

UNPLANNED EXTUBATIONS IN TRAUMA ICU

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ABSTRACT

BACKGROUND: Unplanned endotracheal extubation (UE) is the most common airway adverse event in ICU. This study aimed to determine the incidence, characteristics, complications and outcomes of UE in patients in a level one trauma ICU.

METHODS: A chart review of all patients admitted to the Trauma ICU at Inkosi Albert Luthuli Central Hospital for a 24-month period was performed.

RESULTS: Of the 534 patients admitted to the trauma ICU, 420 were intubated and mechanically ventilated for 4484 days. Forty events of UE occurred in 33 patients. The incidence of UE per 100 ventilator days was 0.89. UE was reported as unplanned self-extubation in 70% of cases and accidental self-extubation in 30%. Reintubation was required in 78% of patients and was strongly associated with the accidental nature of extubation where 100% of cases were reintubated. Mortality was lower in patients with an UE than the total study population (15% vs 27.65% $P = 0.12$). Patients that required reintubation had longer durations of mechanical ventilation (15,5 days vs 6 days $P < 0.001$) and longer ICU stays (17 days vs 9 days $P = 0.04$).

CONCLUSION: This study is in keeping with previously described incidences of UE in ICU, however the rate is higher than suggested benchmarks. UE increased the need for mechanical ventilation and ICU care. Due to the increased incidence, ICU practices must be reviewed to improve this potentially modifiable adverse event.

INTRODUCTION

Airway related incidents are one of the most common adverse events to occur in ICU (1). Elective removal of an endotracheal tube is performed as soon as the reason for the intubation has been resolved. If this happens earlier, it is termed an unplanned extubation (UE). (2) UE is a serious ICU complication. Many authors divide the UE into two broad groups, namely endotracheal self-extubation (ESE) and accidental extubation (AE). Endotracheal self-extubation (ESE) is “a deliberate action of premature removal of the endotracheal tube by patients resulting in the loss of the artificial airway”. (3) Accidental extubation (AE) results from procedural activities and are thus staff related. (4) It far less common than ESE. UE and its outcomes have been used as a monitoring tool for Performance Improvement and Patient Safety (PIPS) programs. A high rate of UE but no need for reintubation decreases time on the ventilator, ICU stay, hospital stay and cost to the provider and patient. (5) It could indicate that weaning protocols need to be revised as that patient could have been extubated in a planned or elective manner prior to the UE (6). A Cochrane review showed that protocolised weaning is better than physician based weaning. (7) A high rate of reintubation after UE indicates a need for nursing care and sedation protocols to be addressed. (3)

In a systematic review the incidence of UE per intubated patient ranged from 0.5%-33.3% but when calculated per 100 intubation days, a narrower range was observed 0.3%-4.2% with one exception. (8) The benchmark set by Kapadia et al for UE suggests an incidence of less than 1% per patient and 0,5% per tracheal tube day in a mixed medical and surgical ICU. (9) Risk factors of UE can be broadly divided into patient associated, nurse associated, sedation, physical restraints, tube fixation and route of intubation. Patient risk factors include agitation, especially for ESE (2, 10), level of consciousness where a GCS of 9-15 increases risk (11, 12), male gender (13), previous UE (14), surgical patients (15), burns (16), older patients, chronic respiratory failure (4), chronic obstructive pulmonary disease (13), nosocomial infection (12). Kapadia et al suggest that the reason for the increased risk in some of these groups is the increased time of intubation and ventilation (9). Many of these risk factors are not relevant in the trauma setting, which often deals with young, previously healthy patients.

Nursing care of patients is generally associated with accidental extubation that occurs most commonly in the morning due to an increase in care activities. (2, 13, 17) The main nursing factor related to ESE is decreased patient surveillance due to the absence from the bedside. This is more common in the night shift as often patient to nurse ratio is higher at this time. (12, 17) Nurse experience has also been associated with risk of extubation. Yeh et al (17) found that 98% of UEs in their study occurred when being nursed by nurses with less than 4 years' experience.

There are many techniques in which endotracheal tubes (ETT) are strapped and secured to a patient. A systemic review by Gardener et al showed that the evidence in this area is very poor with no significant trials to suggest that any strapping technique is superior to decrease tube movement and incidence of UE. (18)

The use of physical restraints in the prevention of UE has shown conflicting reports. Some studies suggest restraining agitated or confused patients decreases the risk of UE (17). Others found that restraints increased UE (12, 19) often due to increased agitation and delirium. Sedation needs to be titrated finely to achieve optimum results. Over sedation increases ventilator days and the attendant adverse effects of prolonged intubation, such as ventilator associated pneumonia (VAP). Under sedation, whilst potentially decreasing ventilator days and allowing for more rapid weaning, results in agitation, delirium and an increase in rate ESE. (20) A sedation protocol linked to the Ramsay Scale was shown to reduce the incidence of unplanned extubation by more than 50% in one year. (21)

The consequences of self-extubation are numerous. An inflated ETT cuff may cause physical damage to airway structures, laryngospasm, aspiration, oedema and bleeding. (10, 22) UE may result in difficult reintubation,(2) and an increase risk of hospital acquired pneumonia (HAP) (23). On the other hand, successful ESE may shorten the duration of intubation and may therefore be beneficial to the patient.

Rates of reintubation after UE are varied from 28% to 74%(8). *Listello et al* showed that medical patients had a higher rate of reintubation than surgical patients (66% vs 15%) despite similar ventilatory support requirements.(24) The suggested difference is possibly due to pre-existing pulmonary disease in the medical group. ESE carries a lower incidence of reintubation (less than 45%) than AE as many patients are awake and being actively weaned. The most common reasons for reintubation in the ESE and AE groups are respiratory insufficiency and airway protection respectively. Accidental extubation generally occurs in patients with a lower levels of consciousness (11, 25) The use of non-invasive positive pressure ventilation in patients in whom an UE occurred during the weaning period showed a decreased need for reintubation. (26) It indicated 85-90% of re-intubations should occur within the first hour of UE to prevent further complications. (15)

Patients that needed re-intubation after an UE had a seven times higher mortality than patients that tolerated an UE. (13, 27) Besides the increase in mortality, these patients also had a longer ICU stay, increased occurrence of ICU acquired infections and rate of resource utilisation.(5) However, patients not needing reintubation had a decreased mortality compared to patients that did not have an UE. (5) This indicates that the need for reintubation is an indicator of illness severity which in turn indicates risk of mortality.

The aim of this study was to describe the incidence and characteristics of unplanned extubations a level one trauma ICU.

METHODS

To determine the incidence and characteristics of UE, all patients admitted to the TICU were reviewed for a 24-month period. The TICU is a 10-bed closed unit consisting of 8 ICU beds and 2 step down high care beds. The ICU is staffed by trauma surgery consultants and registrars from orthopaedic surgery, anaesthesiology as well as other varying surgical disciplines. Nursing staff work in two shifts, 07:00 am to 18:00 and 18:00 to 07:00. During the study, the ICU nurse-patient ratio was 1:1. Maquet Servo-i (Getinge, Germany) ventilators are used throughout the ICU.

All patients requiring manual ventilation were orally intubated with high volume, low pressure endotracheal, tubes. Tracheal tubes were secured using around the neck strapping with Lillehei strapping technique. (28) Ventilatory parameters were set according to the attending physician. Ketamine and morphine were used as the primary sedative and analgesic drugs, and propofol, midazolam and occasionally haloperidol were added as needed. Patients sedation was titrated according to the Ramsay sedation scale (29) to a value of 2-3. The use of muscle relaxants was infrequent. Wrist restraints were used on all patients. ICU weaning was commenced as per a common weaning approach. Patient were placed on pressure support ventilation (PSV) with progressive decrease in the pressure support till extubation was possible.

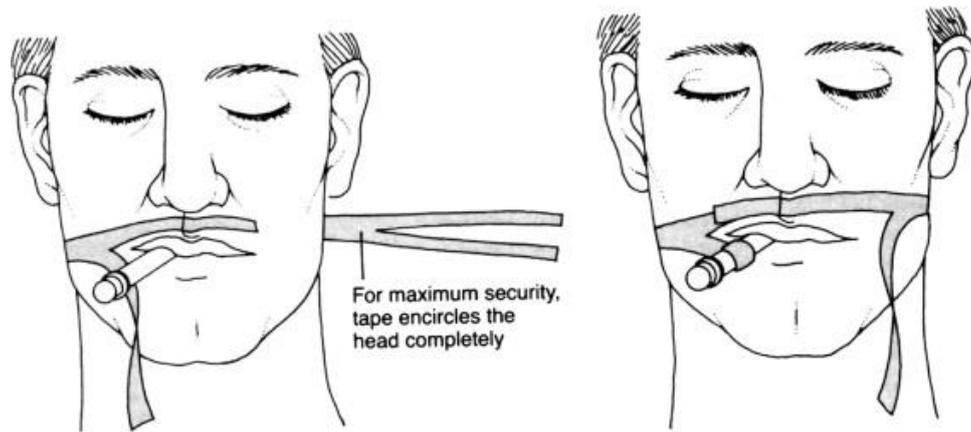


Diagram 1: Lillehei Strapping Technique To Secure Endotracheal Tube (30)

The study was approved by the University of KwaZulu-Natal Research Ethics Committee (BREC) using the BE207/09 class approval database.

This chart review was guided by morbidity forms that are completed whenever certain events such as UE occur in TICU. These forms were reviewed, then the charts and nursing notes of all patients admitted were also reviewed to ensure all UE were included. Data gathered on patients with UE included age, gender, method of injury, type and category of injury, ISS, need for manual ventilation (MV), length of intubation, length of ICU stay, tracheostomy insertion and outcome (deceased or discharged). In every episode of UE, additional information was collected as follows: type of UE, GCS, time to re-intubation (immediate or delayed), mode of ventilation and ventilator settings, most recent arterial blood gas prior to UE, need for reintubation, time to reintubation and reason for reintubation.

We considered UE to be any unplanned removal of an endotracheal tube. These were divided into two groups, namely patient related endotracheal self-extubation (ESE) where the patient deliberately pulled out their ETT, and accidental extubation (AE) where the ETT was accidentally dislodged by staff during procedural work or transport. Reintubation within 1 hour was considered immediate. All reintubations occurred within 6 hours. The usual criteria for reintubation were used: increased work of breathing and respiratory distress, persistently low or decreasing oxygen saturation, inability to protect airway, severe arterial blood gas deterioration.

Complications in Trauma

Name	Number	Age	Sex	Scene	IHT
Admission Date	Discharge Date		Alive	Dead	ISS
Ventilator Days	ICU Days		Total		

MVC pedestrian	MVC passenger	MVC driver	GSW	SW	Blunt	Other
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Sepsis	Day in ICU	Organism	Sensitivity
Pneumonia			
Line sepsis			
UTI			
Cholecystitis			
Sinusitis			
Surgical Site Sepsis			
Other			

Non-septic events	Day in ICU	Comments
Failed intubation		
Accidental extubation		
Endobronchial intubation		
Failed extubation		
Post-extubation stridor		
Pneumothorax		
Drains		
Arterial line		
CVP line		
Urinary catheter		
Gastric catheter		
Abdominal hypertension		
Wound dehiscence		
DVT : PE		
Pressure sore		
Adverse drug reaction		
Transfusion reaction		
Medication Error		
Other		

	Complication	Comments
Resuscitation		
Theatre		

Diagram 2: Trauma ICU Morbidity Form

STATISTICS

A descriptive analysis consisting of central location (median) and dispersion (standard deviation, confidence intervals) – mostly applicable to continuous variables; and frequency tables and graphical displays for the categorical variables. Subgroup comparisons were made using chi squared test. A P-value of 0.05 was be considered statistically significant. The data was analysed in STATA version 13 (Stata Corp, College Station, TX).

RESULTS

During the 24-month period of the study, 534 patients were admitted to the TICU. Four hundred and twenty of these required MV. These patients were ventilated for a duration of 4484 days. There were 40 UE events (9,4%) occurring in 33 patients, 5 patients had 2 episodes and one had 3 episodes of UE. The incidence of UE was 0.89 per 100 ventilated days. Of the 40 events, 28 were deliberate ESE by the patient and 12 were AE. Data that did not change and was patient related are described for the 33 patients. Data relating to the event of an unplanned extubation are described for each of the 40 events.

Demographics and clinical characteristics are shown in Table I and Table II. The median age for UE was 26 (IQR 12-31) and 4 years younger than the study population (30 IQR 21-40). Ninety one percent of patients with UE were male. The median ISS for UE was 32 (IQR 18-41), and blunt mechanism of injury accounted for 76% of patients.

Table I: Demographics and clinical characteristics of patients

	Unplanned Extubation		Non- UE patients		p value	Total study patients	
	N	median (IQR)	N	median (IQR)		N	median (IQR)
Age	33	26.0 (12-31)	387	30.0 (21-40)	0,03	420	30 (21-40)
Sex (patients)							
Male	30	91%	313	81%	0,2	343	82%
Female	3	9%	74	19%		77	18%
Total	33	100%	387	100%		420	100%
Mechanism of injury							
Blunt	25	76%	307	79%	N/S	332	79%
Penetrating	8	24%	71	18%		79	19%
Both	0	0%	4	1%		4	1%
Other	0	0%	5	1%		5	1%
Total	33	100%	387	100%		420	100%
ISS	33	32 (18-41)	387	29.0 (22-41)	N/S	420	29 (22-42)

N: number; IQR: inter quartile range; ISS: injury severity score

As shown in Table II, 28 events (70%) were classified as endotracheal self-extubations (ESE) and 12 (30%) were accidental extubations (AE). Of these AE, two cases (16%) were dislodged while re-strapping the endotracheal tube, two (16%) dislodged during transport (CT scanner and theatre) and one endotracheal tube (8%) was coughed out by the patient – probably related to poor fixation. ESE occurred two days later, on average, than AE. ESE was more common in the patients undergoing weaning and on PS/CPAP mode of ventilation. Extubation was unsuccessful in 59% of ESE group whereas **all** the AE patients required re-intubation. The most common reasons for reintubation in both these groups were respiratory distress and a low GCS. Both groups had 4 complications during reintubation which included desaturation, hypotension and aspiration.

Table II: Comparison between ESE and AE

	ESE		AE		P value
	n 28	Median (IQR)	n 12	Median (IQR)	
ISS	22	31.0 (18-41)	11	32 (14-41)	0,8
Day of Event	28	4.5 (4-7)	12	2.5 (2-4.5)	0,04
GCS	28	9.0 (7-10)	12	6.5 (3-8)	0,01
	ESE:		AE		P value
	n	n (%)	n	n (%)	
Reintubation n (%)	28	19 (68%)	12	12 (100%)	0,04
Deceased	22	1 (4,5%)	11	3 (27%)	
Mode of ventilation					
SIMV	11	11 (39%)	6	6 (50%)	0,2
PS/CPAP	17	17 (61%)	5	5 (42%)	
T-piece	0	0 (0%)	1	1 (8%)	
Total	28	28 (100%)	12	12 (100%)	
Reason for re-intubation					
Respiratory distress	19	14 (74%)	12	6 (50%)	0,4
Low GCS	19	4 (21%)	12	5 (42%)	
Difficult airway	19	1 (5%)	12	1 (8%)	
Complications of re-intubation					
desaturation	4	2 (50%)	4	3 (75%)	0,9
hypotension	4	1 (25%)	4	0 (0%)	
aspiration	4	1 (25%)	4	1 (25%)	

ESE: endotracheal self extubation; AE: accidental extubation; IQR: inter quartile range; ISS: injury severity score; SIMV: synchronized intermittent mechanical ventilation; PS/CPAP: pressure support/ continuous positive airway pressure ventilation; GCS: Glasgow coma scale

Re-intubation was performed in 78% (31) of cases of UE, divided as 68% (19 episodes) of ESE and in 100% of cases (12 episodes) of AE. The main reasons for reintubation were the presence of respiratory distress (65% of cases) and decreased level of consciousness (29%). Reintubation was immediate in 30 cases and only delayed in one case, where non-invasive ventilation was unsuccessfully attempted for 5 hours. Complication rates of reintubation was higher in the AE group at 33 % of reintubations. Patients had a lower level of consciousness with a GCS of 6,5 (IQR 3-8) versus 9,0 (IQR 7-10) and were less likely to be able to protect their own airways.

When comparing the reintubated group to the non-reintubated group of UE, we found that patients requiring re-intubation were younger than those not requiring reintubation, or compared to the total study population (25,5 vs 30; p value 0,1) although this difference was not statistically significant. Sex and mechanism of injury (blunt or penetrating trauma) were not significantly different from each other or the total study population. Length of total intubation (15,5 days vs 4 days) as well as ICU stay (17 days vs 11 days) were significantly longer in the reintubated group when compared to the non-reintubated group as well as the study population. The injury severity score (ISS) was higher and the level of consciousness before the UE was lower in the reintubated group. The day of complication was the same for both.

Table III: Comparison Between Reintubated And Non-Reintubated Patients

	Re-intubated (n:31)		Non-reintubated (n:9)		Study population		p value
	N	Median (IQR)	N	Median (IQR)	N	Median (IQR)	
Age (years) patients	24	25,5 (17-30)	9	30,0 (8,0-37,0)	387	30 (21-40)	0,1
ISS (patients)	24	32,0 (20,5-41)	9	30,0 (18,0-41,0)	387	29 (22-41)	0,8
GCS (episodes)	31	7,0 (6,0-10,0)	9	9,0 (8,0-10,0)			0,2
Day of MV prior to complication (episodes)	31	4,0 (2,0-6,0)	9	4,0 (4,0-9,0)			0,3
Length of intubation (total days) (patients)	24	15,5 (8,5-20,5)	9	4,0 (4,0-9,0)	387	6 (3-13)	0,001
Length of ICU Stay (patients)	24	17,0 (13,5-28,5)	9	11,0 (8,0-16,0)	387	9 (5-16)	0,04

IQR: inter quartile range; ISS: injury severity score; MV: manual ventilation; GCS: Glasgow coma scale; ICU: intensive care unit

The PF ratio is a marker of acute lung injury and is calculated by the arterial partial pressure of oxygen divided by the inspired oxygen fraction. Patients that had an UE and needed to be reintubated had a lower PF ratio (median 272 IQR 172,9-355) than those that did not require reintubation (PF median 390 IQR 200-452). Positive end expiratory pressure (PEEP) prior to UE was the same in both groups. The pre- UE respiratory rate was lower in the group of patients not requiring reintubation (16 vs 20). When comparing arterial blood gas parameters, pH, partial pressure of arterial oxygen and carbon dioxide were similar in both groups.

Mortality was lower in patients that experienced an UE than the rest of the study population (15% vs 27.65%). Mortality was higher in the AE group (25%) versus the ESE group (3.57%). However, patients that needed reintubation after an UE had a higher mortality (13% vs 0%) although the numbers were too small to gain significance with a p value of 0,3. Twenty-one percent of patients that required re-intubation also had a tracheostomy inserted where 15% of the total trauma ICU population required this procedure.

DISCUSSION

Most studies of unplanned extubation in ICUs were performed in medical or mixed ICU populations. The data on purely trauma patients is limited, and the closest available information is on surgical units. Looking at a systematic review by Da Silva et al (31), of the 50 studies included in their review, only eight studies involved purely surgical ICU of multiple surgical disciplines and none specifically for a trauma population.

This study was designed as an audit of the TICU's quality of nursing and medical care. All adverse events are recorded in the morbidity and mortality statistics of the ICU. Weekly academic morbidity and mortality meetings are held and involve discussions around safe practice pitfalls that arise with each unplanned extubation. UEs can indicate a variety of issues in the ICU environment including assessment of sedation, weaning protocols, staff vigilance and possible need for training. A high incidence of UE could point to various matters in the ICU that need addressing. If most of the patients do not require re-intubation, weaning and extubation protocols should be addressed. (6) If a high proportion do require reintubation, sedation, methods of securing the endotracheal tube, transport and staff training issues need to be addressed. (3) A high incidence of AE would also particularly alert to securing of endotracheal tube and staff training. (4)

In this study, the aim was to describe the incidence of unplanned extubation in TICU. Many different methods have been described to assess the incidence of UE. The first is the method of the number of events of accidental extubation per intubated patients as a percentage. In a review by *Kiekkas et al* (8) the incidence had a wide range between 0.5%-14.2%. We found an incidence of 40 incidents of UE in the 420 ventilated patients (9,4%) in the 24 months period observed. Another method that more accurately couples unplanned extubations to time at risk (i.e. days on manual ventilation) is the incidence per 100 ventilator days. This reveals a much narrower range of 0.3- 4.2 (8). Our study found an incidence of 0.89 events per 100 ventilator days. Both values are higher than the suggested “benchmark” set by *Kapadia et al* (9) in a general medical and surgical ICU of 1% per patient and 0,5 incidents per 100 ventilator days. This benchmark was for a different patient population. Trauma patients are on average younger, predominantly male and have few comorbidities. (32) We would suggest a using the current rates as a baseline for future trauma studies as a comparison.

Patients with UE were 4 years younger (26 years vs 30 years) than the total study population average. This is much younger than the previously elderly patients aged 70.9 +- 17.2 years (although this was in medical ICU).(4, 32)

In their systematic review, *Da Silva et al* (31) found a rate of 69%-95% for ESEs. A high rate of ESE has been associated with inadequate patient comfort: inadequate sedation, unnecessary restraints. It is also more common in patients in the weaning phase of ventilation and a higher GCS. In this study 70% of the UE were ESEs. This is in the lower range of previously described studies and may show that either sedation and restraint protocols are adequate in the ICU to keep patients comfortable or that this rate is low due to the increased percentage of AE. A higher proportion of patients with ESE were in the weaning phase of ventilatory support when compared with AE (61% vs 42%). High-risk patients for ESE also include GCS scores of 9 – 15 (11, 12). The median GCS of ESE in this study was 9 (IQR 7-10) compared to the lower GCS of AE of 6.5 (IQR 2.5-8). Interestingly, AE occurred 2 days before ESE (day 2.5 (IQR 2-4.5) vs day 4.5 (IQR 4-7)). *Christie et al* (2) found that AE occurred 2 days later on average than ESE (7 vs 5). There is little other literature about the relative timing of these events but, since many procedures, transfers and operations happen early in the ICU stay, this could be in keeping with the nature of an AE. Similarly, the lower GCS during the early admission and ICU stay of patients is in keeping with the nature of the event, being staff or procedure related.

The AE were in the higher distribution of ranges described by *Da Silva*.(31) As patients have little to do with the AE it is purely passive and therefore staff and procedure related. Contributing factors are therefore interrogated. The ICU physicians are made up of surgical, orthopaedic and anaesthetic trainees, many relatively junior in their training with limited prior ICU experience. Two AE occurred during patient transfer from CT and theatre. These transfers are overseen by the ICU trainees. Two AE also happened during re-strapping of endotracheal tubes by nurses. In a prospective, questionnaire-based study that explored the roles of nursing on the occurrence of UE, *Yeh et al* (17) showed that 98% of UE occurred when nurses with less than 4 years' experience were looking after the patient. This concern can be extrapolated to any medical staff working in an ICU setting. Experience is important in preventing these avoidable AE.

In their study of a majority trauma population ICU (71% of patients), *Fontenot et al* (3) hypothesized that surgical and trauma patients would cope better with UEs than other ICU population patients. However, they found that 54% of patients still needed intervention after an UE. In this study, 78% of patients required reintubation after UE. This is a higher rate than they found, however their average ISS was 22 +- 2.4, whereas the ISS in this study was 32 (IQR 18-41), showing the increased severity of injury in this study population. The main reasons for reintubation were the presence of respiratory distress (65% of cases) and decreased level of consciousness (29%).

Reintubation rates after unplanned extubation differed according to the type of patient population (medical vs surgical), the type of unplanned extubation (endotracheal self-extubation versus accidental extubation) and the level of support of ventilation required by the patient (weaning vs full mechanical ventilation). (31) We found a similar picture although all patients were surgical trauma patients.

Reintubation rate was higher in the AE group and those requiring full ventilatory support. The most common reason for reintubation in the ESE group is respiratory insufficiency in keeping with our study. (11, 25) In accidental extubation the most common indication for reintubation is airway protection due to a decreased level of consciousness. (11) Respiratory insufficiency was the most common reason for reintubation in the AE group in our study accounting for 50%, although closely followed by decreased level of consciousness at 42%.

Reintubated patients had a longer ICU stay than the general population as well as the UE's that did not require reintubation. In keeping with literature (33), those patients who did not require reintubation also had a shorter overall ventilation period (4 days vs 6 days) and a shorter total ICU stay than the general population (9 days vs 11 days). (5) As 22% of patients had a successful UE could indicate that weaning protocols could be even more effective as these patients would have spent a longer duration on the ventilator than necessary had they not self-extubated.

All patients with AE were reintubated. As these are totally preventable and serious complications, an emphasis on training and suitable vigilance is essential for junior ICU staff. Christie et al (2) found a reduction in AE of 33% over a 12 months period after nursing training as the sole intervention.

Reintubation was more likely in those patients with lower PF ratio prior to UE (272 vs 355) in keeping with predictors of failed elective extubation (25, 34). The injury severity score (ISS) was higher in the re-intubated group (32 vs 30 $p=0.8$) in keeping with the increased need for support for injuries sustained. Although not statistically significant, it is in keeping with clinical reasoning.(13) Other predictors such as age older than 65 years, arterial pH greater than 7.45 before UE, non-surgical patients, the presence of three or more comorbidities as described by da Silva et al (31) were not found in this population.

The use of non-invasive positive pressure ventilation (NIV) in patients in whom an unplanned extubation occurred during the weaning period has been shown to significantly decrease the need for reintubation. (26) NIV was only attempted in one patient in this study and was unsuccessful. Perhaps a greater emphasis on NIV could prevent reintubations in this ICU after UE.

Complications of reintubation have been well described. Vassal et al (4) described a rate of 15% of complications on reintubation after UE. In our study, 20% of reintubation had complications which included desaturation, hypotension and aspiration. The complication rate for reintubation after AE was more than double that of ESE (33% vs 14%). AE had a lower GCS, decreased airway protection and respiratory drive than the more awake ESE's, thus resulting in more rapid decompensation. Re-intubating patients after an UE is not an ideal setting. It is an emergency intubation, patients are not starved, and rapid sequence intubation is necessary. This, coupled with difficult access in the ICU setting as well as most patients needing reintubation within 1 hour of UE, result in the need for airway experts to be available on site for patients after an UE.

Most of the patients who had an UE were discharged from the ICU (88%) although some with significant morbidity. The outcomes depended primarily on the need for reintubation. In this study, patients that experienced UE had a lower mortality than the general ICU population (12% vs 27.65%). This may be explained by the high number of successful self-extubations (22% of UE), decreasing the patient's time at risk on a ventilator and in ICU and resulting in a low mortality of these patients (4.5%) and overall in the UE group. This suggests more effective weaning protocols could improve overall patient outcome as these patients could have been electively extubated at an earlier stage. Although these patients had a higher ISS on admission, they were on average four years younger (26 years vs 30 years) which could possibly account for an increased reserve. The AE group, having a 100% reintubation rate had a higher mortality at 27%, the same as the overall study population. Patients that successfully self-extubated did not require tracheostomies. Those that required reintubation after UE had a higher rate of tracheostomy insertion (23%) than the general TICU population (15%).

The monitoring of unplanned extubation in an intensive care unit is a continuous quality improvement program. Some studies in the past 20 years have reported the efficacy of preventive measures to reduce the incidence of unplanned extubations. Da Silva et al found "the following preventive measures have been assessed: continuous education for nurses, agitation avoidance, 24-hour bedside supervision, regular surveillance, protocols for patient transport, securing the endotracheal tube before adjusting patient positioning or bathing the patient and changing the method for securing the endotracheal tube, implementation of a sedation protocol, staff ability for weaning patients, protocols for identifying patients ready for withdrawal from mechanical ventilation, and appropriate nurse to patient ratio."(31) Quality improvement programs have been shown to reduce unplanned extubations by between 22%-53% (14, 35). Quality improvement programs involved various interventions that included data collection tools, anonymous reporting of events, staff education and surveillance, identification and management of high risk patients and standardisation of procedures.

Sedation requirements are different in each ICU patient and this requires dose titration and continuous assessment of patients for preventing agitation related self extubation. (36) In patients that are agitated, the cause must be investigated and treatment specific to that cause instituted. This may include relieving pain and anxiety, facilitating patient orientation to time and place, expanding visiting hours to encourage contact with relatives, and increased nurse-presence at the bedside. (16, 17) The use of physical restraints may decrease unplanned extubations, but these should be used on an individual patient basis and their use instituted only when agitated behaviour has already been manifested. (37)

LIMITATIONS

As this study is a retrospective chart review, no causation of UE can be determined, only associations are possible. A single centre study may also lead to bias. The retrospective nature relies the clinicians' and nurses' accuracy in reporting the incidents and thus not all information is readily available. This may result in under reporting, lower rates of UE than expected and inaccurate data on patients. The sample size is also relatively small as data was collected for 24 months and 40 events noted in this time, which is often insufficient to gain significance in the data presented. Patients were only followed up until discharge from ICU, so little is known about their course and outcome later on.

CONCLUSION

This study has higher rates of UE than the benchmark suggested but similar rates to other previous surgical ICU studies, although the population is entirely different to other studies. In keeping with literature, UE resulted in increased length of ventilation and ICU stay when compared to the general ICU population. Preventable risk factors such as staff training, and vigilance could decrease this serious and potentially fatal adverse event.

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