the participants.

Selections of participants

Based on inclusion and exclusion criteria participants were selected. If participants didn't meet inclusion criteria, they exclude from the study.

Inclusion criteria

- Participants age between 18 to 75 either sex of both male and female.
- Participants present with cardiac symptoms such as chest pain
- Participants with troponin levels between 0.04, >0.04
- Participants willing to given informed consent form.
- Troponin T test and echocardiography performed within 3 hours of arrival.
- Participants admitted in cardiac emergency ward.

Exclusion criteria

- Participants with known chronic cardiac conditions with ongoing management (chronic heart failure under treatment).
- Pregnant women.
- Participants with other comorbidities such as diabetes mellites, acute and chronic renal failure.
- Renal failure patients with persistently elevated troponin.
- Incomplete diagnostic work-up (missing either troponin or echo).
- Participants involved in other clinical studies.
- Participants with arrogant behaviour.
- Participants with wheel chair or unable to walk.

Study plan

In this study we were enrolled the participants who are joining in emergency

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department. After their getting admission, we were conforming the whether the patient suitable or not for this clinical study and check the vitals and demographic characteristics. After that the participants meet the all-inclusion criteria, we were explaining the about the study and taking the informed consent form the participants or legal guardian and then send to diagnosis either troponin T test and 2D echo or both. Then we were collected that information from these tests and store in the case report form.[4] Troponin T test and 2D echo was conducted in hospital. X ml of blood was collected from patients by well-known phlebotomist and determine the troponin T level. Troponin T estimates by Siemens Atellica CI & Dimensions EXL series-Fujiflim DRI-CHEM NX500 and for radiographic imaging for heart structure abnormality were analysed by using Konica Minolta.

Statistical analysis

In this observational study, data were analysed by descriptive statistics, correlation statistics through using SSPS software and values are represented by mean and standard deviation.

Results

We have collected the data from 367 patients and out of that only 300 patients are suitable based on the criteria of our study.

Demographics characteristics

Most variables show near normal distribution with mild skewness. And some parameters show 2.74 as high skew

The present clinical study analysed demographic characteristics of 300 patients reveals that the majority of peoples belong to the age group of 51–60 years (30%) is highly risk age group for cardiovascular diseases when compared other age groups. Another finding of this study, male predominance was observed, with 182 males (60.7%) and 118 females (39.3%), reflecting a common trend seen in cardiac-related admissions. In the case BMI, a significant proportion of patients were either overweight (41.3%) or obese (43.7%), with only 15% falling within the normal range (BMI 20–24). This finding suggests a strong association between elevated BMI and cardiac risk.[5] Regarding nutritional status, only 25% of patients had good nutrition, while 30% had poor nutritional status and 45% had moderate nutrition, highlighting the potential role of dietary factors in disease progression. Employment status showed that 63.7% were employed, and 36.3% were unemployed, which may influence access to healthcare and health-seeking behaviour. When assessing lifestyle habits, (51.3%) reported poor habits, including lack of exercise, smoking, or unhealthy diet, further reinforcing the impact of modifiable risk factors as mentioned in (Table 1).

Reasons for Admission in Emergency Cardiology Department

Present study was observed; subjects were admitted in the emergency department with various reasons as shown in the (Table 2). Among that reasons, most frequent reason for emergency admission was chest pain, reported by all 300 patients (100%). Unexplained shortness of breath and hypertension were each present in 81% of patients, followed by palpitations (72.7%), fatigue (60.7%), and dizziness or light-headedness (54.3%), indicating these are frequent presenting complaints in suspected cardiac cases in this study. Other notable symptoms included nausea and vomiting (38.3%), dyspnoea (27%), and persistent cough (25.7%). Less frequently reported symptoms were pedal oedema (15%), orthopnoea (18%), and hypotension (19%). Cold, clammy skin with sweating (9.7%) and syncope (4.3%) were the least common but may indicate more severe or acute presentations.[6]

Diagnostic Tests Performed at Time of Admission

ECG, 2D Echo, Troponin T are having high precision with a great confidence interval, whereas electrolytes, RFT, and LFT have moderate precision, and low CI was observed in cardiac CT, Holter, and TMT.

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Table 1: Demographic characteristics		
Demographic characteristics	No. of Patients (n=300)	Descriptive statistics
Age (%)		
18-30	30	3.45 ± 1.29
31-40	45	
41-50	60	
51-60	90	
>61	75	
Gender (%)		
Males	182	1.39 ± 0.49
Females	118	
Body Mass Index (BMI) (%)		
18.5–24.9 kg/m²	45	2.29 ± 0.71
25–29.9 kg/m²)	124	
≥30 kg/m²	131	
Nutritional Status (%)		
Average	90	1.95 ± 0.74
Moderate	135	
Good	75	
Employment (%)		
Employed	191	1.36 ± 0.48
Unemployed	109	
Life style habits (%)		
Bad	154	1.39 ± 0.49
Better	91	
Excellent	55	
Marital Status (%)		
Married	271	
Unmarried	29	
Ethnicity (%)	100	

At the time of admission, all 300 subjects underwent essential diagnostic tests, including ECG, 2D echocardiography, and Troponin T assessment, reflecting the standard protocol for evaluating suspected cardiac conditions in the emergency setting. Electrolyte levels were tested in 85.3% of patients, while renal and liver function tests were performed in 64.7% and 57.7% of cases, respectively, indicating selective use based on clinical presentation and comorbidities. Advanced diagnostic tools such as Cardiac CT (15.7%), Holter monitoring (17.3%), and the treadmill test (4.0%) were employed in a smaller subset of patients as shown in the (Table 3 and Fig. 1).

Stabilization of patient in Emergency Department

At the time of presentation, various emergency stabilization measures were administered based on clinical need as shown in (Table 4). IV fluid management was the most commonly employed intervention,

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Table 2: Reasons for Admission in Emergency Department	
Reasons	No. of Patients
Chest pain	300
Unexplained shortness of breath	243
Palpitations	218
Syncope	13
Fatigue	182
Dyspnoea	81
Pedal oedema	45
Hypertension	243
Hypotension	57
Persistent cough	77
Cold calmy skin with sweating	29
Nausea and vomiting	115
Dizziness or light-headedness	163
Orthopnoea	54

Table 3: Diagnostic Tests Performed at Time of Admission	
Test	No. of Patients
ECG	300
2D Echo	300
LFT	173
RFT	194
Electrolytes	256
Troponin T	300
Cardiac CT	47
Treadmill test	12
Holter monitoring	52

used in 91% of patients, followed by nitro-glycerine (84%). Oxygen therapy was provided to 73% of patients, supporting those with hypoxia or respiratory distress. Anticoagulation therapy was widely used,[7] with heparin/enoxaparin administered in 61.7% and thrombolytics in 65%, reflecting a high prevalence of suspected or confirmed thrombotic events. Diuretics were used in 62.3% of cases, likely for managing fluid overload or heart failure symptoms. Vasodilators were used in 37.7% of patients to reduce afterload and improve cardiac output. Meanwhile, beta blockers (24.3%) and morphine (18.7%) were used more selectively, based on heart rate, blood pressure, and severity of chest pain.

Correlation between Troponin T levels and 2D Echo

Figure 2 shows the diagnostic associations of Troponin T and 2D Echo with echocardiographic abnormalities, the findings suggest differing degrees of correlation. Troponin T shows a strong negative association with Regional Wall Motion Abnormalities (RWMA) (correlation coefficient: –0.216), implying that as Troponin T levels increase, RWMA findings become more prominent, which is consistent with myocardial injury or infarction.[8] However, its correlation with Global Hypokinesia (0.01) and other abnormalities (0.005) is minimal, indicating limited predictive value for diffuse or non-regional dysfunctions. In contrast, 2D Echocardiography demonstrates modest positive correlations across all abnormality types: RWMA (0.08), Global Hypokinesia (0.02), and other abnormalities (0.026).

Diagnostic accuracy of Troponin T, 2D Echo, and combined approach

Diagnostic accuracy and individual levelsare shown in tables 5 and 6.

Clinical outcomes based on combined troponin and 2D Echo

Table 7 shows the clinical outcomes based on Troponin T and 2D Echo findings reveals that patients with both tests' positive had significantly worse clinical outcomes. This group had the longest mean hospital stay (8 hours), the highest need for ICU admission (32.9%), revascularization (88.4%), inotrope use (65.8%), and mortality (11%). Patients with either Troponin or 2D Echo positive also showed considerable clinical burden, with 32.9% requiring ICU admission, but notably lower rates of revascularization (21.4%), inotrope use (42.9%), and mortality (4.3%) compared to

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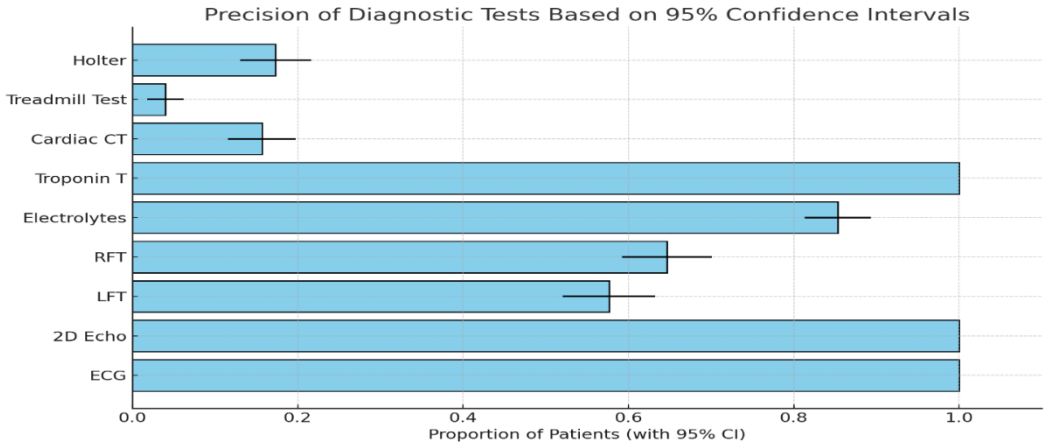

Fig. 1:

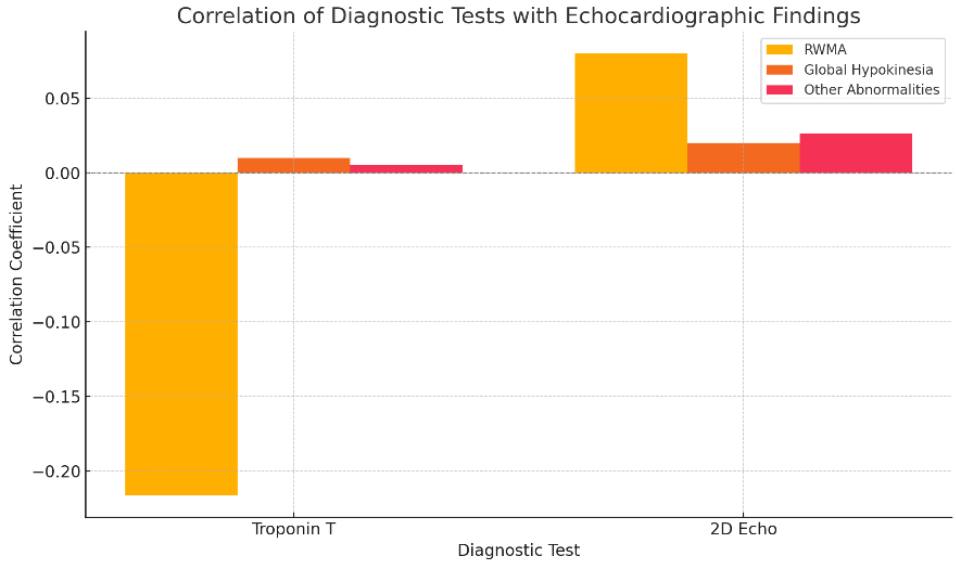

Fig. 2: Correlation between Troponin T levels and 2D Echo

the dual-positive group. Patients with both tests negative (only 5 individuals) had no ICU admissions, interventions, or deaths, suggesting a low-risk profile.

Distribution of drug therapy administered in emergency department for cardiac complications

Table 8 shows drug therapy used emergency cardiac department. In this study, antiplatelet therapy with aspirin (n=270) and clopidogrel/ticagrelor (n=46) was widely administered, with over 90% receiving the drugs within 1 hour, emphasizing prompt initiation of dual antiplatelet therapy (DAPT). Heparin (n=230) and unfractionated heparin (n=54) were the main anticoagulants used, targeting patients with NSTEMI/STEMI/PE. Among vasodilators, nitroglycerin was used in 204 patients, primarily for chest pain and

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hypertension, and administered rapidly in 95.6% of cases. Metoprolol, though prescribed to 186 patients, showed a lower early administration rate (48.4%), indicating cautious use in hemodynamically unstable cases. ACE inhibitors/ARBs and statin**s** were part of long-term cardiac management and given to 164 and 264 patients respectively.[9] Furosemide (n=135) and dobutamine (n=30) played key roles in managing fluid overload and cardiogenic shock, with dobutamine being promptly administered in 100% of applicable cases. Morphine, used in 32 patients for pain and anxiety relief, was also quickly administered in 93.8% of cases.

Table 4: Stabilization of patient in Emergency Department

Stabilization	No. of Patients (n=300) (%)
Oxygen therapy	73.00
IV fluid management	91.00
Nitro-glycerine	84.00
Morphine	18.67
Beta blockers	24.33
Heparin/ Enoxaparin	61.67
Thrombolytics	65.00
Diuretics	62.33
Vasodilators	37.67

Drugs prescribed pattern based on troponin T levels

Figure 3 shows aspirin was universally administered to all patients, reflecting its foundational role in acute coronary syndrome (ACS) management. The use of dual antiplatelet therapy (Clopidogrel/Ticagrelor) progressively increased with Troponin elevation, indicating intensified antiplatelet therapy in cases of myocardial injury. Anticoagulant therapy (Heparin/Enoxaparin) was administered to only a few patients in the normal Troponin group but was widely used in those with elevated levels, aligning with evidence-based protocols for thrombotic risk. Statins were prescribed more frequently as Troponin levels increased, showing proactive lipid management in higher-risk patients. [10]Beta-blocker usage also rose significantly with elevated Troponin, supporting their role in reducing myocardial oxygen demand and preventing arrhythmias. Overall, the pattern demonstrates a rational, evidence-aligned escalation of pharmacotherapy based on Troponin-guided risk stratification.

Table 5: Diagnostic accuracy of Troponin T, Emergency Cardiography, and combined approach

Diagnostic modality	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive value	Overall accuracy
Troponin T alone	89.2	74.6	83.3	82.9	83.5
Emergency echocardiography	84.6	78.3	81.8	82.1	82.5
Combined approach	96.3	88.5	92.6	94.1	93

Table 6: Diagnostic accuracy of Troponin T, 2D Echo, and combined approach

Test	TP	FN	TN	FP	Accuracy (%)
Troponin T alone	134	16	112	38	82.0
Emergency Echo	127	23	117	33	81.3
Combined Approach	145	5	133	17	92.7

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Table 7: Clinical outcomes based on combined troponin and 2D Echo

Troponin/2d Echo	No of patients	ICU admission	Mean hospital stays	Revascularization required	Inotropes used	Mortality
Both Positive	155	51	8 hours	137	102	17
Either one Positive	140	46	5 hours	30	60	6
Both negative	5	0	0	0	0	0

Table 8: Distribution of cardiac drug therapy administered in emergency department

Drug class	Drug name	No. of patients	ROA	Given with in 1hr	Primary indication
Antiplatelets	Aspirin	270	Oral	97.7%	ACS
	Clopidogrel/ Ticagrelor	246	Oral	91.4%	DAPT
Anticoagulants	Heparin	230	SC	78.9%	NSTEMI, STEMI, PE
	Unfractionated heparin	54	IV	77.8%	STEMI, pre-PCI
	Nitro-glycerine	204	SL/IV	95.6%	Chest pain, HTN
Nitrates	Metoprolol	186	Oral/IV	48.4%	Rate control, ACS
Beta blockers	Ramipril/ Losartan	164	Oral	32.7%	HTN, LVD
ACE/ARB	Atorvastatin	264	Oral	79.5%	ACS, dyslipidaemia
	Furosemide	135	IV	93.3%	PE, Heart failure
Statins	Dobutamine	30	IV	100%	Cardiogenic shock, severe LVF
Diuretics	Morphine	32	IV	93.8%	Pain relief in MI, anxiety, pulmonary oedema

Drugs prescribed pattern based on echocardiographic findings

Based on the 2D Echo findings, drug administration varied significantly according to cardiac function and wall motion abnormalities as shown in (Fig. 4). Patients with normal echocardiographic findings received full-dose antiplatelet therapy (Aspirin and Clopidogrel/Ticagrelor), but use of other agents was limited, reflecting lower clinical suspicion of cardiac ischemia. In contrast, those with regional wall motion abnormalities (RWMA) or global hypokinesia were managed more aggressively. Aspirin and dual antiplatelet therapy were administered to nearly all such patients, alongside high usage of Heparin/Enoxaparin, Statins, and Beta-blockers indicating alignment with standard ACS management protocols.[11] In patients with dilated left ventricles and reduced

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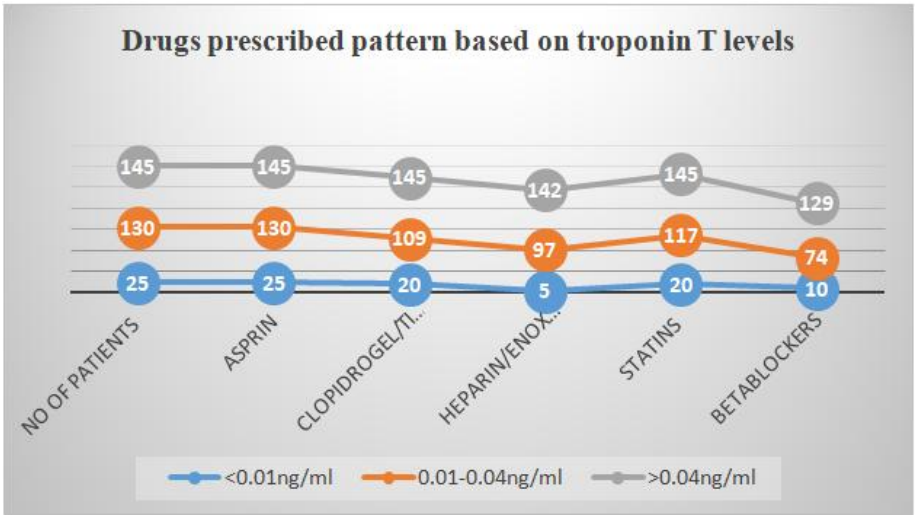

Fig. 3: Drugs prescribed pattern based on troponin T levels

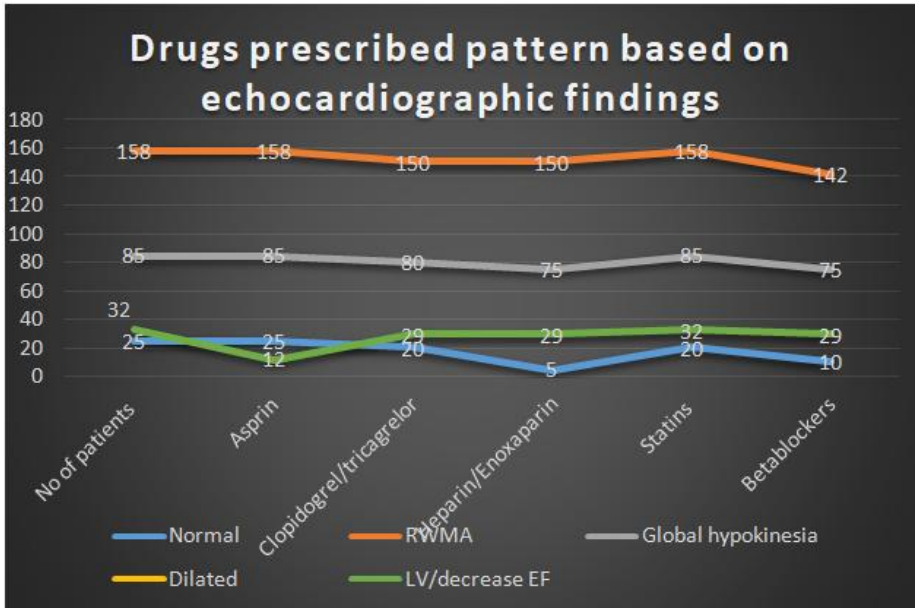

Fig. 4: Drugs prescribed pattern based on echocardiographic findings

ejection fraction (EF), although antiplatelet and statin use remained high, a slightly reduced use of anticoagulants and beta-blockers was noted, possibly reflecting hemodynamic considerations or contraindications. Overall, pharmacological treatment was tailored based on echocardiographic severity, demonstrating the utility of 2D Echo in guiding early therapeutic decisions.

Clinical outcomes based on troponin T levels and pharmacologic intervention

Based on Troponin T levels, a clear gradient in clinical severity and management intensity was observed. Patients with

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Table 9: Clinical outcomes based on troponin T levels and pharmacologic intervention

Troponin T	Primary drugs used	ICU admissions	Mean hospital stays	Revascularization	Inotropes	ADRs observed	Mortality
<0.01ng/mL 9 (25)	Aspirin, statin	3	2.2 days	0	0	1	0
0.01-0.04ng/mL (130)	DAPT, statin, beta blocker	65	5.4 days	43	13	26	9
>0.04ng/mL (145)	Full ACS protocol, DAPT, heparin, statins, nitrates	106	8.6 days	107	29	16	12

Troponin T <0.01 ng/ml (n=25) were mostly managed with aspirin and statins, reflecting a lower likelihood of acute coronary syndrome (ACS). ICU admissions and inotrope use were minimal in this group, with an average hospital stay of just 2.2 ± 0.9 hours, and no need for revascularization. Adverse drug reactions (ADRs) and mortality were negligible. In the intermediate group (0.01–0.04 ng/ml, n=130), more intensive therapy was implemented, including dual antiplatelet therapy (DAPT), statins, and beta-blockers. ICU admissions increased significantly to 65 patients, and the mean hospital stay was prolonged to 5.4 ± 1.6 hours. Revascularization was required in 43 patients, and inotropes were used in 13 cases, indicating moderate myocardial compromise. [12]ADRs and mortality rates increased in this group (26 and 9 cases respectively). Among patients with Troponin T >0.04 ng/ml (n=145), full ACS protocols were employed—incorporating DAPT, heparin, statins, and nitrates—signifying severe myocardial injury. This group had the highest ICU admissions (106), revascularization requirements (107), and inotrope use (29). The hospital stay was longest at 8.6 ± 2.1 hours. Although mortality was highest in this group (12 cases), the use of comprehensive management strategies likely helped in preventing worse outcomes as shown in (Table 9).

Adverse drug reactions (ADRs) reported during emergency management

Table 10 represents, patients receiving cardiovascular medications, several adverse drug reactions (ADRs) were reported, varying in severity, onset, and required management. Heparin was associated with minor bleeding in 18 patients, typically occurring within 6 to 12 hours of administration. These cases were mild and managed with pressure dressings and dose adjustments, resulting in full resolution. Clopidogrel induced gastrointestinal discomfort and nausea in 12 patients, with a mild to moderate severity that presented within 1 to 3 hours; symptoms were alleviated using proton pump inhibitors and supportive co-prescriptions. Metoprolol led to bradycardia and hypotension in 9 patients, classified as moderate ADRs with early onset (within 30 minutes to 2 hours), and in some cases, the drug had to be withheld, requiring fluid resuscitation this was the only drug necessitating withdrawal. [13] Nitroglycerin caused headache and flushing in 15 patients, appearing rapidly (within 15 to 30 minutes) but was mild in nature and responded well to symptomatic treatment with analgesics.

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Table 10: Adverse drug reactions (ADRs) reported during emergency management

Drug name	Type of ADR	No of cases	Severity	Onset	Management provided	Outcome (resolved/ Required Withdrawal)
Heparin	Minor bleeding GI discomfort, nausea	18	Mild	Within 6-12hrs	Pressure dressing, dose adjustment	Resolved
Clopidogrel	Bradycardia,	12	Mild/moderate	Within 1-3hrs	PPI, Co prescription	Resolved
Metoprolol	Headache, flushing	9	Moderate	Within 30min -2hrs	Drug withheld Fluids	Required withdrawal
Nitro-glycerine	Hypotension	15	Mild	Within 15-30min	Symptomatic analgesics	Resolved
Furosemide	Hypokalaemia	6	Moderate	After 24-48hrs	Electrolyte replacement	Resolved
Morphine	Muscle cramps	6	Severe	Within 30-60min	Naloxone, O2 therapy	Resolved
Statins	Respiratory depression, nausea myalgia	3	Mild	After 2-3 days	Dose reduction	Resolved

Furosemide led to hypokalaemia in 6 patients, manifesting after 24 to 48 hours; these were moderate events managed with appropriate electrolyte replacement. Morphine, used for pain management, resulted in respiratory depression and nausea in 6 patients these were severe and required immediate interventions like naloxone administration and oxygen therapy, but all cases resolved successfully. Lastly, statins caused *myalgia* in 3 patients, typically emerging after 2 to 3 days; the symptoms were mild and resolved with dose reduction.

Discussion

In this observational study, involving 300 participants presenting to a cardiac emergency department, we assessed the clinical utility, diagnostic accuracy, and outcome implications of combining two pivotal diagnostic tools such as Troponin T levels and two-dimensional echocardiography (2D Echo).

Previous studies suggest that age is one of the risk factors for cardiovascular diseases. The demographic analysis revealed that individuals aged 51–60 years comprised

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the highest percentage (30%) of cardiac emergency cases, aligning with epidemiological trends that demonstrate a steep increase in cardiovascular risk with age due to endothelial dysfunction, arterial stiffness, and comorbidities such as hypertension and diabetes. Males (60.7%) outnumbered females (39.3%), reinforcing global data that men are more frequently affected by ischemic heart disease, particularly in middle age, potentially due to hormonal protection in premenopausal women.[14] BMI and lifestyle habits further reflected a high cardiovascular risk burden. A large group of patients were either obese (85%), or overweight and out of all half reported poor lifestyle habits, including smoking, alcoholic status, and unhealthy diet. These modifiable factors underscore the urgent need for public health interventions targeting nutrition, exercise, and weight control to reduce CVD occurrence and incidence.

Majority studies reveal the chest pain is the primary symptoms of CVD. In this study, most frequently reported symptoms were chest pain (100%), unexplained shortness of breath (81%), palpitations (72.7%), and fatigue (60.7%), all hallmark features of acute coronary syndromes (ACS) and other cardiac emergencies. Dizziness, pedal oedema, hypotension, and orthopnoea are commonly observed, reflecting varying degrees of cardiac dysfunction. Reinforcing the importance of timely diagnosis with biochemical and imaging investigations. Notably, 300 (100%) of patients underwent Troponin T testing and 2D Echo upon admission, signifying these tests as functional tools in cardiac triage.[15]

Troponin T, a sensitive and specific biomarker for myocardial injury, demonstrated excellent diagnostic performance. It begins to rise 3–4 hours after myocardial injury and remains elevated for up to 14 days. In our study, it correlated significantly with Regional Wall Motion Abnormalities (RWMA), as evidenced by a negative correlation coefficient ($r = –0.216$). [16] This study is consistent with previous literature suggesting that Troponin elevation reflects localized myocardial necrosis and perfusion deficits, which manifest on 2D Echo as segmental wall motion changes with abnormal complications.

2D Echo offered a broader assessment of cardiac function for overall assessment of cardiac complications, allowing identification of Global Hypokinesia, valvular dysfunction, chamber enlargement, and pericardial abnormalities. [17] Its correlations with biochemical markers were less pronounced, its ability to detect non-ischemic pathologies provides added diagnostic value beyond Troponin testing for better treatment approach.

When evaluated individually, Troponin T and 2D Echo showed similar diagnostic accuracies (82.0% and 81.3%, respectively). However, the combined approach demonstrated superior accuracy (92.7%), with significantly reduced false positives and false negatives. These findings prioritize the synergistic value of collaborating biomarker and imaging data, particularly in equivocal clinical scenarios where either test alone may yield inconclusive results.[18]

The clinical outcomes reinforced the diagnostic findings. Patients who tested positive for both Troponin T and 2D Echo abnormalities had markedly worse prognoses longer hospital stays (mean 8 hours), higher ICU admissions (32.9%), increased inotrope requirement (65.8%), and higher mortality (11%). Subgroup also had a greater need for invasive revascularization (88.4%), reflecting a higher burden of myocardial ischemia and compromised cardiac output.

Most Probably the group with both tests negative showed excellent outcomes with no treatment, ICU admissions or mortality. This phenomenon supports the use of these tools not just for diagnosis but also for early risk stratification and triage decisions, guiding intensive versus conservative management approaches.[19]

Drug utilization was preferred with current evidence-based guidelines. Antiplatelet therapy, particularly aspirin and dual antiplatelet

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therapy (DAPT), was administered in over 90% of patients with suspected ACS, with most receiving treatment within 1 hour—a critical window for maximizing therapeutic efficacy. Troponin-positive patients received more aggressive therapy, including heparin, nitrates, statins, and beta-blockers, in accordance with protocols for STEMI and NSTEMI management.

The pattern of pharmacologic escalation based on Troponin T levels demonstrates the clinical value of this biomarker in guiding treatment intensity. Patients with Troponin >0.04 ng/ml received the most comprehensive therapy, reflecting severe myocardial injury. This group had the longest hospital stays, highest ICU utilization, and most frequent use of inotropes and revascularization procedures.

Likewise, echocardiographic findings significantly influenced drug selection. RWMA and Global Hypokinesia prompted greater use of anticoagulants, vasodilators, and diuretics, highlighting the utility of echocardiography in tailoring therapy to functional impairments and volume status.

The study also monitored ADRs during emergency management. Heparin-induced bleeding, Nitroglycerin-related hypotension, and beta-blocker-induced bradycardia were among the most common adverse events. Although most ADRs were mild and resolved with dose adjustment or symptomatic management, a few (e.g., morphine-related respiratory depression) required urgent intervention.[20] Only metoprolol necessitated drug withdrawal in some cases.

These findings underscore the importance of vigilant monitoring for ADRs, especially in patients receiving polypharmacy in an acute setting. Integrating lab parameters such as Troponin and imaging findings can help predict which patients are most at risk of deterioration, aiding in drug selection and dosage adjustment.

Clinical Implications and Recommendations

The study supports a dual-modality diagnostic strategy for patients with suspected cardiac events in the emergency department. Troponin T offers high sensitivity for myocardial injury, while 2D Echo provides rapid bedside assessment of functional and structural cardiac status. Used together, they provide a comprehensive picture that enables more accurate diagnosis, better risk stratification, and individualized treatment plans.[21]

We recommend routine use of both Troponin and 2D Echo in emergency cardiac care, especially in patients presenting with chest pain, dyspnoea, or hemodynamic instability. Moreover, incorporating these diagnostic insights into standardized care pathways could help reduce time to intervention, optimize resource utilization, and improve patient outcomes.

Emergency physicians and cardiologists should also be trained to interpret the interplay between biomarker levels and echocardiographic findings, ensuring prompt, informed decisions. [22,23]Healthcare systems should invest in point-of-care echo equipment and rapid Troponin testing platforms to enhance diagnostic efficiency.[24,25]

Conclusion

In our study we concluded that the study strongly suggests that combining Troponin T levels and 2D Echocardiography finding enhances proper diagnosis, risk stratification, and clinical outcomes in patients reporting with cardiac emergencies. The integrated approach significantly outperformed either modality alone in diagnostic accuracy and informed the intensity of pharmacologic interventions. Due to the global burden of CVD and the critical role its importance of timely management and better quality of life. These findings advocate for widespread adoption of combined biochemical-imaging strategies in emergency cardiac care in hospital setting.

Limitations

Single centred study, Limited sample size, potential reporting bias, confidentiality constraints, variability in diagnosing timings, un measured confounders, short follow-up period.

Vol. 20 (Supplementary Issue 2A), June 2026, ISSN 0973-8916 (Print)., 2230-7303 (Online)
10.5530/ctbp.2026.2s.6

Acknowledgements

The authors would like to acknowledge the management and the Principal of Vignan Pharmacy College for supporting this work.

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