Patient and Operative Factors Predict Risk of Discretionary Prolonged Postoperative Mechanical Ventilation in a Broad Surgical Cohort

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Background: Patients undergoing surgery with general anesthesia and endotracheal intubation are ideally extubated upon case completion, as Prolonged Postoperative Mechanical Ventilation (PPMV) has been associated with poor outcomes [1]. However, some patients require PPMV for surgical reasons, such as airway compromise, while others remain intubated at the discretion of the anesthesia provider. Incidence and risk factors for discretionary PPMV (DPPMV) have been described in individual surgical subspecialties [2, 3] and intensive care unit (ICU) populations [4], but are relatively understudied in a broad surgical cohort. The present study seeks to fill this gap and identify the perioperative risk factors that predict DPPMV.

Methods: After obtaining IRB exemption, existing electronic health record databases at our large referral center were retrospectively queried for adult surgeries performed between January 2018 and December 2020 with general anesthesia, endotracheal intubation, and by surgical services that do not routinely leave patients intubated for surgical reasons. Patients who arrived to the ICU intubated after surgery were identified as experiencing DPPMV. Candidate risk factors were screened for physiologic plausibility and clinical availability. Further variable selection was performed with LASSO-regularized logistic regression, and surviving variables were used to generate a multivariable logistic regression model of DPPMV risk.

Results: A total of 32,917 cases met inclusion criteria, of which 417 (1.27%) experienced DPPMV. Compared to extubated patients, those with DPPMV were more likely to have undergone emergency surgery (42.7% versus 3.4%, p < 0.001), surgery during an existing ICU stay (30.7% versus 2.8%, p < 0.001), and have 20 of the 31 Elixhauser comorbidities (p < 0.05), amongst other differences. A risk model (Table 1) with thirteen variables yielded an area under the receiver operating characteristic curve of 0.97 (95% Confidence Interval [CI], 0.96-0.97), sensitivity of 0.92 (95% CI, 0.89-0.96), and specificity of 0.90 (95% CI, 0.87-0.93) for prediction of DPPMV.

Conclusions: DPPMV was uncommon in this broad surgical cohort but could be accurately predicted using readily available patient-specific and operative factors. These results may be useful for preoperative risk stratification, postoperative resource allocation, and clinical trial planning.

Variable	aOR	95% CI	P Value
Demographics			
ASA Class			
ASA class 2	1.15	[0.25, 5.23]	0.852
ASA class 3	1.86	[0.42, 8.15]	0.410
ASA class 4	5.34	[1.21, 23.6]	0.027 ***
ASA class 5	21.3	[3.33, 136.]	0.001 ***
ASA E designation	11.1	[8.39, 14.8]	<0.001 ***
Elixhauser comorbidities			
Peripheral vascular disease	1.22	[0.90, 1.66]	0.205
Arrhythmia	1.60	[1.24, 2.07]	<0.001 ***
Coagulopathy	2.51	[1.88, 3.34]	<0.001 ***
Fluid/electrolyte disorder	4.52	[3.44, 5.92]	<0.001 ***
Operative Characteristics			
Case during ICU stay	4.96	[3.72, 6.62]	<0.001 ***
OR duration, min.	1.01	[1.00, 1.01]	<0.001 ***
Case end 1601-0659	1.64	[1.25, 2.16]	<0.001 ***
Estimated handoffs	1.19	[1.05, 1.35]	0.006 ***
Intraoperative Medications			
Vasopressor infusion	2.07	[1.63, 2.64]	<0.001 ***
Albuterol administration	3.41	[2.33, 4.99]	<0.001 ***
Bicarbonate administration	4.94	[3.30, 7.39]	<0.001 ***

Table 1: Multivariable logistic regression model of DPPMV risk. aOR: Adjusted Odds Ratio; CI: Confidence Interval; "***" denotes statistical significance.

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