Risk Factor Analysis and Prognosis of Patients With Unplanned Reintubation After Head and Neck Surgery [Postprint]

Authors: Chen Si, Zhang Yuelun, Che Lu, Shen Le, Huang Yuguang

Date: 2019-11-15T00:00:00+00:00

Abstract

Objective: To analyze the risk factors and prognosis of patients undergoing unplanned reintubation after head and neck surgery. Methods: This study was a case-control study. Between 2014 and 2018, all patients who underwent unplanned reintubation after head and neck surgery under general anesthesia at Peking Union Medical College Hospital were matched with controls at a 1:4 ratio. Risk factors and prognosis were evaluated using univariate and multivariate analyses. Results: Over the 5-year period, a total of 36 postoperative patients under general anesthesia underwent unplanned reintubation in the operating room due to airway reasons, of which 12 were head and neck surgeries (33.3%). Multivariate logistic regression analysis showed that history of general anesthesia (OR=11.93, 95%CI=1.36-104.63, P=0.025), endogenous creatinine clearance rate (Ccr) <70ml/min (OR=10.12, 95%CI=1.03-99.17, P=0.047), Cormack-Lehane grade III (OR=132.34, 95%CI=2.89-6065.81, P=0.012), and fluid load 20ml/kg (OR=13.95, 95%CI=1.66-117.42, P=0.015) were high-risk factors for unplanned reintubation after head and neck surgery. The postoperative hospital stay (P=0.013) and ICU stay (P<0.001) of these patients were significantly prolonged. Conclusion: For head and neck surgery patients under general anesthesia at Peking Union Medical College Hospital over the 5-year period, history of general anesthesia, Ccr<70ml/min, Cormack-Lehane grade III, and fluid load 20ml/kg were independent risk factors for unplanned reintubation, and their postoperative hospital stay and intensive care unit stay were significantly prolonged.

Full Text

Risk Factors and Prognosis of Unplanned Reintubation After Head and Neck Surgery

Si Chen[1], Yuelun Zhang[2], Lu Che[1], Le Shen[1], Yuguang Huang[1]

[1]Department of Anesthesiology, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing, China
[2]Central Laboratory, Department of Scientific Research, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing, China

Corresponding Author: Le Shen, pumchshenle@aliyun.com

Abstract

Objective: This study aimed to identify risk factors and evaluate the prognosis of unplanned reintubation in patients undergoing head and neck surgery.

Methods: This retrospective case-control study included all patients who underwent unplanned reintubation after head and neck surgery under general anesthesia at Peking Union Medical College Hospital between 2014 and 2018. Cases were matched with controls at a 1:4 ratio. Risk factors and prognosis were assessed using univariate and multivariate analyses.

Results: Over the five-year period, 36 patients required unplanned reintubation in the operating room due to airway compromise following general anesthesia, of whom 12 (33.3%) had undergone head and neck surgery. Logistic multivariate regression analysis revealed that history of general anesthesia (OR=11.93, 95%CI=1.36-104.63, P=0.025), creatinine clearance rate (Ccr) <70 ml/min (OR=10.12, 95%CI=1.03-99.17, P=0.047), Cormack-Lehane grade III (OR=132.34, 95%CI=2.89-6065.81, P=0.012), and fluid load 20 ml/kg (OR=13.95, 95%CI=1.66-117.42, P=0.015) were independent risk factors for unplanned reintubation after head and neck surgery. These patients also demonstrated significantly prolonged postoperative hospital stays (P=0.013) and ICU stays (P<0.001).

Conclusions: For patients undergoing head and neck surgery under general anesthesia at Peking Union Medical College Hospital from 2014 to 2018, history of general anesthesia, Ccr <70 ml/min, Cormack-Lehane grade III, and fluid load 20 ml/kg were independent risk factors for unplanned reintubation, with significantly increased postoperative hospital and ICU stays.

Keywords: head and neck surgery; reintubation; extubation; airway; general anesthesia

Introduction

Unplanned reintubation refers to reintubation following failed extubation and represents one of the serious complications of tracheal intubation under general anesthesia. It is frequently associated with postoperative pneumonia, tracheostomy, prolonged hospitalization, increased healthcare costs, and higher mortality rates [1]. The causes of unplanned reintubation are multifactorial and can be categorized as airway-related or non-airway-related. Non-airway causes include hemodynamic instability and unplanned changes in surgical approach. By surgical type, reintubation events have been reported across various specialties including thoracic, general, and vascular surgery [2]. While previous studies have identified risk factors for reintubation in vascular surgery patients [2], no studies have specifically focused on patients undergoing head and neck surgery. This study selected patients from Peking Union Medical College Hospital who underwent head and neck surgery to evaluate the risk factors and prognosis of unplanned reintubation after general anesthesia, providing valuable insights for clinical practice in China.

Methods

1.1 Data Collection This retrospective case-control study was approved by the Institutional Review Board of Peking Union Medical College Hospital on April 25, 2019 (approval number s-k745). Information regarding patients who underwent reintubation in the operating room—including demographic data, event descriptions, and causes—was obtained from the Department of Anesthesiology Adverse Event Reporting System. Intraoperative data such as surgical type and fluid load were extracted from the Operating Room Anesthesia Information System. Patient medical history, laboratory tests, and postoperative information were retrieved from the Hospital Information System (HIS).

The reintubation group (case group, Group R) inclusion criteria were: patients who underwent head and neck surgery under general anesthesia, received intubation and extubation in the operating room, and required unplanned reintubation due to airway causes between January 1, 2014 and December 31, 2018. Patients who entered or left the operating room with an endotracheal tube in place and those with non-airway causes for reintubation were excluded. Airway-related reintubation was defined as unplanned reintubation due to hypoxia, respiratory muscle weakness, airway obstruction, residual neuromuscular blockade, or phrenic nerve injury after planned extubation.

Given that head and neck surgery involves multiple surgical departments, the normal extubation group (control group, Group C) was selected by randomly generating a list of 500 patients who underwent general anesthesia with intubation and extubation in the operating room during the same period, then sequentially selecting those who had undergone head and neck surgery. Group R and Group C were matched at a 1:4 ratio.

1.2 Risk Factors Based on previous literature and clinical experience, the following potential risk factors were analyzed: sex, age, body mass index (BMI), American Society of Anesthesiologists (ASA) classification, smoking history, cardiac disease history, stroke history, asthma/chronic obstructive pulmonary disease (COPD) history, history of general anesthesia, Cormack-Lehane grade, anesthesiologist experience level, fluid load, and preoperative laboratory tests including white blood cell (WBC) count, hemoglobin (Hb) concentration, and creatinine clearance rate (Ccr). Prognostic variables included postoperative hospital stay duration and intensive care unit (ICU) stay duration.

In this study, cardiac disease history was defined as a preoperative history of myocardial infarction, coronary atherosclerotic heart disease, structural heart disease, or arrhythmia. Fluid load was defined as the difference between total output (blood loss and urine output) and total input (ml) divided by body weight (kg).

1.3 Statistical Analysis Continuous variables with normal distribution were expressed as mean ± standard deviation and compared between groups using independent samples t-test. Non-normally distributed continuous variables were presented as median and interquartile range (IQR) and compared using Mann-Whitney U test. Categorical variables were expressed as frequencies and percentages and compared using Chi-square test. Variables for multivariate logistic regression analysis were selected based on clinical experience and model fitting. A P-value <0.05 was considered statistically significant. Random sampling was performed using R software version 2.13.0, while other statistical analyses were conducted using SPSS version 19.0.

Results

Between 2014 and 2018, a total of 123,068 patients underwent tracheal intubation, extubation, and general anesthesia in the operating room at Peking Union Medical College Hospital. Among these, 36 patients (approximately 0.03%) required unplanned reintubation in the operating room due to airway compromise after extubation following general anesthesia. Of these 36 reintubation cases, 12 (33.3%) had undergone head and neck surgery.

Univariate analysis revealed that compared with Group C, Group R patients had significantly higher risks of unplanned reintubation if they were aged >65 years, had ASA classification 2, history of stroke, history of general anesthesia, Cormack-Lehane grade III, fluid load >40 ml/kg, preoperative hemoglobin below normal values, or Ccr <70 ml/min. In terms of prognosis, Group R demonstrated significantly prolonged postoperative hospital stays and ICU stays compared with Group C .

Multivariate regression analysis identified history of general anesthesia, Ccr <70 ml/min, Cormack-Lehane grade III, and fluid load 20 ml/kg as independent risk factors for unplanned reintubation after head and neck surgery .

Discussion

Head and neck surgery involves operative fields in close proximity to the airway, often sharing the same anatomical space, which carries inherently high risks. Compared with other surgical types, even minor head and neck procedures frequently encounter airway issues, requiring anesthesiologists to maintain high vigilance and anticipate potential complications [3]. Our univariate analysis showed that age >65 years and ASA classification 2 were significantly associated with reintubation in Group R compared with Group C, consistent with previous studies. For example, research has demonstrated that age 65 years is a risk factor for extubation failure in ICU patients [4], while ASA class 3 is an independent risk factor for postoperative respiratory failure [5]. Regarding comorbidities, previous literature has reported that cerebrovascular accidents or central nervous system diseases increase the risk of postoperative reintubation [6], which aligns with our findings.

In terms of laboratory findings, previous studies have identified anemia as a risk factor for postoperative reintubation in patients undergoing major general and vascular surgery [7]. Our univariate analysis similarly found that patients with hemoglobin levels below normal values had higher risks of reintubation after head and neck surgery.

Our multivariate analysis confirmed that fluid load 20 ml/kg and Ccr <70 ml/min were independent risk factors for unplanned reintubation after head and neck surgery. Evidence suggests that excessive intraoperative fluid administration can lead to postoperative pulmonary edema and pneumonia [8], which may contribute to respiratory complications. However, other similar studies have not reached consistent conclusions [9,10], possibly due to varying definitions of fluid load across studies. Several studies have confirmed that renal insufficiency is a risk factor for postoperative reintubation [2,9,11], which supports our findings, though some investigations have not observed similar associations [12,13].

This study is the first to analyze the impact of general anesthesia history and Cormack-Lehane grade on reintubation in patients undergoing head and neck surgery under general anesthesia. In clinical practice, the Cormack-Lehane grade is commonly used to predict difficult intubation, with higher grades indicating more difficult glottic visualization and intubation. Limited glottic exposure also increases extubation difficulty, particularly in patients who have undergone head and neck surgery. Although not strongly evidence-based, we hypothesize that a history of general anesthesia correlates with disease severity and previous airway or head and neck procedures, both of which may increase extubation risk.

Regarding prognosis, patients requiring unplanned reintubation after head and neck surgery under general anesthesia experienced significantly prolonged postoperative hospital and ICU stays, consistent with findings from similar studies across various patient populations [14,15].

The overall low incidence of unplanned reintubation during the five-year study period may be attributed to four factors. First, this study included only airway-related reintubations, excluding those due to hemodynamic or surgical causes. Second, at Peking Union Medical College Hospital, extubation is performed by both a junior and senior anesthesiologist following established guidelines [16], which may reduce extubation risk. Third, most critically ill patients return to the ICU with the endotracheal tube in place and were thus excluded. Fourth, despite mandatory reporting of reintubation as an adverse event in our department, some cases may have been missed. The small sample size represents the primary limitation of this study, potentially increasing the false-negative rate. Additional limitations include the single-center retrospective design, which may involve uncontrolled confounding factors, and incomplete information systems that prevented inclusion of important clinical variables such as body temperature, blood gas analysis, and respiratory infection history. The study's strengths include its exclusive focus on airway-related reintubation cases and stratification by surgical type, as well as being the first to examine the relationship between general anesthesia history, Cormack-Lehane grade, and unplanned reintubation after general anesthesia.

In summary, for patients undergoing head and neck surgery at Peking Union Medical College Hospital between 2014 and 2018, history of general anesthesia, Ccr <70 ml/min, Cormack-Lehane grade III, and fluid load 20 ml/kg were independent risk factors for unplanned reintubation, with significantly prolonged postoperative hospital and ICU stays. Increased vigilance, reduction or avoidance of these risk factors, and development of targeted strategies are essential for improving surgical outcomes.

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Note: Figure translations are in progress. See original paper for figures.