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Is quicker better? A NSQIP analysis of anesthesia time and complications following tracheostomy placement

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ABSTRACT

Background: Increased anesthesia time may lead to respiratory complications in patients receiving tracheostomy, which contributes to patient morbidity.
Methods: The American College of Surgeon's National Surgical Quality Improvement Program (ACS-NSQIP) database was queried for cases of planned tracheostomy (CPT 31600) from 2005 to 2012. Patients were stratified into quintiles based on anesthesia duration. Pearson's chi square, Fischer's exact test, one-way ANOVA, and multivariate regression were used to determine the association between patient characteristics with pneumonia and ventilator dependence.
Results: Out of 752 patients, 83 patients experienced post-operative pneumonia, and 166 experienced ventilator dependence. Following multivariate regression analysis, anesthesia quintiles were not significantly associated with pneumonia or ventilator dependence. Age (OR 1.03, 95% CI 1.00–1.05, P = .032), dyspnea (OR 2.21, 95% CI 1.18–4.13; P = .013), pre-operative ventilator dependence (OR 3.08, 95% CI 1.19–7.98; P = .020), and sepsis (OR 6.68, 95% CI 3.19–14.0; P < .001) remained as significant predictors of post-operative ventilator dependence.
Conclusions: Faster may not be better– prolonged anesthesia time does not increase the risk of post-operative pneumonia or ventilator dependence in patients receiving a planned tracheostomy in the operating room.

Introduction

Tracheotomy is performed for many indications including upper airway obstruction, prolonged ventilation, airway access, and occurs as a sole procedure or in conjunction with other supportive interventions, such as gastrostomy tube placement. While the basic tenets of the procedure are similar, it can be performed in many different ways, including at the bedside or in the operating room, and as a percutaneous or open tracheotomy. The benefits of tracheostomy placement include a reduction in mechanical ventilation (MV) time,[1,2] and decreased occurrence of pneumonia.[3,4] These outcomes are important to investigate, as early ventilatory weaning and the prevention of pneumonia are emphasized in the treatment goals of patients undergoing tracheostomy placement.

The relationship between operative time and post-operative complications has been extensively studied.[5–10] Previous studies have shown the association between increased operative time and prolonged ventilation and pneumonia among patients with endotracheal intubation.[11,12] In a study of patients with esophageal and gastric cancer who underwent esophagectomy, advanced age, longer operative time, smoking, alcohol use, dyspnea, and COPD were significant risk factors for developing post-operative respiratory complications including pneumonia, unplanned intubation, and ventilator dependence for greater than 48 h.[13] The literature on anesthesia time however, which is a surrogate for operative time, as a specific risk factor for post-operative complications, is lacking. Previous studies have shown anesthesia duration to be associated with complications such as free flap failure in the head and neck,[14,15] and venous thromboembolism.[16] Although operative time has been implicated in post-operative respiratory complications, we sought to evaluate the role of anesthesia duration on post-operative complications following planned tracheostomy.

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Methods

Data acquisition and patient selection

The American College of Surgeon's National Surgical Quality Improvement Program (NSQIP) is a nationwide database that reports on perioperative surgical data and 30-day outcomes. It was queried for 752 cases of planned tracheostomy under general anesthesia from 2005 to 2012. Minimum sample size for our study was calculated using an online sample size calculator[17] previously described in Kim et al.[18] Cases were isolated using concurrent procedural code 31600 for planned tracheostomy. Exclusion criteria included patients with missing information on anesthesia time, gender, or ASA class. In addition, patients with an anesthesia time of 0 min were excluded with the assumption that this was an error in coding. Outpatients were also excluded. Because the NSQIP data file is de-identified, this analysis was determined to be exempt from approval by the Institutional Review Board at Rutgers New Jersey Medical School, and no patient informed consent was required.

Variables

The primary outcomes of interest were respiratory complications, which in our study were defined as post-operative ventilator dependence for greater than 48 h and post-operative pneumonia. Anesthesia duration was normalized by logarithmic transformation to the power of 10. Data normalization functions to restructure the data to fit a more normal distribution, and improve its integrity. Patients were then stratified into 5 quintiles based on normalized anesthesia duration, with quintile 1 representing the shortest anesthesia duration, and quintile 5 representing the longest. Anesthesia duration is measured from when anesthesia is first administered, until when the anesthesia is stopped. In contrast, operative time is recorded as the time from incision until closure. Pre-operative patient characteristics are given in Table 1. Pre-operative demographics included age, sex, and race. Pre-operative comorbidities included smoking, dyspnea, pneumonia, chronic obstructive pulmonary disease (COPD), pre-operative ventilator dependence, ASA class 3, 4, or 5, obesity, diabetes mellitus (DM), congestive heart failure (CHF), history of myocardial infarction (MI), hypertension requiring medication, steroid use for a chronic condition, bleeding disorder, systemic sepsis, functional status, pre-operative would infection, and prior operation less than 30 days before the index procedure. Patients were recorded as ventilator dependent if he or she required ventilator-assisted respiration at any time in the 48 h preceding surgery. Pneumonia was recorded if patients had radiographic and clinical evidence of disease.

Statistical analysis

Pearson's chi square (χ^2) and Fischer's exact test were used to analyze associations between categorical variables. One-way ANOVA was used to determine associations between continuous variables and anesthesia duration quintiles. Multivariate logistic regression models were used to evaluate the independent effect of anesthesia time on pneumonia and ventilator dependence. Models were adjusted for age, sex, race, pre-operative respiratory disease (smoking, dyspnea, pre-operative ventilator dependence, COPD, and pneumonia), ASA class, as well as comorbidities that were statistically significant on univariate analysis. Statistically significant results were identified with a $P < 0.05$, and confidence intervals (CI's) were set at 95%. All analyses were performed using SPSS version 23 (IBM Corp Armonk, NY).

Results

Patient characteristics

752 patients were stratified into 5 quintiles based on log-transformed anesthesia duration. Mean (standard deviation, SD) anesthesia time in quintile 1 was 141.7 (28.3) minutes, 251.3 (37.0) minutes for quintile 2, 427.4 (55.2) minutes for quintile 3, 597.0 (43.1) for quintile 4, and 801.8 (111.8) for quintile 5. There was an increase in the number of males across quintile groups, with 54.7% of patients in quintile 1 being male, and 71.1% in quintile 5, $P = .019$ (Table 1). The mean age across quintiles was similar ($P = .644$) with quintile 3 having the oldest mean (SD) of 61.9 (13.6) years, and quintile 5 having the youngest mean (SD) age for patients at 59.7 (12.4) years. All patient characteristics and comorbid conditions, with the exception of age, were statistically significant between quintiles (Table 1). 115 patients had unknown race and were not included in the statistical analysis for race. The number of patients who were smokers increased from 18.1% in quintile 1, to 23.9% in quintile 5. The percentage of patients with many of the comorbid conditions included in our analysis decreased across quintiles. There was a sharp decline in the number of patients in ASA class 4 & 5 between quintile 2 (50.7%) to quintiles 3, 4, and 5 (17.9%, 9.9%, and 4.0%, respectively). The percentage of patients who were classified as ASA class 3 increased from 30.7% in quintile 1, to 73.8% in quintile 5 (Table 1).

Outcomes

206 patients experienced 249 respiratory complications, including 83 patients with pneumonia and 166 with ventilator dependence, within the 30-day post-operative period. The incidence of pneumonia and ventilator dependence decreased across quintiles (Table 2). Pre-operative ventilator dependence, ASA class, dependent functional status, CHF, sepsis, bleeding disorder, and prior operation within 30 days of the index procedure were significant predictors of post-operative pneumonia following chi square (χ^2) analysis (Table 3). Dyspnea, pre-operative ventilator dependence, pre-operative pneumonia, COPD, ASA class, dependent functional status, obesity, diabetes, steroid use, CHF, MI, HTN, wound infection, sepsis, bleeding disorder, and prior operation were significantly associated with post-operative ventilator dependence (Table 3). After adjusting for significant pre-operative predictors in multivariate regression analysis, as well as, age, sex, race, ASA class, and pre-operative respiratory disease, anesthesia duration quintiles were not significantly associated with post-operative pneumonia. There was no significant difference in the odds of post-operative pneumonia between quintile 2 ($P = .351$), quintile 3 ($P = .485$), quintile 4 ($P = .812$), or quintile 5 ($P = .302$) when compared to quintile 1 as the reference category of shortest anesthesia time. Similarly, after multivariate regression analysis, anesthesia quintiles were no longer significantly associated with post-operative ventilator dependence, while age (OR 1.03, 95% CI 1.00–1.05, $P = .032$), dyspnea (OR 2.21, 95% CI 1.18–4.13; $P = .013$), pre-operative ventilator dependence (OR 3.08, 95% CI 1.19–7.98; $P = .020$), and sepsis (OR 6.68, 95% CI 3.19–14.0; $P < .001$) remained as significant predictors of post-operative ventilator dependence.

Discussion

Quicker is not better

A planned tracheostomy is a commonly performed procedure used to establish a stable airway. Overall, in our analysis, we found a low risk of respiratory complications following tracheostomy