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A LASSO-DERIVED PREDICTIVE MODEL FOR POSTOPERATIVE RESPIRATORY FAILURE IN A HETEROGENEOUS ADULT ELECTIVE SURGERY PATIENT POPULATION

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PURPOSE: Background:

Postoperative respiratory failure is associated with increased hospital charges and worse patient outcomes. Reliably identifying the most at-risk patients is necessary to reduce the incidence of and harm from postoperative respiratory failure.

RESEARCH QUESTION: We sought to develop a predictive model to accurately identify patients at high risk for postoperative respiratory failure.

METHODS: Study Design and Methods:

In this single-site proof-of-concept study we utilized structured query language to extract, transform, and load electronic health record data from 23,999 consecutive adult patients admitted for elective surgery (2014-2021). Our primary outcome was postoperative respiratory failure, defined as postoperative mechanical ventilation ≥48 hours. Predictors of interest included demographics, comorbidities, and perioperative factors. We used logistic regression to build a predictive model and the least absolute shrinkage and selection operator procedure to select variables and estimate model coefficients. We evaluated model performance using optimism-corrected area under the receiver operating curve (AUC) and area under the precision-recall curve (AUPRC) and calculated sensitivity, specificity, positive and negative predictive values, and Brier scores. We conducted secondary analyses to verify the optimism-corrected bootstrap procedure results and evaluate the model's performance.

RESULTS: Results:

Two hundred twenty-five patients (0.94%) developed postoperative respiratory failure. The LASSO procedure retained 14 predictors in at least 75% of the 1,000 bootstrap samples for the logistic regression. Longer duration of anesthesia, higher positive net fluid balance at 24 hours, and higher Elixhauser comorbidity count were selected as predictors in all bootstrap samples and increased the odds of PRF. Other predictors included: Elixhauser comorbidity score; surgery on the cardiovascular or nervous systems; surgical specialty orthopedic (non-spine); ASA Class ≥III; Medicare as the primary payer; vasoactive infusions during surgery; higher intraoperative fraction of inspired oxygen and heart rate; and lower tidal volume and end-tidal carbon dioxide. This model achieved an optimism-corrected AUC of 0.851 (95% CI: 0.825–0.878) and an AUPRC of 0.180 (95% CI: 0.128-0.238). Findings from the secondary analyses were similar to the primary model. The AUC declined by a small amount from 0.851 in the full model with optimism correction to between 0.793 to 0.839 in the supplementary analyses while the AUPRC values increased from 0.180 for the primary model to between 0.230 and 0.247 for models in the secondary analyses.

CONCLUSIONS: Interpretation:

This single center proof-of-concept study demonstrates that a novel structured query language to extract, transform, and load process, based on readily available patient and perioperative variables, can be used to develop a prediction model for postoperative respiratory failure. This may represent an intuitive and practical tool for postoperative respiratory failure prediction in the ICU setting.

CLINICAL IMPLICATIONS: We developed a prediction model for postoperative respiratory failure based on readily available patient and perioperative data using an automated procedure to extract large volumes of data from the electronic health record. If validated in other centers, our model may represent an intuitive and practical tool for prediction of postoperative respiratory failure in the hospital setting that could be used to optimize care pathways designed to reduce the incidence of postoperative respiratory failure in high-risk patients.

DISCLOSURES:

No relevant relationships by Ivo Abraham

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No relevant relationships by Timothy Albertson

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