Frailty and Inflammation as Predictors of Mortality in Patients Undergoing Elective Cardiac Surgery

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OBJECTIVE

To investigate whether combining frailty assessment and perioperative inflammatory/nutritional biomarkers with the EuroSCORE improves the prediction of postoperative mortality and severe complications in patients undergoing major elective cardiac surgery.

METHODS

This observational, prospective, single-center study, conducted between (January 5, 2023) and (May 10, 2024) at the Department of Cardiac Surgery, Heart Institute, Pécs, Hungary, enrolled 40 patients undergoing major elective cardiac surgery, coronary artery bypass grafting, valve replacement/repair, or combined procedures. The patients were stratified into three categories (non-frail, pre-frail, and frail). Biomarker sampling was performed preoperatively (baseline) and on postoperative days 1, 2, and 6. The primary endpoint was a composite of in-hospital mortality and postoperative complications, including sepsis, graft occlusion, acute renal failure, and stroke. Logistic regression and random forest classifiers were used to model the primary outcomes.

RESULTS

Frail patients exhibited significantly higher IL-6 and CRP levels and lower IGF-1 levels than non-frail and pre-frail patients. The EuroSCORE alone had limited discriminatory power (AUC = 0.62). The predictive accuracy improved with the addition of EFS (AUC = 0.75), and the random forest model incorporating biomarkers further increased the accuracy (AUC = 0.80). Spearman's correlations showed moderate associations between EFS and IL-6 (r = 0.43), CRP (r = 0.36), and IGF-1 (r = − 0.41).

CONCLUSIONS

Combining frailty assessment, inflammatory/nutritional biomarkers, and traditional surgical risk scoring yields a more accurate prediction of postoperative mortality and complications in patients undergoing cardiac surgery than EuroSCORE alone. Elevated IL-6 and CRP levels, together with reduced IGF-1 concentrations, are closely associated with frailty and adverse outcomes, highlighting the pivotal role of preoperative inflammatory and nutritional status in shaping recovery trajectories.

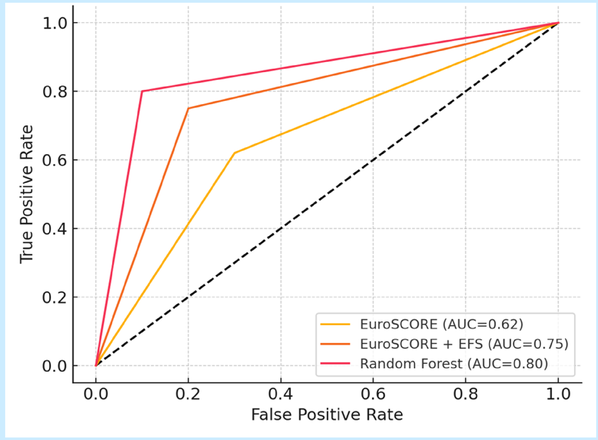

Figure 1. ROC curves comparing EuroSCORE alone, EuroSCORE combined with EFS, and Random Forest model for predicting the composite endpoint of mortality or severe complications.

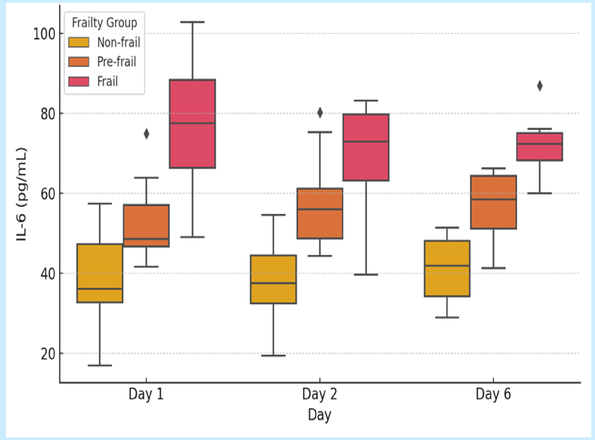

Figure 2. IL-6 levels (pg/mL) on postoperative days 1, 2, and 6 were stratified by the frailty group. Patients with frailty had significantly higher IL-6 levels at different time points.

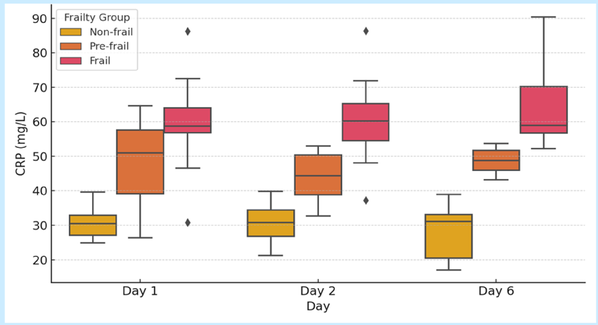

Figure 3. CRP levels (mg/L) on postoperative days 1, 2, and 6 were stratified by the frailty group. Frail patients showed elevated CRP levels with a prolonged inflammatory response.

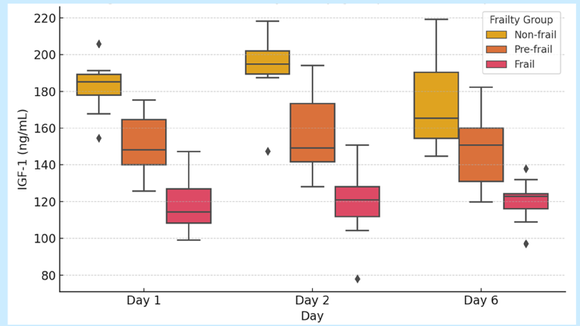

Figure 4. IGF-1 levels (ng/mL) preoperatively and postoperatively in non-frail, pre-frail, and frail patients. Frail patients had consistently lower IGF-1 levels

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