

Risk Factors for Reintubation and Effects of Reintubation on Outcomes of Intensive Care Patients with Unplanned Extubation

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Abstract

Objective: When unplanned extubation (UE) occurs in intensive care patients, mechanical ventilation is negatively affected. In this study, we aimed to investigate the characteristics of UE patients, the duration of extubation, and the characteristics of reintubation patients.

Material and Methods: In this retrospective cohort study of UE patients between May 1, 2010 and December 31, 2012, reintubation patients were included in Group 1 (n=12) and patients who did not require reintubation were included in Group 2 (n=12). The demographic features, mechanical ventilation mode, UE cause (patient/staff), APACHE II score, presence of ventilator-associated pneumonia, extubation time, sedation requirement, NIV requirement after extubation, and need of reintubation were recorded. Patients in groups 1 and 2 were compared in terms of risk factors for reintubation.

Results: Twenty-four patients (23 males) were included. Their median age was 75 years (range, 56-81 years) [Group 1=79 years (range, 74-81 years) and Group

2=62 years (range, 56-76 years)]. The APACHE II score was significantly higher in Group 1 patients than in Group 2 patients (27 vs. 23, p=0.03). The pH was significantly lower in Group 1 (7.26 vs. 7.35, p=0.008). Weaning success was significantly lower and mortality was significantly higher in Group 1 patients than in Group 2 patients (1/12 vs. 8/12, p=0.003 and 11/12 vs. 1/12, p=0.0001, respectively). The number of patients with ventilator-associated pneumonia was higher in Group 1 than in Group 2 (7/12 vs 2/12, p=0.035). NIV was applied to all patients except one.

Conclusion: Unplanned extubation is an undesirable condition in intensive care. Patients with advanced age and higher APACHE II scores may be at a high risk of reintubation and mortality.

Keywords: Intubation, pneumonia, mortality, intensive care

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Introduction

Unplanned extubation (UE) is a condition with high morbidity and mortality which can be observed in critical patients undergoing endotracheal intubation (1-12). The incidence varies by the characteristics of intensive care and the patients and the duration of mechanical ventilation (0.3-16%) (7, 13, 14). UE defined as the removal of an endotracheal tube before the planned time in patients subjected to mechanical ventilation may be intentionally performed by patients (15) or may occur accidentally during nursing care (16). The sedation level and tube fixation method are important for UE (3, 15, 16). There is no clear information about the UE incidence, facilitating factors and their results so the recognition of the facilitating factors for reintubation becomes important. We aimed to determine the risk factors for the reintubation of UE cases in an intensive care unit and their relationship with weaning and mortality.

Material and Methods

Patients monitored in a 28-bed intensive care unit with the diagnosis of respiratory insufficiency between the dates of May 1, 2010 - December 31, 2012 were evaluated. In this retrospective cohort study including orotracheal intubated patients, the demographic characteristics of the patients, APACHE II (Acute Physiology and Chronic Health Evaluation) score, arterial blood gas (ABG) value, mechanical ventilation mode before UE, invasive mechanical ventilation duration, noninvasive mechanical ventilation (NIV) requirement after UE, NIV duration, UE frequency during off-hours, need for reintubation and mortality rate were recorded. The cases requiring endotracheal intubation within 72 hours after UE were classified as Group 1 (n=12). Inability to protect the airway, development of respiratory acidosis and an arterial oxygen saturation (SaO₂) < 90% when breathing 50% oxygen (FiO₂) were accepted

as the reintubation criteria. The cases not requiring reintubation were included in Group 2 (n=12). The cases were monitored with 100%-minute ventilation (MV) target according to the ideal body weight (IBW) in the adaptive support ventilation (ASV) mode. Following UE, intermittent NIV was applied to each patient by an intensive care ventilator (2 hours of NIV, 1-hour intervals). Group 1 and 2 were compared in terms of the risk factors causing reintubation. Since it was a retrospective observational study, consents were not obtained from the patients included in the study; the ethics committee approval for the study was obtained from the February 08, 2010, no:268, Dr. Suat Seren Chest Diseases Training and Research Hospital.

Statistical Analysis

The statistical analyses were conducted using the SPSS program (Statistical Package for the Social Sciences 21.0 version IBM Corp.; NY, USA). Continuous variables were indicated as median (25-75 percentiles) and compared with the Mann-Whitney U test, while categorical variables were indicated as number (%) and compared with Fischer's Exact Test. The value of $p < 0.05$ was accepted as a statistical significance value.

Results

A total of 633 patients were evaluated. Twenty-four UE patients (23 males) among 355 patients who underwent mechanical ventilation were included in the study (Figure 1). The demographic characteristics of the patients are summarized in Table 1. The most common hospitalization diagnosis was chronic obstructive pulmonary disease (COPD). UE occurred at the rate of 54% during off-hours, especially during the night shift (23:00-06:00). Eleven of the cases (n=11, 45%) developing UE were reintubation within the first 24 hours, 1 patient (n=1, 4%) was reintubation within the second 24 hours. Five patients (n=5, 45%) required mechanical ventilation within the first hour. The differences between the groups are presented in Table 2. The median age and the APACHE II score were observed to be higher in Group 1. All cases were followed under the ASV mode. pH was lower in Group 1 after UE ($p=0.008$). Unplanned extubation occurred in 16 cases due to the patient, and in 8 cases during patient care. The duration of IMV was observed to be longer in Group 1. However, it was not found to be statistically significant [9.5 (3.5-16.5) vs. 4.5 (2.5-9) ($p=0.26$)]. After UE, the rate of reintubation was observed to be significantly higher in cases diagnosed with ventilator-associated pneumonia (VAP) (n=7, 58% vs. n=2, 16%, $p=0.035$). Two cases (n=2, 16%) in both groups received sedation on the day when UE occurred. Midazolam was applied as intermittent intravenous bolus for sedation, and the cases were sedated at Ramsay sedation scale level 2-3. Sedation was not applied to any of the cases after extubation. In Group 1, the rate of planned weaning was observed to be significantly lower (n=1, 8% vs. n=8, 66%, $p=0.003$), and mortality was observed to be significantly higher (n=11, 91% vs. n=1, 8%, $p=0.0001$) in the period after re-extubation.

Discussion

In our study, mortality was found to be higher in unplanned extubation cases who were reintubation. Advanced age, high APACHE II score and low pH were found to be risk factors for reintubation.

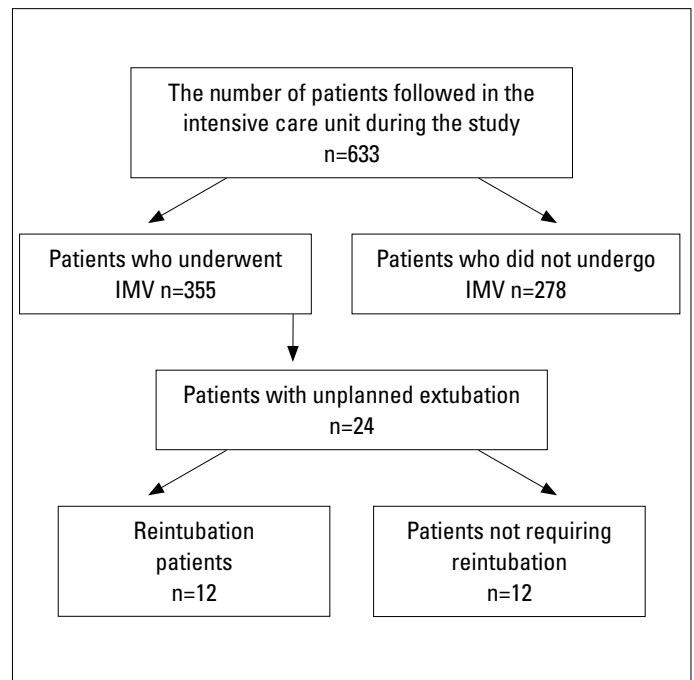


Figure 1. Patient selection diagram
IMV: invasive mechanical ventilation

Table 1. The demographic characteristics of the patients

	Group 1 (n=12)	Group 2 (n=12)	p
Age, median	79 (74-81)	62 (56-76)	0.044
Gender, F/M	1 / 11	0 / 12	1
APACHE II	27 (26-31)	23 (18-27)	0.030
Diagnosis			
COPD	12 (100%)	11 (91.6%)	1
CHF	2 (16.6%)	3 (25%)	1
Comorbidity			
DM	1 (8.3%)	2 (16.6%)	1
The number of patients receiving sedation, n (%)	2 (16)	2 (16)	1
VAP n (%)	7 (58)	2 (16)	0.035
IMV duration, day	9.5 (3.5-16.5)	4.5 (2.5-9)	0.265

Group 1: reintubation cases; Group 2: The patients not requiring reintubation COPD: chronic obstructive pulmonary disease; CHF: congestive heart failure; DM: diabetes mellitus; IMV: invasive mechanical ventilation; VAP: ventilator-associated pneumonia; F: female; M: male

Many conditions may occur in the intensive care unit, which can threaten patient safety. UE which is an important complication that may develop after endotracheal intubation is a condition causing the patient to be separated from the ventilator and lose airway control (17). The rate of the patients extubated without planned weaning was reported to be between 0.3-16% in many studies (7, 13, 14, 18). The rate of UE was 6.7% in our study. The average rate of the reintubation of the cases was reported to be 57% (31-78%) (4). Similar results were also obtained in our study. The cases with the increased respiratory distress and developing respiratory acidosis after UE were reintubation. The pH level was found

Table 2. The differences between the groups

	Group 1 (n=12)	Group 2 (n=12)	p
ABG after UE, median (25-75 percentile)			
pH	7.35 (7.33-7.40)	7.26 (7.19-7.32)	0.008
pCO ₂ , mmHg	65.5 (57.5-76)	83 (64-109)	0.059
pO ₂ , mmHg	73.5 (62.5-94)	66.5 (53-80)	0.127
HCO ₃ , mmol/L	35 (31.5-41)	35 (27.5-42.5)	0.629
SaO ₂ , %	94.5 (92-98)	92 (90-94)	0.068
The number of patients with weaning, n (%)	1 (8)	8 (66)	0.003
The number of patients who underwent NIV, n (%)	12 (100)	11/12	0.300
Mortality, n (%)	11 (92)	1 (8)	0.0001

UE: unplanned extubation; ABG: arterial blood gas; NIV: noninvasive mechanical ventilation

to be significantly low in the ABG analysis of the reintubation cases. Acute respiratory insufficiency, health care-associated pneumonia and the need for intubation due to serious infection are frequently observed in the patients requiring reintubation (19, 20). Multi-organ failure (6), fatal complications and an increase in hospital mortality are observed in the reintubation cases (21, 22). It was observed in our study that the rate of reintubation in cases with VAP was higher. In our study, it was found out that advanced age and high APACHE II score were risk factors for reintubation. The risk for reintubation, hospitalization duration, and mortality were reported to be significantly higher in cases older than sixty-five years (4, 23, 24). In our study, NIV was applied to all cases except for one in the group not reintubation. It was stated in the literature that reintubation was avoided by applying NIV after UE (25). In our study, NIV failure was attributed to the presence of older patients with more serious conditions in the reintubation group. In our study, it was recorded that 16 of the UE cases were patient precipitated. No anxiety and delirium were observed in these patients, and sedation was applied intermittently to only 4 patients. In the literature, pain, as well as patients' desire to talk and effort to breathe by themselves were reported to be the most frequent patient-induced causes. It was emphasized that UE could occur independently of agitation, the state of consciousness and sedation (26). It was observed in our study that UE occurred in 13 cases during the night shift (23:00-06:00). The working hours of nurses, especially night shift, were considered to be important in the occurrence of UE (26).

The fact that the study was conducted in a single center, randomization could not be applied due to its design and the low number of cases can be listed as the limitations of the study.

Conclusion

Nurse follow-up is important in intensive care patients, especially during the night shift. Additional sedation may be required for patients to avoid UE. Patients of advanced age, with high APACHE II score may be under risk for reintubation after UE.

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