Section: General Medicine

Original Research Article

ASSOCIATION OF ADMISSION FREE TRIIODOTHYRONINE (FT3) WITH IN-HOSPITAL MORTALITY IN ICU-ADMITTED HEART FAILURE PATIENTS: A CROSS-SECTIONAL STUDY

Praveen Kumar[1], Gattu Varun Reddy[2], Yashaswi V[2], Vagesh Kumar[3]

[1]*Senior Resident, Department of General Medicine, Basaveshwar Medical College and Hospital, Chitradurga, Karnataka, India.*
[2]*Junior Resident, Department of General Medicine, Basaveshwar Medical College and Hospital, Chitradurga, Karnataka, India.*
[2]*Junior Resident Department of Pathology, Basaveshwar Medical College and hospital, Chitradurga Karnataka India.*
[3]*Professor and Head, Department of General Medicine, Basaveshwar Medical College and Hospital, Chitradurga, Karnataka, India.*

Received *: 02/09/2026*
Received in revised form *: 26/09/2026*
Accepted *: 10/10/2026*

Corresponding Author:
Dr. Gattu Varun Reddy,
Junior Resident, Department of General Medicine, Basaveshwar Medical College and Hospital, Chitradurga, Karnataka, India.
Email: varunreddygattu@gmail.com

DOI: 10.70034/ijmedph.2026.4.146

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (4); 965-968

ABSTRACT

Background: Objectives: To evaluate the association of admission serum FT3 with in-hospital mortality among ICU-admitted heart failure patients and to assess its relationship with ejection fraction, NT-proBNP, and duration of hospital stay.

Materials and Methods: This cross-sectional study included 80 consecutive ICU-admitted heart failure patients over one year at Basaveshwar Medical College and Hospital, Chitradurga. Serum FT3, ejection fraction (EF%), NT-proBNP and duration of hospital stay were recorded at admission and compared between survivors and non-survivors using the independent-samples t-test, chi-square test, and Pearson correlation.

Results: Mean FT3 was significantly lower among non-survivors (2.38 ± 0.60 pg/mL) than survivors (3.12 ± 0.78 pg/mL; t=4.73, p<0.0001). Patients with low FT3 (<2.3 pg/mL) had markedly higher mortality (73.9%, 17/23) than those with FT3 ≥2.3 pg/mL (24.6%, 14/57; χ^2=14.80, p=0.0001). FT3 correlated inversely with mortality (r=−0.45, p<0.0001), a stronger correlation than that observed for NT-proBNP (r=0.41) or ejection fraction (r=−0.40) in the same cohort, and the AUC for FT3 predicting in-hospital death was 0.77.

Conclusion: Low serum FT3 at admission was strongly associated with in-hospital mortality among critically ill heart failure patients, suggesting that low T3 syndrome may serve as a simple, inexpensive adjunct prognostic marker for risk stratification in the ICU setting.

Keywords: Heart failure, low T3 syndrome, free triiodothyronine, non-thyroidal illness syndrome, prognosis, intensive care unit, cross-sectional study.

INTRODUCTION

This hospital-based observational cross-sectional study included 80 consecutive ICU-admitted heart failure patients over one year at Basaveshwar Medical College and Hospital, Chitradurga. Admission serum FT3, ejection fraction (EF), NT-proBNP, and duration of hospital stay were recorded and compared between survivors and non-survivors using independent-samples t-tests and chi-square tests. Point-biserial/Pearson correlation was used for continuous variables against the binary outcome of death, and exploratory receiver-operating-characteristic (ROC) analysis was performed.

In a large Japanese cohort of hospitalised, euthyroid HF patients, those with low FT3 (<2.3 pg/mL) had significantly higher cardiac and all-cause mortality than those with normal FT3, accompanied by higher central venous pressure, poorer nutritional status, and impaired exercise capacity. Earlier prospective work in 573 patients with a range of cardiac diseases similarly showed low fT3 to be a strong independent predictor of one-year mortality, and combined FT3/NT-proBNP models have been shown to

improve risk prediction for death beyond either marker alone in acute decompensated HF.

However, its prognostic role specifically among ICU-admitted heart failure patients in Indian tertiary care settings — where such patients are often critically ill with multi-organ involvement — is less well characterised. This study was therefore designed to assess the association between admission serum FT3 and in-hospital mortality, ejection fraction, NT-proBNP, and duration of hospital stay among heart failure patients admitted to the ICU of a tertiary care teaching hospital.

Objectives

Results: Mean FT3 was lower among non-survivors than survivors (2.38 ± 0.60 vs 3.12 ± 0.78 pg/mL; t=4.73, p<0.0001). Patients with FT3 <2.3 pg/mL had higher in-hospital mortality than those with FT3 ≥2.3 pg/mL (73.9% vs 24.6%; χ^2=14.80, p=0.0001). FT3 was inversely associated with mortality (r=−0.45, p<0.0001). Exploratory ROC analysis yielded an AUC of 0.77 for FT3; confidence intervals were not reported. FT3 also differed significantly between survivors and non-survivors for hospital stay, although patients who survived had a longer mean hospital stay (11.7 ± 5.9 vs 6.1 ± 7.7 days; p=0.0011).

2. To correlate FT3 with in-hospital mortality, ejection fraction, NT-proBNP, and duration of hospital stay.

Conclusion: Lower admission FT3 was strongly associated with in-hospital mortality in this ICU cohort. FT3 may have value as an adjunctive marker for early risk stratification in critically ill heart failure patients, but prospective studies with appropriate multivariable adjustment are required before it can be considered an independent prognostic marker.

MATERIALS AND METHODS

Hospital-based, observational, cross-sectional study conducted in the Intensive Care Unit of Basaveshwar Medical College and Hospital, Chitradurga, a tertiary care teaching institute, over one year.

Study population

Eighty consecutive patients aged >18 years admitted to the ICU with a clinical and echocardiographic diagnosis of heart failure were enrolled after informed consent.

Inclusion Criteria: ICU-admitted patients with confirmed heart failure (HFrEF or HFmrEF).

Heart failure (HF) is frequently accompanied by alterations in thyroid hormone metabolism, even in the absence of intrinsic thyroid disease. This phenomenon, termed non-thyroidal illness syndrome (NTIS) or low-T3 syndrome, is characterised by reduced peripheral conversion of thyroxine (T4) to the biologically active triiodothyronine (T3), resulting in low serum FT3 with normal or low FT4 and normal or mildly reduced TSH. It may occur during severe systemic illness, including acute decompensated and advanced chronic HF, and has been associated with disease severity and adverse outcomes.

Exclusion Criteria: Known primary thyroid disease, thyroid hormone replacement or antithyroid drug use, pregnancy, and non-consenting patients.

In a large Japanese cohort of hospitalised, euthyroid HF patients, those with low FT3 (<2.3 pg/mL) had higher cardiac and all-cause mortality than those with higher FT3 concentrations. Earlier prospective work in patients with cardiac disease also reported an association between low FT3 and mortality, and studies have explored combinations of FT3 and natriuretic peptides for risk stratification.[4-6]

However, the prognostic role of admission FT3 specifically among ICU-admitted heart failure patients in Indian tertiary-care settings is less well characterised. This study therefore assessed the association between admission serum FT3 and in-hospital mortality, ejection fraction, NT-proBNP, and duration of hospital stay among heart failure patients admitted to the ICU of a tertiary-care teaching hospital.

Statistical analysis

Data were entered in Microsoft Excel and analysed using SPSS (version 25 or later) / equivalent statistical software. Continuous variables (mean ± SD) were compared between survivors and non-survivors using the independent-samples t-test; categorical variables were compared using the chi-square test. Pearson correlation assessed the association between FT3 and other continuous variables. A two-tailed p-value <0.05 was considered statistically significant.

1. To measure serum FT3 levels among ICU-admitted heart failure patients at admission.
2. To assess the association of FT3 with in-hospital mortality, ejection fraction, NT-proBNP, and duration of hospital stay.
3. To evaluate the exploratory discriminatory performance of admission FT3 for in-hospital mortality.

Eighty ICU-admitted heart failure patients were studied; mean age was 52.6 ± 11.9 years, with 58 males (72.5%) and 22 females (27.5%). Overall in-hospital mortality was 38.8% (31/80). Mean serum FT3 for the entire cohort was 2.83 pg/mL.

RESULTS

Table 1: Comparison of parameters between survivors and non-survivors

Parameter	Survivors (n=49)	Non-survivors (n=31)	t	p-value
FT3 (pg/mL)	3.12 ± 0.78	2.38 ± 0.60	4.73	<0.0001*
NT-proBNP (pg/mL)	3127.8 ± 2118.5	5239.4 ± 2568.4	3.83	0.0003*
Ejection fraction (%)	36.9 ± 5.6	31.9 ± 5.4	3.91	0.0002*
Hospital stay (days)	11.7 ± 5.9	6.1 ± 7.7	3.46	0.0011*

A hospital-based, observational cross-sectional study was conducted in the Intensive Care Unit of Basaveshwar Medical College and Hospital, Chitradurga, Karnataka, India, a tertiary-care teaching institute, over one year.

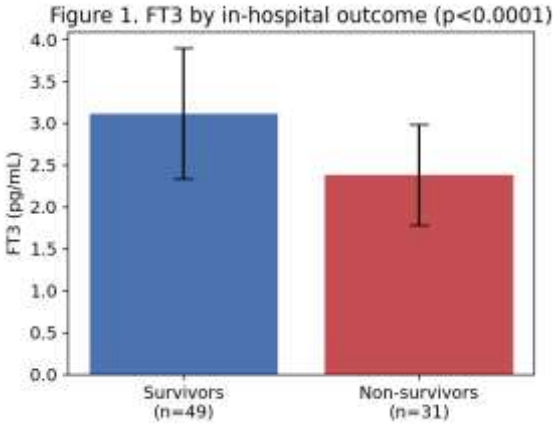


Figure 1: Mean FT3 (± SD) among survivors versus non-survivors (t=4.73, p<0.0001)

Table 2: Eighty consecutive patients aged >18 years admitted to the ICU with a clinical and echocardiographic diagnosis of heart failure were enrolled after informed consent. Patients were selected consecutively from eligible ICU admissions during the study period

FT3 category	n	Deaths (%)	χ^2	p-value
Low FT3 (<2.3 pg/mL)	23	17 (73.9%)	14.80	0.0001*
Normal/higher FT3 (≥2.3 pg/mL)	57	14 (24.6%)	—	—

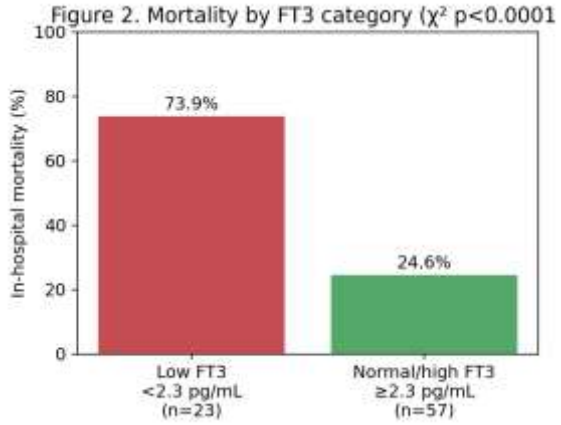


Figure 2: In-hospital mortality according to FT3 category (χ^2=14.80, p=0.0001)

FT3 correlated inversely with mortality (r=−0.45, p<0.0001) — a correlation of comparable or greater strength than ejection fraction (r=−0.40, p=0.0002) and NT-proBNP (r=0.41, p=0.0001) with mortality in this cohort. No significant correlation was observed between FT3 and NT-proBNP (r=−0.04) or FT3 and haemoglobin (r=0.03), suggesting that low FT3 reflects a largely independent dimension of illness severity. The AUC for FT3 predicting in-hospital death was 0.77, compared with 0.75 for NT-proBNP and 0.75 for ejection fraction.

Serum free T3 (FT3) was measured at admission along with two-dimensional echocardiographic ejection fraction and serum NT-proBNP, using a structured proforma. Patients were followed until hospital discharge or death, and final in-hospital outcome and duration of stay were recorded.

This cross-sectional study of 80 critically ill heart failure patients demonstrates a strong association between low admission FT3 and in-hospital mortality, with nearly three-fourths of patients with low FT3 dying during hospital stay compared with roughly one-fourth of those with preserved FT3. These findings mirror the large Japanese hospitalised-HF cohort in which patients with FT3 below the same 2.3 pg/mL threshold had significantly higher cardiac and all-cause mortality, accompanied by higher central venous pressure and poorer nutritional and functional status, and are consistent with earlier work identifying low fT3 as a strong, independent predictor of death across a broad range of cardiac diseases.

The prognostic strength of FT3 in the present cohort was comparable to, and in this sample even exceeded, that of NT-proBNP and ejection fraction, echoing reports that combining low T3 syndrome with NT-proBNP improves risk prediction for death in acute decompensated HF beyond either marker alone. Because FT3 estimation is inexpensive and widely available even in resource-limited settings, it may offer practical advantages as an adjunct prognostic tool where advanced biomarker testing is not always feasible.

Data were entered in Microsoft Excel and analysed using SPSS (version 25 or later). Continuous variables are presented as mean ± standard deviation and were compared between survivors and non-survivors using independent-samples t-tests. Categorical variables were compared using the chi-square test. The binary outcome of in-hospital death was coded for correlation analysis; Pearson correlation with a binary outcome is equivalent to a point-biserial correlation. Exploratory ROC analysis

was used to estimate the area under the curve (AUC) for FT3. A two-tailed p-value <0.05 was considered statistically significant. All analyses were unadjusted; no multivariable regression model was performed. Missing-data handling was not performed as a separate analysis.

Limitations

This was a single-centre, cross-sectional study with a modest sample size and no serial thyroid function measurements, limiting assessment of temporal trends. Free T4 and TSH were not analysed alongside FT3, which would have allowed more complete characterisation of low T3 syndrome versus primary thyroid dysfunction. Confounding by comorbidities such as sepsis, chronic kidney disease, and nutritional status was not formally adjusted for.

Low serum FT3 at ICU admission was strongly associated with in-hospital mortality among heart failure patients in this tertiary care cohort, with prognostic strength comparable to established markers. FT3 estimation may serve as a simple, low-cost prognostic marker complementing NT-proBNP and echocardiographic ejection fraction in the risk stratification of critically ill heart failure patients.

CONCLUSION

Data availability statement

The datasets generated and/or analysed during the current study are not publicly available because they contain patient-related information. Appropriately de-identified data may be made available from the corresponding author on reasonable request, subject to institutional and ethical restrictions.

Author contributions

Dr Praveen Kumar, Dr Gattu Varun Reddy, and Dr Yashaswi V contributed to data collection, statistical analysis, interpretation of results, and manuscript preparation. Dr Vagesh Kumar provided study supervision, critically reviewed the manuscript, and approved the final version. All authors approved the final manuscript and agree to be accountable for all aspects of the work.

Conflicts of interest: The authors declare that they have no conflicts of interest.

Funding: This study received no external funding.

Ethics approval and informed consent

Aproved. Written informed consent was obtained from all participants or their legally authorised representatives.

REFERENCES

1. Eighty ICU-admitted heart failure patients were studied; mean age was 52.6 ± 11.9 years, with 58 males (72.5%) and 22 females (27.5%). Overall in-hospital mortality was 38.8% (31/80). Mean serum FT3 for the entire cohort was 2.83 pg/mL. All 80 enrolled participants were included in the analysis.
2. Bozkurt B, Coats AJS, Tsutsui H, Abdelhamid CM, Adamopoulos S, Albert N, et al. Universal definition and classification of heart failure. Eur J Heart Fail. 2021;23(3):352–380.
3. Savarese G, Becher PM, Lund LH, Seferovic P, Rosano GMC, Coats AJS. Global burden of heart failure: a comprehensive and updated review of epidemiology. Cardiovasc Res. 2023;118(17):3272–3287.
4. Sato Y, Yoshihisa A, Kimishima Y, Kiko T, Kanno Y, Yokokawa T, et al. Low T3 syndrome is associated with high mortality in hospitalized patients with heart failure. J Card Fail. 2019;25(3):195–203.
5. Iervasi G, Pingitore A, Landi P, Raciti M, Ripoli A, Scarlattini M, et al. Low-T3 syndrome: a strong prognostic predictor of death in patients with heart disease. Circulation. 2003;107(5):708–713.
6. Wang B, Liu S, Li L, Yao Q, Song R, Shao X, et al. Non-thyroidal illness syndrome in patients with cardiovascular diseases: a systematic review and meta-analysis. Int J Cardiol. 2017;226:1–10.
7. He CJ, Zhu CY, Fan HY, Qian YZ, Zhai CL, Hu HL. Low T3 syndrome predicts more adverse events in patients with hypertrophic cardiomyopathy. Clin Cardiol. 2023;46(10):1234–1241.
8. Pingitore A, Galli E, Barison A, Iervasi A, Scarlattini M, Nucci D, et al. Acute effects of triiodothyronine (T3) replacement therapy in patients with chronic heart failure and low-T3 syndrome: a randomized, placebo-controlled study. J Clin Endocrinol Metab. 2008;93(4):1351–1358.