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Incidence and Predictors of Postoperative Heart Failure in Patients Undergoing Elective Noncardiac Surgery

Anitha Rajamanickam, MD; Ali Usmani, MD; Jelica Janicijevic, MD; Preethi Patel, MD; Eric Hixson; Omeed Zardkoobi, MD; Michael Pecic; Changhong Yu; Michael Kattan, PhD; Sagar Kalahasti, MD; and Mina K. Chung, MD

Cleveland Clinic, Cleveland, OH

Introduction: Heart failure (HF) is a major concern after surgery. However, predictors of postoperative HF after noncardiac surgery (NCS) have not been well studied.

Methods: Patients aged > 18 years undergoing elective NCS in 2005–2007 who required at least an overnight stay were identified. Demographics, diagnoses, labs, medications, and primary outcomes, including postoperative HF, were obtained from the electronic medical record. All HF events were validated by individual chart analysis. Missing values in the predictor variables were multiply imputed by chained equations in order to effectively utilize the sample size. A stepwise selection method identified the important predictive variables in the multivariable logistic regression. Concordance indices were calculated for the selected final models to assess predictive accuracy.

Results: Of the 34,793 patients identified, 579 (1.7%) developed postoperative HF; 150 of these 579 patients carried a prior diagnosis of HF. Increased age, vascular surgery, platelet count, hematocrit, glucose, calcium, and prior history of hypertension, hyperlipidemia, insulin-dependent diabetes, myocardial infarction, HF, atrial fibrillation, and sleep apnea were found to be independent predictors of postoperative HF (**Table, below**). The reduced model achieved a concordance index of 0.842 after internal cross-validation.

Conclusions: A predictive model of risk for postoperative HF was generated. Components of the model contain easily determined factors that can be entered into risk stratification tools that may be used in preoperative assessments for NCS.

TABLE
Postoperative HF predictor variables included in the final logistic regression model

Predictor variables	P value	Odds ratio
Patient age: 69 vs 47*	< 0.001	3.63 (2.84, 4.63)
Hypertension: yes vs no	0.014	0.75 (0.60, 0.94)
Myocardial infarction: yes vs no	0.002	2.06 (1.31, 3.26)
Heart failure: yes vs no	< 0.001	10.80 (8.36, 13.96)
Atrial fibrillation: yes vs no	< 0.001	1.84 (1.37, 2.47)
Transient ischemic attack: yes vs no	0.056	0.24 (0.05, 1.03)
Sleep apnea: yes vs no	0.003	1.88 (1.24, 2.85)
Chronic obstructive pulmonary disease: yes vs no	0.136	1.43 (0.89, 2.28)
End-stage renal disease: yes vs no	0.051	1.81 (1.00, 3.27)
Hyperlipidemia: yes vs no	0.005	0.70 (0.55, 0.90)
BUN: 21 vs 13*	0.062	1.17 (0.99, 1.39)
Calcium: 12 vs 10*	< 0.001	0.76 (0.67, 0.86)
Glucose: 114 vs 85*	< 0.001	0.92 (0.81, 1.06)
Hematocrit: 38 vs 32*	< 0.001	3.24 (1.80, 5.84)
Platelet count: 316 vs 210*	0.004	0.86 (0.76, 0.97)
WBC: 8.92 vs 5.77*	0.090	1.18(1.02, 1.37)
Insulin-dependent diabetes: yes vs no	0.006	1.63 (1.15, 2.32)
Vascular surgery: yes vs no	< 0.001	2.09 (1.67, 2.60)

* Restricted cubic splines were applied to numeric predictor variables to relax linearity assumption. Odds ratio for numeric predictors was measured for the amount of the third quartile compared with the first quartile.