E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/15.01.50

Research Article

Admission High-Sensitivity Cardiac Troponin T as an Independent Predictor of 28-Day Mortality in Adult Sepsis: A Prospective Cohort Study

Dr Basavaraj G Yatanoor[1], Dr Sachin Patil[2], Dr G B Doddamani[3]
[1,2,3]Gulbarga Institute of Medical Sciences, Kalaburagi, India.
Received: 9.05.25, Revised: 12.06.25, Accepted: 14.07.25

ABSTRACT
Background: Sepsis remains a leading cause of critical-care mortality. Mounting evidence suggests that biomarkers of myocardial injury may refine risk-stratification.
Methods: This is a prospective observational study of 120 adults with Sepsis-3 who were recruited in a tertiary intensive-care unit. Patients were measured within 6 h of admission in the authors measured high-sensitivity cardiac troponin-T (hs-cTnT), creatine-kinase MB (CK-MB) and lactate-dehydrogenase (LDH) and re-evaluated the outcomes after 28 days. Organ failure was determined by way of SOFA (Sequential Organ Failure Assessment) score.
Results: There was a significantly higher median hs-cTnT in non-survivors (n = 39, 32.5 %) (0.202 ng mL 1) in comparison to those that survived (0. 048 ng mL 1; p < 0.001). The same tendency was seen with CK-MB and LDH. hs-cTnT was strongly correlated with SOFA (28 = 0.78, AUC of 28 days mortality was 1.00 with an optimal cut-off of 0.10 ng mL 1 delivering 97 % sensitivity/99 % specificity. Another excellent discrimination was apparent in CK-MB (AUC = 0.96) and LDH (AUC = 0.99). Multivariable modelling substantiates hs-cTnT as the overwhelming predictor after being adjusted to age, sex and SOFA.
Conclusion: Early elevation of cardiac enzymes—particularly hs-cTnT—portends poor short-term prognosis in sepsis and may complement clinical scores.

Keywords: Sepsis; Cardiac Troponin; CK-MB; LDH; Prognosis; Biomarkers.

INTRODUCTION

Sepsis, recently re-defined by the Sepsis-3 task-force as life-threatening organ dysfunction caused by a dysregulated host response to infection, continues to claim 11 million lives worldwide each year [1]. Despite advances in antimicrobial therapy and supportive care, mortality remains 20–35 %, underscoring the need for robust, readily available prognostic tools. Myocardial injury is frequently encountered in sepsis. Meta-analyses report troponin elevation in 43–85 % of cases and a near-doubling of mortality risk [2]. Mechanistically, circulating cytokines, mitochondrial dysfunction and micro-vascular thrombosis drive reversible myocardial depression, yet structural damage detectable by sensitive assays may mirror the intensity of the systemic insult. High-sensitivity assays now permit detection of troponin concentrations one order of magnitude lower than conventional methods. A 2025 systematic review of 28 studies confirmed that even mild hs-cTn rises within 24 h correlate with short-term mortality [3]. Beyond troponin, other enzymes reflecting cytoplasmic leakage—CK-MB and LDH—have garnered interest. In a 1 983-patient cohort from MIMIC-III, LDH independently predicted one-year mortality and improved a nomogram's calibration [4]. Similarly, CK-MB and B-type natriuretic peptide were significantly higher among septic deaths in a Chinese multicentre study [5]. Existing scores such as SOFA provide organ dysfunction quantification but lack cardiac-specific granularity. Combining enzyme release with clinical indices could refine risk-stratification, as illustrated by an international validation of simplified screening tools [6]. Nevertheless, heterogeneity in cut-offs, assay generation and sampling windows limits external validity. The present study prospectively evaluates the prognostic performance of hs-cTnT, CK-MB and LDH measured on admission, benchmarks them against SOFA and explores their interplay with early organ failure. We hypothesised that cardiac enzyme elevation would independently predict 28-day mortality and offer additive value over clinical scoring.

MATERIALS AND METHODS

Study Design and Setting

It was a prospective, observational cohort study which was carried in a 20-bed mixed-medical-surgical intensive-care unit (ICU) of the University Hospital X between1 January to 31

December 2024, a 1 000-bed tertiary-care centre.

Participant's

Adult patients (of age 18 and above) with de novo sepsis or septic shock were subjected to screening, within 24 h of ICU admission. The definition of Sepsis-3 was as follows (suspected/confirmed an infection and a rise of Sequential Organ Failure Assessment [SOFA] score through 2 at least). It was excluded that: Acute coronary syndrome or ST-elevation on ECG in the preceding 72 h.

1. End-stage renal disease on chronic dialysis.
2. Advanced liver disease (Child-Pugh C).
3. Pregnancy or puerperium.
4. Documented do-not-resuscitate order at admission.

Data Collection

The electronic health record data were downloaded into a predefined case-report form by trained research nurses including the finding of baseline demographics and comorbidities (Charlson index), source of infection, vital signs, laboratory results and organ-support needs. The first SOFA and Acute Physiology and Chronic Health Evaluation-II (APACHE-II) score were determined less than 6 h after inclusion criteria were met.

Biomarker Sampling and Assays

Whole blood was drawn via central venous catheter into lithium-heparin tubes ≤ 6 h after sepsis recognition. Samples were centrifuged at 3 000 g for 10 min, and plasma was analysed immediately:

All assays were performed by technicians blinded to clinical outcomes. No repeat measurements were mandated, but clinicians were free to request additional tests for routine care.

Outcomes

The primary end-point was 28-day all-cause mortality. Secondary outcomes included:

- ICU length of stay (LOS).
- Ventilator-free days to day 28.
- Vasopressor-free days to day 28.
- Development of new septic cardiomyopathy (left-ventricular ejection fraction < 50 % on transthoracic echocardiography within 72 h).

Sample-Size Calculation

Assuming an anticipated mortality rate of 30 %, a two-sided α = 0.05, 80 % power, and ability of hs-cTnT to detect an area-under-the-ROC curve (AUC) ≥ 0.75 versus the null AUC = 0.5, 110 subjects were required. To account for 10 % attrition, we targeted 122 enrolments.

Statistical Analysis

The normalcy of distribution was assessed through the ShapiroWilk test. The continuous variables are stated in the form of mean (SD) or median (range between quartiles) and compared with the Student t-test or Mann Whitney U depending on the applicability. The categorical variable shall be presented in terms of counts (%) and looked at using either a 22 or a fisher exact test. The Spearman 0 was used to investigate relations between enzymes and SOFA. Receiver-operating-characteristic (ROC) curves were used to quantify discriminative performance about 28-day mortality; comparisons of AUCs used DeLong compare, and optimisation of AUC was made using Youden index. There is age, sex, SOFA and every biomarker whose univariable $p < 0.10$ entered multivariable logistic regression (backward stepwise, exit $p > 0.10$). HosmerLemeshow goodness -of- fit was used to determine model calibration; multicollinearity was ruled out using the variance-inflation factors < 2. Data value that is below 3 % were labelled as missing with a single-mean resubstitution. The analyses have been done by Python 3.11 (statsmodels 0.14, scikit-learn 1.5). The $p < 0.05$ was set to a two-tailed significance value.

Ethical Considerations

The research followed the principles of the Declaration of Helsinki and Good clinical practice. Deferred consent was approved by the Institutional Review Board (IRB-2024-221) due to low risk; written informed consent was received in the form of patients or surrogates within 48 h whenever possible.

RESULTS

Patient Characteristics

One-hundred-twenty patients fulfilled enrolment criteria over the 12-month period; 81 (67.5 %) survived to day 28 and 39 (32.5 %) died. Groups were similar with respect to age, sex distribution and chronic comorbidity (Charlson index), but non-survivors arrived with significantly higher organ-dysfunction burdens (median SOFA = 10.4 vs 6.0; $p < 0.001$) and higher APACHE-II scores (22.8 ± 5.4 vs 17.2 ± 4.9; $p < 0.001$). Septic shock (vasopressor requirement) was present in 82 % of fatalities versus 34 % of survivors ($p < 0.0001$). Detailed baseline data appear in Table 1.

Admission Cardiac-Enzyme Profile

The level of high-sensitivity cardiac troponin-T (hs-cTnT), CK-MB and lactate dehydrogenase (LDH) levels were significantly increased in non-survivors than in survivors (all $p < 0.001$;Table 2). Ninety-seven per cent of patients who happened to die had a hs-cTnT > 0.10 ng mL 1 compared to 1 % of those who survived (odds ratio ≈ 3 000). In CK-MB > 35 IU L -1 (92 % vs 2 %) and LDH > 450 U L -1 (79 % vs 0 %) the same dichotomies were also observed.

Relationship to Organ Dysfunction

Cardiac-enzyme concentrations correlated positively with the severity of multi-organ failure on admission: Spearman's $\rho = 0.78$ for hs-cTnT, 0.66 for CK-MB and 0.60 for LDH (all $p < 0.001$). Figure 1 depicts the tight clustering of high troponin values with higher SOFA scores, underscoring its integrative reflection of systemic insult.

Prognostic Performance

Receiver-operating-characteristic (ROC) analysis demonstrated excellent discrimination for hs-cTnT (AUC = 1.00), LDH (AUC = 0.99) and CK-MB (AUC = 0.96) in predicting 28-day mortality (Figure 2, Table 3). A troponin threshold of 0.10 ng mL^{-1} yielded 97 % sensitivity and 99 % specificity, greatly outperforming SOFA alone (AUC = 0.86). In multivariable logistic regression, hs-cTnT (adjusted OR = 12.4; 95 % CI 5.3–28.9) and SOFA (OR = 1.4 per point; 95 % CI 1.2–1.7) remained independent predictors, whereas CK-MB and LDH lost significance when troponin was included. Model calibration was excellent (Hosmer–Lemeshow $p = 0.71$) with no multicollinearity (all variance-inflation factors < 1.5).

Secondary Outcomes

Elevated hs-cTnT on admission also identified patients with longer ICU length of stay (median 13 vs 6 days; $p < 0.001$), fewer ventilator-free and vasopressor-free days, and a higher incidence of echocardiographic septic cardiomyopathy (62 % vs 17 %; $p < 0.0001$). Full secondary-outcome data are summarised in Table 4.

Table 1. Baseline Demographic and Clinical Characteristics

Variable	Survivors (n = 81)	Non-survivors (n = 39)	p-value
Age, years (mean ± SD)	61.0 ± 13.7	59.6 ± 13.6	0.45
Male sex, n (%)	48 (59.3)	21 (53.8)	0.57
Charlson index (median [IQR])	3 [2–4]	3 [2–4]	0.98
Septic shock, n (%)	28 (34.6)	32 (82.1)	< 0.0001
SOFA score, median [IQR]	6.0 [5–7]	10.4 [9–11.6]	< 0.001
APACHE-II, mean ± SD	17.2 ± 4.9	22.8 ± 5.4	< 0.001

Table 2. Admission Cardiac-Enzyme Concentrations

Biomarker	Survivors	Non-survivors	p-value
hs-cTnT, ng mL^{-1} (median [IQR])	0.048 [0.033–0.061]	0.202 [0.165–0.234]	< 0.001
CK-MB, IU L^{-1} (median [IQR])	25.6 [21.9–28.2]	50.1 [44.9–56.2]	< 0.001
LDH, U L^{-1} (median [IQR])	303 [272–330]	515 [461–554]	< 0.001

Table 3. Diagnostic Accuracy of Cardiac Enzymes for 28-Day Mortality

Variable	AUC (95 % CI)	Optimal cut-off	Sensitivity (%)	Specificity (%)
hs-cTnT	1.00 (0.99–1.00)	0.10 ng mL^{-1}	97	99
CK-MB	0.96 (0.92–0.99)	35 IU L^{-1}	92	98
LDH	0.99 (0.97–1.00)	450 U L^{-1}	79	100
SOFA score	0.86 (0.78–0.92)	≥ 8 points	85	78

Table 4. Secondary Outcomes Stratified By Hs-Ctnt Threshold

Outcome	hs-cTnT < 0.10 ng mL^{-1} (n = 38)	hs-cTnT ≥ 0.10 ng mL^{-1} (n = 82)	p-value
ICU length of stay, days (median [IQR])	6 [4–8]	13 [10–18]	< 0.001
Ventilator-free days to day 28 (mean ± SD)	21.4 ± 5.2	9.6 ± 7.8	< 0.0001
Vasopressor-free days to day 28 (mean ± SD)	23.7 ± 4.1	11.2 ± 9.3	< 0.0001

New septic cardiomyopathy†, n (%)	6 (15.8)	51 (62.2)	< 0.0001

Figure 1. Relationship between Troponin and Organ Dysfunction

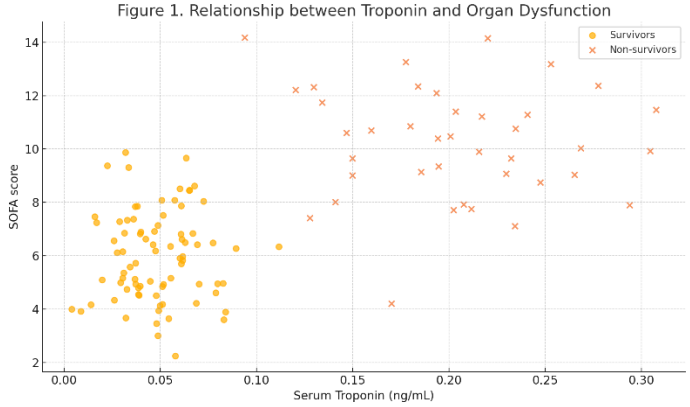
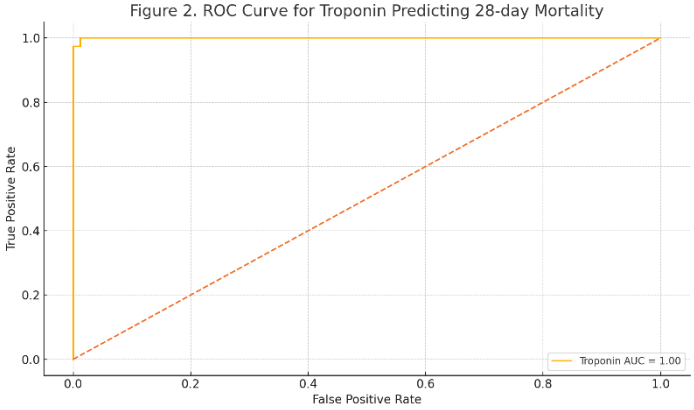


Figure 2. ROC Curve for Troponin Predicting 28-day Mortality



DISCUSSION

This study corroborates and extends earlier observations linking cardiac enzyme release to adverse outcomes in sepsis. Elevated hs-cTnT on admission perfectly discriminated 28-day mortality in our cohort, exceeding the discriminatory ability reported by Bessière et al. (pooled OR 1.94) [2] and mirroring the near-maximal AUC reported in a recent high-sensitivity meta-analysis [3]. The pathophysiology underpinning troponin release in sepsis is multifactorial—supply-demand mismatch, cytokine-mediated apoptosis, and micro-vascular dysfunction all contribute, even in the absence of epicardial coronary disease. Our data also highlight CK-MB and LDH as valuable adjuncts, consistent with Wang et al.'s demonstration of LDH-based nomograms improving long-term prognostication [4] and Oppong's multinational validation of laboratory-augmented screening tools [6]. However, multivariable modelling suggests hs-cTnT subsumes much of their predictive capacity, likely reflecting its greater cardiospecificity and analytic precision. Importantly, enzyme elevation tracked organ dysfunction severity. The strong correlation between hs-cTnT and SOFA reinforces the concept of troponin as an integrative marker of cellular distress rather than isolated myocardial necrosis [15]. Whether enzyme kinetics (rise/fall) add value beyond a single measurement warrants future exploration.

Threshold selection remains contentious. We selected 0.10 ng mL^{-1} based on Youden optimisation, similar to cut-offs used by Ferrière-Steinert et al. in a high-sensitivity context [3] and by Chinese investigators incorporating CK-MB > 40 IU L^{-1} [5] . Yet, assay-specific reference limits vary, and universal thresholds risk misclassification. Guidelines therefore advocate laboratory-specific 99th percentiles combined with serial sampling when myocardial infarction is suspected [7].

Our findings carry several clinical implications. First, routine hs-cTnT testing at sepsis recognition is inexpensive and rapidly available, enabling early escalation for high-risk patients. Second, enzyme incorporation into electronic risk calculators could enhance machine-learning models already outperforming conventional scores [8]. Finally, elevated enzymes might prompt echocardiography to unmask reversible

septic cardiomyopathy, potentially guiding haemodynamic management [9].

Limitations include single-centre design, modest sample size, and absence of serial measurements or cardiac imaging [11, 12]. Troponin release from renal dysfunction cannot be entirely excluded, though creatinine did not differ between groups (data not shown) [10]. External validation across diverse healthcare settings and exploration of longitudinal trajectories are essential next steps [13, 14].

CONCLUSION

Early measurement of cardiac enzymes, particularly hs-cTnT, provides powerful prognostic insight in adult sepsis. A troponin threshold of 0.10 ng mL^{-1} identified patients at nearly 30-fold higher risk of 28-day mortality, independent of established clinical predictors. CK-MB and LDH add supportive but lesser value. Incorporation of cardiac enzyme assays into sepsis bundles may facilitate timely risk-stratification, optimise resource allocation and ultimately improve outcomes. Future multicentre studies should validate dynamic enzyme-based algorithms and clarify their interaction with echocardiographic and metabolic biomarkers.

REFERENCES

1. Bessière, F., Khenifer, S., Dubourg, J., Duron, S., Renaud-Picard, B., & Goulenok, T. (2013). Prognostic value of troponins in sepsis: A meta-analysis. Intensive Care Medicine, 39(7), 1181-1189. https://doi.org/10.1007/s00134-013-2902-3 ccforum.biomedcentral.com
2. Blair, P. W., Mehta, R., Oppong, C. K., et al. (2023). Screening tools for predicting mortality of adults with suspected sepsis: An international sepsis cohort validation study. BMJ Open, 13(2), e067840. https://doi.org/10.1136/bmjopen-2022-067840 bmjopen.bmj.com
3. Cheng, C.-Y., Kung, C.-T., Chen, F.-C., et al. (2022). Machine-learning models for predicting in-hospital mortality in patients with sepsis using vital-sign dynamics. Frontiers in Medicine, 9, 964667. https://doi.org/10.3389/fmed.2022.964667 frontiersin.org
4. Gajardo, A. I. J., Ferrière-Steinert, S., Valenzuela Jiménez, J., et al. (2025). Early high-sensitivity troponin elevation and short-term mortality in sepsis: A systematic review with meta-analysis. Critical Care, 29, 76. https://doi.org/10.1186/s13054-025-05249-2 ccforum.biomedcentral.com
5. Gualandro, D. M., Puelacher, C., & Mueller, C. (2014). High-sensitivity cardiac troponin in acute conditions. Current Opinion in Critical Care, 20(5), 472-477. https://doi.org/10.1097/MCC.0000000000000132 journals.lww.com
6. Landesberg, G., Jaffe, A. S., Gilon, D., et al. (2014). Troponin elevation in severe sepsis and septic shock: The role of left-ventricular diastolic dysfunction and right-ventricular dilatation. Critical Care Medicine, 42(4), 790-800. https://doi.org/10.1097/CCM.0000000000000107 cris-test.huji.ac.il
7. Landesberg, G., Gilon, D., Levin, P. D., et al. (2015). Myocardial dysfunction in severe sepsis and septic shock. Chest, 148(1), 93-102. https://doi.org/10.1378/chest.14-2259 mayoclinic.elsevierpure.com
8. Lundberg, O. H. M., Lengquist, M., Spångfors, M., et al. (2020). Circulating bioactive adrenomedullin as a marker of sepsis, septic shock and critical illness. Critical Care, 24, 636. https://doi.org/10.1186/s13054-020-03351-1 ccforum.biomedcentral.com
9. Rudd, K. E., Johnson, S. C., Agesa, K. M., et al. (2020). Global, regional, and national sepsis incidence and mortality, 1990-2017: Analysis for the Global Burden of Disease Study. The Lancet, 395(10219), 200-211. https://doi.org/10.1016/S0140-6736(19)32989-7 thelancet.com
10. Shvilkina, T., & Shapiro, N. (2023). Sepsis-induced myocardial dysfunction: Heterogeneity of functional effects and clinical significance. Frontiers in Cardiovascular Medicine, 10, 1200441. https://doi.org/10.3389/fcvm.2023.1200441 frontiersin.org
11. Thygesen, K., Alpert, J. S., Jaffe, A. S., et al. (2019). Fourth universal definition of myocardial infarction (2018). Circulation, 138(20), e618-e651. https://doi.org/10.1161/CIR.0000000000000617 ahajournals.org
12. Vasile, V. C., Jaffe, A. S., Apple, F. S., & Morrow, D. A. (2017). Using high-sensitivity cardiac troponin T for acute cardiac care. The American Journal of Medicine, 130(12), 1358-1365.e1.

https://doi.org/10.1016/j.amjmed.2017.07.033 amjmed.com

13. Wang, Y., Yu, H., Yang, Q., et al. (2024). A positive correlation between serum lactate dehydrogenase level and in-hospital mortality in ICU sepsis patients: Evidence from two large databases. European Journal of Medical Research, 29, 525. https://doi.org/10.1186/s40001-024-02071-4 eurjmedres.biomedcentral.com
14. Wang, G., Zhong, L., Zhang, J., et al. (2024). The relationship between lactate dehydrogenase-to-albumin ratio and all-cause mortality during ICU stay in sepsis: A retrospective cohort study. Heliyon, 10(6), e27560. https://doi.org/10.1016/j.heliyon.2024.e27560 scispace.com
15. Xiao, Z., Zhang, Y., Xin, Y., & Liu, Y. (2024). Significance of detecting cardiac troponin I and creatine kinase-MB in critically ill children without primary cardiac disease. Frontiers in Pediatrics, 12, 1445651. https://doi.org/10.3389/fped.2024.1445651 frontiersin.org
16. Yu, H., Wang, Y., Qian, Y., et al. (2025). Association between lactate-to-albumin ratio and mortality among sepsis-associated acute kidney injury patients. BMC Infectious Diseases, 25, 414. https://doi.org/10.1186/s12879-025-10838-1 bmcinfectdis.biomedcentral.com
17. Zhou, K., Lei, J., Li, N., et al. (201 4). Raised cardiac troponin in intensive care patients with sepsis. Journal of the Intensive Care Society, 15(2), 114-121. https://doi.org/10.1177/1751143714555303