Research article

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Prognostic Value of hs-cTnT for Mortality in Patients with Sepsis at Thong Nhat Hospital

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Abstract

Background/Objectives: Sepsis remains a leading cause of mortality in critically ill patients, with myocardial injury playing a crucial role in disease progression. High-sensitivity cardiac troponin T (hs-cTnT) has emerged as a potential biomarker for cardiac dysfunction in sepsis, yet its prognostic significance remains under investigation. This study aimed to evaluate the prognostic value of hs-cTnT levels and their dynamic changes in predicting 28-day mortality among sepsis patients at Thong Nhat Hospital.

Methods: A prospective observational cohort study was conducted on adult sepsis patients admitted to the Intensive Care Unit (ICU). Serial hs-cTnT measurements were obtained at admission and 24 hours post-admission. The primary outcome was 28-day all-cause mortality. Statistical analysis included receiver operating characteristic (ROC) curve evaluation, logistic regression modeling, and Youden's index determination for optimal cutoff values.

Results: A total of 60 sepsis patients were included. The prevalence of hs-cTnT elevation (>14 ng/L) at admission and 24 hours was 98.3%. The area under the ROC curve (AUC) for hs-cTnT at admission in predicting mortality was 0.574, which improved to 0.691 at 24 hours. The absolute changes in hs-cTnT over 24 hours had higher prognostic value, with AUC of 0.768.

Conclusions: This study demonstrates that dynamic changes in hs-cTnT over 24 hours provide superior prognostic accuracy for 28-day mortality in sepsis patients compared to single-timepoint measurements. Serial hs-cTnT assessments may enhance risk stratification and aid in clinical decision-making for critically ill sepsis patients.

Keywords: Sepsis, high-sensitivity cardiac troponin T, myocardial injury, mortality prediction, risk stratification, biomarker.

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1. INTRODUCTION

Sepsis is a life-threatening condition caused by a dysregulated host response to infection, leading to multi-organ dysfunction and high mortality rates [1]. Despite significant advancements in critical care management, sepsis remains a major global health burden, with an estimated 48.9 million cases and 11 million sepsis-related deaths annually [2]. In Vietnam, mortality rates in intensive care units (ICUs) can reach up to 50% in some tertiary hospitals [3]. Early risk stratification and prognostication are essential for guiding timely interventions and improving clinical outcomes in sepsis patients.

Patients with sepsis often have a hidden onset and are easy to be ignored, resulting in the delay of treatment. There are numerous scoring systems available for diagnosing and evaluating sepsis at the moment such as SOFA, APACHE II, SAPS II. However, no scoring system can completely and accurately evaluate the prognosis of patients with sepsis. Some scoring systems are too cumbersome, while others limit the time and occasion of use [4].

Cardiac injury is a well-recognized complication of sepsis, often manifesting as myocardial dysfunction, arrhythmias, and elevated cardiac biomarkers, such as troponins [5]. High-sensitivity cardiac troponin T (hs-cTnT) has emerged as a valuable biomarker for detecting myocardial injury, even in non-cardiac conditions such as pulmonary embolism, stroke, and sepsis [6]. Previous studies have demonstrated that elevated hs-cTnT levels in sepsis are associated with increased disease severity, prolonged ICU stay, and higher short- and long-term mortality [7]. However, the prognostic performance of hs-cTnT in sepsis remains inconsistent across studies, with variable cutoff values and unclear thresholds for mortality prediction.

In Vietnam, limited research has explored the prognostic value of hs-cTnT in sepsis. Given the high burden of sepsis-related mortality and the potential role of hs-cTnT as a dynamic biomarker, further investigation is warranted. This study aims to evaluate the prognostic significance of hs-cTnT levels in predicting 28-day mortality in sepsis patients admitted to the ICU. Specifically, we aim to:

1. Determine the prevalence of hs-cTnT elevation in sepsis patients,
2. Assess its predictive value for mortality.

2. STUDY SUBJECTS AND METHODS

2.1. Study Subjects

This study was conducted on adult patients (≥18 years old) diagnosed with sepsis or septic shock and admitted to the Intensive Care Unit (ICU) at Thong Nhat Hospital. Sepsis was defined according to the Sepsis-3 criteria, which characterizes it as life-threatening organ dysfunction resulting from a dysregulated host response to infection, with a Sequential Organ Failure Assessment (SOFA) score of ≥2 points at admission (Singer et al., 2016).

Excluded patients suspected of having acute coronary syndrome based on chest pain or signs of ischemia on electrocardiography (ECG) and regional wall motion abnormalities on echocardiography. Excluded patients with chest/cardiac surgery, chronic kidney disease on regular dialysis, cardiopulmonary resuscitation, or death within 24 hours of ICU admission.

Eligible patients were consecutively enrolled, and comprehensive clinical data-including demographics, comorbidities, laboratory findings, and severity scores-were systematically recorded upon admission and throughout the follow-up period.

2.2. Research Methods

This prospective observational cohort study was conducted at the Intensive Care Unit (ICU) of Thong Nhat Hospital between October 2023 and December 2024, with continuous patient recruitment and data collection throughout the study period. The study aimed to assess the prognostic value of high-sensitivity cardiac troponin T (hs-cTnT) levels in predicting 28-day mortality in patients with sepsis.

Upon admission, The severity of illness was assessed using the Sequential Organ Failure Assessment (SOFA) score and the Acute Physiology and Chronic

Health Evaluation II (APACHE-II) score. Laboratory tests, including hs-cTnT and other routine biochemical markers, were performed at admission and repeated at 24 hours post-admission.

Hs-cTnT levels were measured using an electrochemiluminescence immunoassay (ECLIA) method. The absolute values at admission and after 24 hours, as well as the percentage change in hs-cTnT over 24 hours, were calculated. The primary outcome was 28-day all-cause mortality, defined as death occurring within 28 days of ICU admission.

2.3. Study Flow Diagram

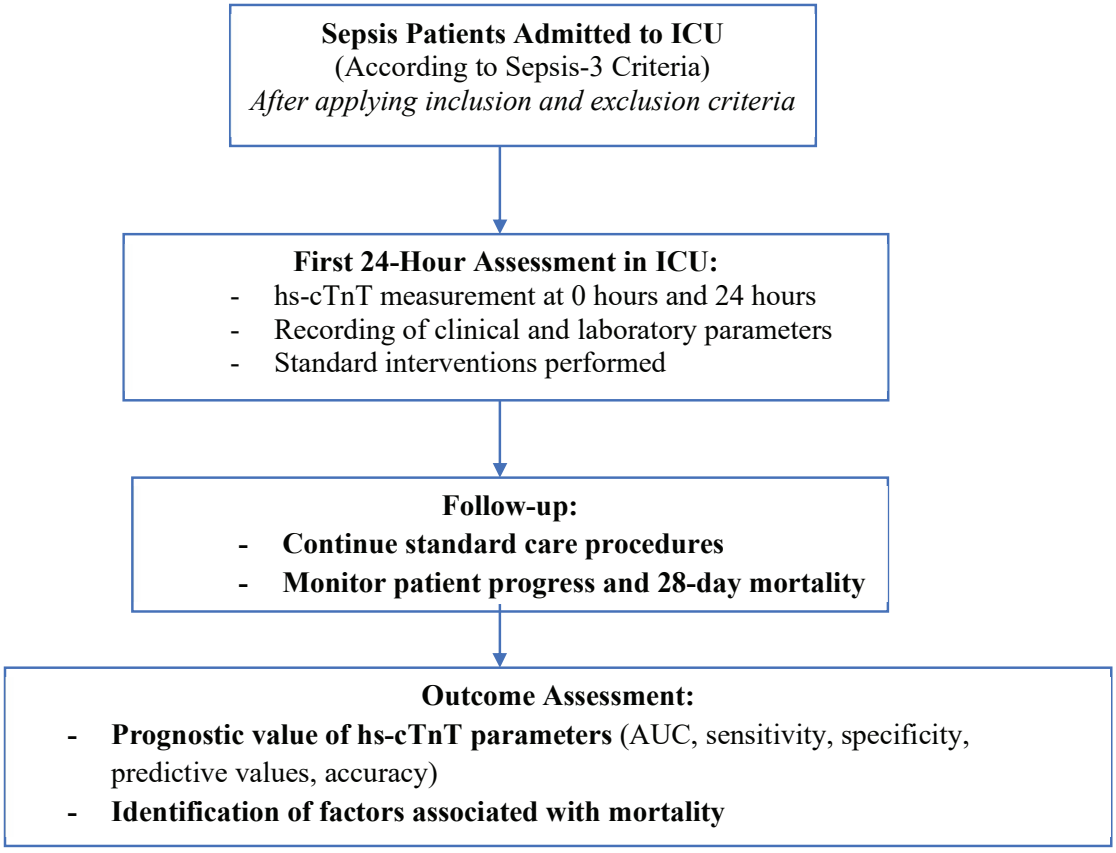

Figure 1: Study Flow Diagram

2.4. Variable Definitions

Variable	Definition
28-day mortality	Death occurring within 28 days due to sepsis-related complications.
hs-cTnT at 0h	hs-cTnT level measured at ICU admission (ng/L).
hs-cTnT at 24h	hs-cTnT level measured 24 hours post-admission (ng/L).
Δ hs-cTnT	(hs-cTnT at 24h) – (hs-cTnT at 0h)
SOFA Score	Sequential Organ Failure Assessment score at admission.
APACHE-II Score	Acute Physiology and Chronic Health Evaluation II score at admission.

2.5. Data Processing

Statistical analysis was performed using SPSS software version 26.0 (IBM, USA), which was licensed for institutional use in accordance with Vietnam's Intellectual Property Law (2005).

Non-normally distributed variables were reported as median with interquartile range (IQR) and analyzed using the Mann-Whitney U test. Categorical variables were presented as frequencies (%).

The prognostic value of high-sensitivity cardiac troponin T (hs-cTnT) levels was evaluated using Receiver Operating Characteristic (ROC) curve analysis, with the area under the curve (AUC) calculated to assess predictive performance. Youden's index was used to determine the optimal cutoff values for hs-cTnT in predicting 28-day mortality.

2.7. Ethical Considerations

Due to the critical condition of sepsis patients, informed consent was obtained from legally authorized representatives (family members or guardians) when patients were unable to provide consent themselves. The study was approved by the Institutional Review Board (IRB) of Thong Nhat Hospital. Additionally, hs-cTnT measurements were paid by investigator.

3. RESULT

3.1. Patient Characteristics

Table 1: Patient Age and Gender Characteristics (n=60)

Characteristic	Median Age (Me, IQR)	Age Range (Min – Max)
Age	73 (63-83)	27-99
Gender	**Male (n, %)**	**Female (n, %)**
	30 (50%)	30 (50%)

The patient in this study has a median age of 73 years, with an interquartile range (IQR) of 63 to 83 years, indicating that the majority of patients are older adults. The age distribution is quite broad, ranging from 27 to 99 years. Furthermore, there is an equal gender distribution, with males and females each accounting for 50% of the sample population.

Table 2: Comorbidity Characteristics (n=60)

Comorbidity	N (%)
Hypertension	28 (46.7)
Type 2 Diabetes Mellitus	23 (38.3)
Dyslipidemia	17 (28.3)
Chronic Coronary Artery Disease	11 (18.3)
Stroke	8 (13.3)
Cancer	6 (10.0)

The data on comorbidities of the patients shows that hypertension is the most common comorbidity, affecting 46.7% of the patients. This is followed by type 2 diabetes mellitus, which affects 38.3% of the patients, and dyslipidemia at 28.3%. Other comorbidities include chronic coronary artery disease (18.3%), stroke (13.3%), and cancer (10.0%).

Table 3: Primary Infection Sites (n=60)

Infection Site	N (%)
Respiratory	38 (63.3)
Urinary Tract	8 (13.3)
Gastrointestinal	7 (11.7)
Soft Tissue	3 (5.0)
Hepatobiliary	4 (6.7)

The data on primary infection sites indicates that the respiratory tract is the most common source of infection, accounting for 63.3% of cases. The urinary tract is the second most frequent source, responsible

for 13.3% of cases, followed by the gastrointestinal tract at 11.7%. Infections originating from the hepatobiliary system and soft tissues are less common, at 6.7% and 5.0%, respectively.

Table 4: Severity Scores

Score	Me (IQR)
SOFA Score	9 (6 – 12)
APACHE II Score	27 (21 – 33)

The severity scores indicate that the study population had a high level of illness severity upon ICU admission. The median SOFA score was 9 (IQR: 6–12). Additionally, the median APACHE II score was 27 (IQR: 21–33).

3.2. Prevalence of Patients with Elevated hs-cTnT

Table 5: Prevalence of hs-cTnT Elevation Above 14 ng/L

Characteristics (n=60)	N(%)
hs-cTnT at 0h	
Yes (>14 ng/L)	59 (98.3)
No (≤14 ng/L)	1 (1.7)
hs-cTnT at 24h	
Yes (>14 ng/L)	59 (98.7)
No (≤14 ng/L)	1 (1.7)

At both the time of ICU admission and 24 hours post-admission, the vast majority of patients exhibited elevated hs-cTnT levels (>14 ng/L), accounting for 98.3% of the study population. Only one patient (1.7%) had hs-cTnT levels within the normal range at both time points.

3.3. Prognostic Performance of hs-cTnT in Predicting Mortality

Table 6: Prognostic Performance of hs-cTnT in Predicting Mortality

Parameter	AUC	95% CI	Cutoff Value (ng/L)	Sensitivity (%)	Specificity (%)	NPV (%)	PPV (%)
hs-cTnT at 0h (ICU admission)	0.57	0.42 - 0.73	40	81.1	39.1	56.0	68.2
hs-cTnT at 24h	0.69	0.55 - 0.84	43	94.6	43.5	83.3	72.9
Δ hs-cTnT	0.77	0.65 - 0.90	10	78.4	78.3	69.2	85.3

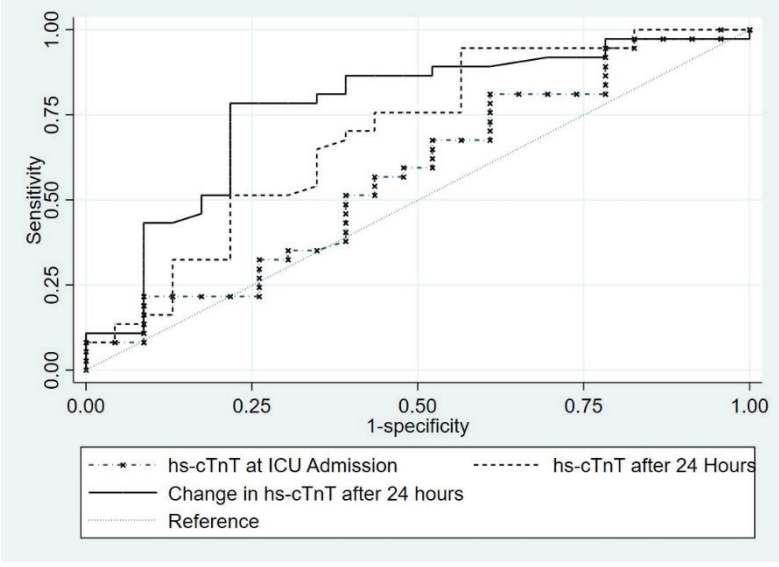

Figure 2: ROC curves for hs-cTnT

The prognostic performance of hs-cTnT in predicting 28-day mortality varies across different time points. The hs-cTnT level at 0h has a relatively low AUC of 0.57 (95% CI: 0.42–0.73), indicating limited predictive accuracy. The hs-cTnT at 24 hours shows an improved AUC of 0.69 (95% CI: 0.55–0.84), with a cutoff value of 43 ng/L, a sensitivity of 94.6%, and a specificity of 43.5%. The **Δ** hs-cTnT levels demonstrates the highest prognostic value, with an AUC of 0.77 (95% CI: 0.65–0.90), a cutoff value of 10 ng/L, a sensitivity of 78.4%, a specificity of 78.3%, a negative predictive value (NPV) of 69.2%, and a positive predictive value (PPV) of 85.3%.

4. DISCUSSION

4.1. Patient Characteristics

Our study found that patients with sepsis had a median age of 73 years, with an equal gender distribution. A study by Vũ Đình Chánh at Thong Nhat Hospital reported similar findings, with a median age of 74.8 years, 51.1% male, and 48.9% female [8]. In contrast, Trần Xuân Chương's study at Hue Central Hospital observed a lower median age of 58.3 years [3]. This discrepancy may be due to differences in sampling criteria, with our study including patients aged 18 years and older, while the latter included those aged 15 years and older. Additionally, Thong Nhat Hospital specializes in geriatric care, which may contribute to the higher proportion of elderly patients.

Hypertension and type 2 diabetes mellitus were the most common comorbidities, affecting 46.7% and 38.3% of patients, respectively. A nationwide study in South Korea also identified hypertension 46.7% as the most prevalent comorbidity, followed by diabetes mellitus 23.6% [9] . These findings suggest that sepsis patients frequently present with underlying cardiovascular and metabolic conditions, which may influence disease severity and prognosis.

The respiratory tract was the most common primary infection site, accounting for 63.3% of cases, followed by the urinary tract 13.3%. Similar findings were reported by Đỗ Ngọc Sơn, with 56.7% of infections originating from the respiratory system and 24.2% from the urinary tract [10].

The median SOFA score was 9, and the median APACHE II score was 27, indicating a high severity of illness. These values were higher than those reported by Đỗ Ngọc Sơn, but comparable to Phạm Thị Ngọc Thảo's study at Cho Ray Hospital [11]. This suggests that elderly sepsis patients, who often have multiple comorbidities, tend to present with more severe illness compared to younger cohorts.

The median hs-cTnT level at ICU admission was 115 ng/L. Studies by Helge Røsjø and S. Lorstad have shown that hs-cTnT levels in sepsis vary widely, depending on sampling time and the extent of myocardial injury [12] [13] . This highlights the importance of appropriate timing for hs-cTnT measurement to ensure accuracy in risk stratification and prognosis assessment.

In our study, the 28-day mortality rate was 61.7%, which is higher than reported in other studies from Vietnam, such as Lâm Kim Bảo 46.2% [14] and Đặng Thanh Bình 41.9% [15]. This reflects the severity of the patient population, with 63.8% requiring invasive mechanical ventilation and 13.3% undergoing renal replacement therapy. Although early resuscitation interventions, including mechanical ventilation and dialysis, are essential in sepsis management, they are often associated with high mortality rates, particularly in critically ill patients.

4.2. Proportion of Patients with Elevated hs-cTnT

Our study found that 98% of sepsis patients exhibited elevated hs-cTnT levels (>14 ng/L) at both time points within the first 24 hours of ICU admission. This is consistent with findings by Helge Røsjø and S. Lorstad, who reported hs-cTnT elevation in 80–90% of sepsis patients within the first 48 hours [12] [13]. Sepsis-induced troponin elevation is thought to result from mechanisms distinct from acute myocardial infarction. Unlike ischemic injury due to coronary artery occlusion, sepsis-associated myocardial injury is primarily linked to microvascular dysfunction, leading to impaired coronary circulation and myocardial cell damage without overt infarction. Furthermore, bacterial endotoxins and inflammatory cytokines have been implicated in direct cytotoxic effects on cardiomyocytes, causing troponin release independently of ischemic mechanisms [16]. Given that hs-cTnT elevation is observed in the vast majority of sepsis patients within the first 24–48 hours, it holds promise as a valuable biomarker for sepsis management and risk stratification.

4.3. Prognostic Performance of hs-cTnT in Predicting Mortality

Our study evaluated the prognostic performance of hs-cTnT in predicting 28-day mortality based on its measurement at ICU admission, after 24 hours, and the Δ hs-cTnT over 24 hours. The AUC for hs-cTnT at ICU admission was 0.574, only slightly above 0.5, indicating limited short-term prognostic value. Although elevated hs-cTnT at admission may reflect disease severity, it is not a strong independent predictor of 28-day mortality. The AUC for hs-cTnT after 24 hours was 0.691, with a cutoff value of 43 ng/L, yielding a sensitivity of 94.6% and a specificity of 43.5%, demonstrating a better prognostic ability compared to the baseline measurement. Notably, Δ hs-cTnT over 24 hours showed the highest predictive value, with an AUC of 0.768, a cutoff value of 10 ng/L, a sensitivity of 78.4%, and a specificity of 65.2%. These results suggest that hs-cTnT dynamics within the first 24 hours provide a superior prognostic indicator compared to single-timepoint measurements. A significant increase in hs-cTnT within 24 hours may indicate myocardial injury associated with sepsis and correlate with poor clinical outcomes. This finding highlights the importance of monitoring hs-cTnT changes over time rather than relying solely on a single measurement for mortality prediction.

A study by Phạm Hải Đăng reported a 28-day mortality AUC of 0.65 for hs-cTnT over 24 hours, with a cutoff value of 35.5 ng/L, a sensitivity of 84.6%, and a specificity of 42%, indicating that hs-cTnT is highly sensitive in detecting mortality risk, though its specificity remains limited [17]. Similarly, Wen KL's study identified hs-cTnT as a significant predictor of 28-day mortality, with an AUC of 0.767, a sensitivity of 62.5%, and a specificity of 79.9% [18]. However, this was a retrospective study, in which the highest hs-cTnT value during hospitalization was used for analysis, potentially inflating its prognostic value while failing to accurately represent admission status.

Overall, Clinical scoring systems like SOFA and APACHE-II are widely used for sepsis prognostication but may not fully capture sepsis-related myocardial injury. In contrast, hs-cTnT directly assesses cardiac dysfunction, a key determinant of sepsis mortality [6]. Unlike static scores, serial

hs-cTnT measurements track dynamic myocardial stress, offering insights into disease progression and improving risk stratification. However, hs-cTnT has limitations in mortality prediction. Unlike SOFA and APACHE-II, it focuses on myocardial stress rather than multi-organ dysfunction, making it less comprehensive. Elevated hs-cTnT levels may also be influenced by non-cardiac factors, reducing specificity. The absence of universally accepted cutoff values complicates clinical application. Despite its strengths, this study has certain limitations. The sample size is relatively small, which may limit the generalizability of the findings. Additionally, the timing of hs-cTnT sampling at fixed time points may not fully reflect the entire dynamic changes of hs-cTnT during the treatment of sepsis.

5. CONCLUSION

This study evaluated the prevalence of hs-cTnT elevation in sepsis patients and assessed its prognostic significance for 28-day mortality. The findings demonstrate that hs-cTnT levels were elevated in 98.3% of patients at both ICU admission and 24 hours post-admission, highlighting its high prevalence in sepsis-related myocardial injury.

In terms of prognostic value, dynamic changes in hs-cTnT over 24 hours exhibited superior predictive accuracy for mortality compared to single-timepoint measurements. The AUC for hs-cTnT at admission was relatively low (0.574), indicating limited early prognostic utility. However, the AUC for hs-cTnT at 24 hours improved to 0.691, with a cutoff value of 43 ng/L, demonstrating high sensitivity (94.6%) but low specificity (43.5%). Notably, the absolute change in hs-cTnT over 24 hours showed the strongest predictive performance, with an AUC of 0.768, a cutoff of 10 ng/L, and balanced sensitivity (78.4%) and specificity (78.3%).

These findings suggest that serial hs-cTnT monitoring provides a more accurate prognostic tool than a single measurement, emphasizing the importance of dynamic assessment in risk stratification for critically ill sepsis patients. Future studies with larger, multicenter cohorts are needed to further validate these results and optimize the use of hs-cTnT kinetics in guiding clinical decision-making.

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