

Unplanned Extubation: A Local Experience

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ABSTRACT

Objectives: To study the outcome of unplanned extubation (UE) in the Medical Intensive Care Unit (MICU) and to identify factors which predict the need for reintubation.

Methods: A prospective study of all mechanically ventilated patients admitted to MICU in 1998. Patients were enrolled into the study at the point of their first UE. The primary endpoint was reintubation after UE and secondary endpoint was death from any cause during hospitalisation.

Results: A total of 543 patients were admitted to MICU of which 312 were mechanically ventilated. UE accounted for 8.7% of our mechanically ventilated patients. The mean APACHE II score was 20 (\pm 10), mean time between intubation and UE was 3.1 days (\pm 3.1), mean length of MICU stay was 10.1 days (\pm 10.2) and mean hospital stay was 27.0 days (\pm 36.1). Eighty-seven percent of the UE was deliberate. The rate of reintubation after failed UE was 58.3% of which 71.4% had immediate reintubation. Twenty-nine percent of patients were undergoing weaning during UE. The in-hospital mortality was 25%. All deaths occurred in the group who failed UE. Patients who failed UE had a higher mean APACHE II score, a higher mean pre-extubation FiO₂ level and a lower mean PaO₂/FiO₂ ratio ($p < 0.05$).

Conclusion: UE accounted for 8.7% of our mechanically ventilated patients and 58.3% of these patients required reintubation. Failed UE was associated with a higher mortality. A higher APACHE II score, higher pre-extubation FiO₂ level and a lower PaO₂/FiO₂ ratio were associated with reintubation after failed UE.

Keywords: outcome, reintubation, mortality, predicting factors

INTRODUCTION

Unplanned extubation (UE) is a recognised complication of translaryngeal intubation. It accounts for 3% to 16% of extubations in mechanically ventilated patients⁽¹⁻⁹⁾. Failed UE has the potential of worsening the outcome of mechanical ventilation by subjecting patients to premature removal of the required ventilatory support⁽¹⁰⁾. Studies have shown a higher mortality for patients with failed UE (28-51%) as compared to those who have successfully tolerated the process (0-12%)^(4,7,11).

Although the risk of hypoxic end-organ damage in patients who failed to tolerate UE is reduced by prompt reinstatement of ventilatory support, they are still subject to the risks of pneumonia and death. The process of reintubation is a recognised risk factor for nosocomial pneumonia in mechanically ventilated patients. UE was shown by Torres et al to be associated with a longer duration of ICU stay and higher crude mortality rate⁽¹²⁾.

Studies have been done to evaluate the outcome of UE and the predictive factors for reintubation in Intensive Care Units (ICU) of established centres in the West^(1-10,13-15). To the best of our knowledge, this is the first study done locally to determine the outcome of our patients from UE. As differences may exist between our local ICU and that in the West in terms of organisation, management protocols and nursing strategies, we want to determine the patients' outcome in our local population.

The objectives of this study are to determine the outcome of unplanned extubation in our Medical Intensive Care Unit (MICU) and to identify factors which may help predict the need for reintubation.

METHODS

We prospectively followed up all patients requiring mechanical ventilation who were admitted to our 8-bedded Medical Intensive Care Unit (MICU) over a 12-month period in the year 1998. Patients were enrolled into the study at the time of the first unplanned extubation (UE). For patients with more than one episode of UE, only the first was considered.

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Table I. Variables monitored in study.

Demographic	Age Sex APACHE II
Clinical	Blood pressure Respiratory rate Heart rate Ventilatory settings Minute ventilation Oxygen requirement (FiO ₂) Length of stay (hospital) Length of stay (ICU) Use of sedation, physical restraints, paralytic agents Inotropic support
Laboratory	Arterial blood gas prior to UE

Table II. Indications for mechanical ventilation.

Indication	No. of patients
Respiratory	
Pneumonia	9
Asthma	4
COPD	2
Bronchiectasis	2
Haemoptysis	1
Pulmonary Haemorrhage	1
Cardiovascular	
Acute Pulmonary Oedema	2
Others	
Seizures	1
Chronic liver disease	1
Drug overdose	1

Table III. Patients requiring sedation, restraints and paralysis.

	Agitated (n = 10)	Not agitated (n = 14)
Sedation	5	8
Physical restraints	9	9
Paralysis	1	0

All the patients had orotracheal intubation. The method of securing the ETTs was standardised using the same type of adhesive tape. Adhesive tape was anchored at the angle of the jaw and wrapped tightly around the ETTs. Physical restraints and intravenous sedation were used for patients noted to be agitated by the attending team of doctors and nurses based on their clinical assessment. There were no protocols for sedation or physical restraints at the time the study was done.

The specific time of UE in relation to shift change, nursing breaks, nursing and medical procedures was

noted. Staffing ratio for nurses was one registered nurse to two patients in the day and one registered nurse to three patients during the night shift. The attending team of doctors comprised a consultant intensivist, a registrar and a medical officer.

Demographic, clinical and laboratory variables monitored are shown in Table I. PaO₂/FiO₂ ratio was calculated from the recorded arterial blood gas results and their corresponding FiO₂ values. Minute ventilation (VE) was defined as tidal volume multiplied by respiratory rate over one minute.

UE was defined as deliberate removal of an endotracheal tube (ETT) by the patient or accidental removal of ETT during nursing care or patient transport. Failed UE was defined as the need for reintubation after the UE.

Decision to reintubate was made by the attending physician based on the presence of hypoxic or hypercapnic respiratory failure, increased signs of respiratory work, or inability to protect airway because of excessive pulmonary secretions or upper airway obstruction.

Weaning was defined as a reduction in the level of ventilatory setting, a reduction in FiO₂ requirement or both. We did not use a weaning protocol during the study period and weaning was based on the discretion of the attending intensivist.

The primary endpoint was reintubation after UE and the secondary endpoint was death from any cause during hospitalisation. All patients were followed up to in-hospital death or hospital discharge.

STATISTICAL ANALYSIS

Statistical Program for Social Sciences for Windows (Version 9) was used for statistical analysis. Descriptive summary measures of central tendency and frequency of the study variables were computed as appropriate.

Comparison of study variables between patients who failed UE and those who tolerated UE was performed using Student's t test for parametric data and Mann-Whitney U test for non-parametric data. Chi-square test with risk estimates was used to assess the association between the use of sedation, physical restraints, paralytic agents as well as inotropes and the need for reintubation after failed UE. All statistical tests performed were 2-tailed and statistical significance was defined by a p value <0.05.

RESULTS

A total of 543 patients were admitted to the MICU over the 12 month study period of which 312 patients required intubation and mechanical ventilation. Unplanned extubation occurred in 27 patients, representing 8.7% of all mechanically ventilated

Table IV. Comparison of patients who failed or tolerated UE.

	Failed UE (n=14)	Tolerated UE (n=10)	p value
Age (years)	60	58	0.87
APACHE II	23.4	15.3	<0.05
Mean Time between Intubation and UE (days)	4	2	<0.05
Mean LOS MICU (days)	15	3	<0.05
Mean LOS Hospital (days)	36	14	0.14
Mean VE (l/min)	6.6	7.5	0.64
Median PEEP (cm H ₂ O)	15	8	<0.05
Mean FiO ₂	0.6	0.4	<0.05
PaO ₂ /FiO ₂	178	307	<0.05
pH	7.39	7.37	0.54
SBP (mmHg)	126	120	0.57
RR/min	18	24	<0.05
HR/min	108	108	0.97
Sedation (no. of patients)	8	5	0.73
Restraints (no. of patients)	10	8	0.63
Inotrope use (no. of patients)	8	2	0.06
Weaning (no. of patients)	3	4	0.33

LOS: Length of stay; VE: minute ventilation; PEEP: Positive End-Expiratory Pressure; SBP: Systolic Blood pressure; RR: Respiratory rate; HR: Heart rate

patients. Three patients were excluded from the study population due to incomplete data.

The male to female ratio of the UE population was 1:1. The mean age was 59.2 (\pm 21.1) and mean APACHE II score was 20 (\pm 10). The mean time between intubation and UE was 3.1 days (\pm 3.1). The mean length of MICU stay and hospital stay was 10.1 days (\pm 10.2) and 27.0 days (\pm 36.1) respectively. Indications for mechanical ventilation are shown in Table II.

Table III shows the distribution in the use sedation, physical restraints and paralysis in the agitated and non-agitated patients.

Nine episodes of UE occurred during nursing breaks, five occurred during change of shifts and the remaining 10 occurred during intervals between. Twenty-one episodes of UE were deliberate and only three were accidental, two of which occurred during medical procedures and one during nursing procedure.

The rate of reintubation after failed UE was 58.3% (14 out of 24 patients) of which 71.4% (10 patients) had immediate re-intubation. Only seven patients (29.2%) were being weaned during the UE. Out of these seven patients, 42.9% (three patients) required reintubation after UE. Fifty-seven percent of the deliberate self extubation required reintubation

compared to 67% in those with accidental extubation (not statistically significant).

The in-hospital mortality was 25% (six out of 24 patients) with all the six patients coming from the group that failed UE. The cause of death for these six patients was pneumonia.

The clinical characteristics and study variables between the patients who failed UE and those who tolerated the process are shown in Table IV.

In our study, patients with failed UE and who required reintubation have a higher APACHE II score when compared to those who tolerated UE. (23.4 vs 15.3, p <0.05). The mean length of ICU stay (15 vs. three days, p <0.05), mean FiO₂ level (0.6 vs. 0.4, p <0.05) and median PEEP value (15 vs 8 cmH₂O, p <0.05) were found to be significantly higher in the group with failed UE. The mean PaO₂/FiO₂ ratio was significantly lower in patients who failed UE (178 vs 307, p <0.05).

There was a trend towards a greater need for inotropic support (57% vs 20%, p =0.06), a longer duration between intubation and UE (four vs. two days, p =0.12) as well as a longer length of hospital stay (36 vs. 14 days, p =0.14) between patients failing UE and those who tolerated, though these did not reach statistical significance.

Patients who were undergoing weaning at the time of UE (42.8%) appeared to tolerate UE better compared to those who were not (64.7%), though this did not reach statistical significance (p =0.33)

DISCUSSION

The findings of our study were in keeping with previous studies in terms of the incidence of UE, rate of failed UE and the mortality of patients with failed UE. The incidence of UE at 8.7% in our MICU was comparable to reported rates ranging from three to 16%⁽¹⁻⁹⁾. Our rate of failed UE at 58.3% was similar to the reported rate of 37-76% in literature^(4,6-8,13,14). All the deaths in our study population occurred in the group who failed UE. This was consistently observed in previous studies with higher mortalities in patients who failed to tolerate UE (28-51%) than for those who succeeded (0-12%)^(4,7,11,15). Interestingly, all deaths resulted from pneumonia and were from the group requiring reintubation.

A greater proportion of our patients (78.6%) who failed to tolerate UE were not undergoing weaning at the point UE occurred. Early recognition of these patients with rapid control of airway and reinstatement of ventilatory support may help minimise the mortality and morbidity associated with delayed reintubation. Studies done by Epstein et al and Esteban et al had shown that patients reintubated within 12 hours of planned extubation had a lower mortality than those

reintubated later^(11,16). Although rapid re-establishment of ventilatory support may reduce the risk of death, significant organ damage can still occur. This will result in a delay in recovery and prolonged ICU care and hospitalisation^(7,10,13,14). Patients who failed UE in our study similarly had a longer length of ICU stay and longer duration of hospitalisation, despite early reinstatement of the required ventilatory support.

The presence of agitation may serve as a predictor of UE. Studies have reported the presence of agitation and restlessness in 48 to 75% of self extubation^(3,17,18). Agitation was present in 42% of our UE population. Although the appropriate use of adequate sedation and physical restraints may be useful in minimising UE⁽¹⁹⁻²¹⁾, a truly determined patient can extubate himself regardless of precautions^(2,3). However, there is a need to exercise caution in the use of sedation in agitated patients as over sedation may result in delayed weaning and prolonged exposure to mechanical ventilation and its complications⁽²²⁾.

In our study, UE was deliberate in 87.5% of cases and 42.8% of these patients did not require reintubation. In these non-reintubated patients, UE shortened the duration of mechanical ventilation. These findings suggest that some patients might have been kept on mechanical ventilation unnecessarily. Patients who are capable of achieving their own spontaneous ventilation need to be identified at the earliest possible time to expedite liberation from mechanical ventilation. The use of weaning protocols to screen and initiate weaning and extubation has been shown to be effective⁽²³⁾.

Since UE is abrupt, unpredictable and not totally preventable, it is important to identify clinical and laboratory parameters which may be useful in identifying patients at high risk for reintubation.

Various clinical predictors for reintubation after failed UE have been reported in previous studies. These include a higher minute ventilation, higher pre-extubation FiO₂, higher APACHE II score, lower PaO₂/FiO₂ ratio and a longer duration of intubation prior to UE⁽⁴⁻⁷⁾. Similarly, in our study, we found a significantly higher APACHE II score, a higher pre-extubation FiO₂ level and a lower PaO₂/FiO₂ ratio in our patients who failed UE. (p<0.05) There is also a suggestion that a longer duration of intubation before UE is a useful clinical predictor for reintubation though this did not reach statistical significance.

In this study, the mean respiratory rate per minute for the group which tolerated UE was observed to be higher than that in the group which failed UE (24 vs 18, p<0.05). This could be attributed to a greater percentage of sedated patients in the

group which failed UE though it did not achieve statistical significance (57% vs 50%, p=0.73). The degree of sedation for these patients was not measured in the study. Though the above observed difference in mean respiratory rate per minute between the two groups was statistically significant, it may not have significant clinical impact in terms of predicting the outcome of UE. Yang and Tobin have shown in a prospective study that a respiratory rate of >38/min to be an accurate index of predicting a failed weaning trial⁽²⁴⁾. The mean respiratory rates per minute of the two groups of patients in our study were within this limit.

The limitations of our study include our small sample size and the lack of a control group for better comparison on the impact of UE on outcome. We have also limited our study to patients in the Medical Intensive Care Unit. The inclusion of surgical patients may affect the outcome of UE due to differences in disease type and severity as well as patient population characteristics. Studies have shown that the incidence of UE in surgical patients is generally lower at two to 3.7%^(17,25,26).

Based on the findings of this study, we have identified the need for changes in our practice to minimise the incidence of UE. These include the development of guidelines for use of sedating agents and use of physical restraints for agitated patients as well as the use of a weaning protocol to avoid the undue delay of elective extubation.

CONCLUSION

Unplanned extubation accounted for 8.7% of our mechanically ventilated patients and 58.3% of these patients required reintubation. Failed UE was associated with a higher mortality. Patients who required reintubation had a significantly higher APACHE II score, higher pre-extubation FiO₂ level and lower PaO₂/FiO₂ ratio.

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