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WARSAW INTERNATIONAL MEDICAL CONGRESS

ABSTRACT BOOK

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Does Refined Iron Deficiency Classification Improve Risk Prediction in Congestive Heart Failure? A Retrospective Cohort Study

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Introduction

Iron deficiency frequently coexists with congestive heart failure, increasing morbidity and mortality. Although guidelines typically define it as ferritin below 100 ng/mL or 100–299 ng/mL plus transferrin saturation under 20%, exact stratification remains unclear. Intravenous iron therapy shows benefits, yet definitive thresholds for deficiency, adequacy, and hyperferritinemia are lacking.

Aim of the study

This study compares a machine learning–devised model vs. a clinically based model in predicting time-to-event outcomes in CHF, refining stratification beyond current guidelines.

Materials and methods

A retrospective design included adults aged 18–89 with congestive heart failure hospitalized for at least one day, with iron panels obtained within 24 hours of admission. Electronic data were gathered by text-mining and standard record searches. Kolmogorov–Smirnov guided normality checks, and parametric or nonparametric tests were selected accordingly. Kaplan–Meier analysis and Cox regression assessed one-year mortality. The machine learning model ("final category tertile") defined T1 as ferritin below 100 ng/mL or 100–299 ng/mL with transferrin saturation under 20%, T2 as ferritin 100–299 ng/mL with transferrin saturation 20% or higher, and T3 as ferritin above 300 ng/mL. The clinically based ferritin custom tertile model comprised T1: ferritin below 100 ng/mL, T2: ferritin 100–299 ng/mL, and T3: ferritin 300 ng/mL or above. Covariates such as age, shock, malignancy, eGFR, and other factors were included in multivariable models (α=0.05).

Results

Univariate Cox analyses showed stronger hazard separation with the machine learning approach than simpler, guideline-based cutoffs ($p<0.001$). T3 (hyperferritinemia) had a higher mortality risk than T1, with T2 intermediate. Multivariable models upheld the machine learning model's robust discrimination (T3 hazard ratio ≈1.84). Although the ferritin custom tertile was also significant (T3 hazard ratio ≈1.48), slightly lower early sensitivity was noted. Iron supplementation reduced hazard in deficiency strata, highlighting the value of precise categorization.

Conclusions

Refined iron-status stratification appears pivotal for risk assessment in congestive heart failure. The machine learning–based model more clearly identified high-risk subsets than standard cutoffs, distinguishing deficiency, adequacy, and possible overload. Prospective validation may encourage adoption of nuanced models, enhance management strategies, and potentially reduce adverse outcomes.

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