

# Unplanned extubations in an academic intensive care unit

MJ Mpe, MS Moloto, BV Mphahlele

Division of Critical Care, Medical University of Southern Africa, South Africa

## Abstract

**Objective:** To describe the incidence, risk factors and outcome of unplanned extubations (UEXs) in our intensive care unit. **Design:** A prospective, observational study. **Setting:** Intensive care unit (ICU) of the Dr. George Mukhari Hospital, which is a teaching hospital. **Patients:** All patients who experienced an episode of unplanned extubation (self-extubation by the patient or accidental extubation by members of staff during bed-side procedures) during the period June 2001 to December 2001. **Interventions:** None. **Measurements and Main Results:** The main variables studied were the occurrence rate of UEX, the risk factors for the event, the re-intubation rate and the mortality rate. A total of 233 patients received ventilatory support with an endotracheal tube during the study period. Twenty-four patients (10.3%) experienced an unplanned extubation. Six of these patients (25%) required re-intubation for respiratory failure (defined as failure to achieve an oxygen saturation of  $\geq 90\%$  or  $\text{PaO}_2$  of  $\geq 8\text{KPA}$ , despite maximum oxygen supplementation via face mask and/or tachypnoea of  $>35$  breaths/min). One death occurred as a direct consequence of the event. Patients who required re-intubation had a significantly higher mean  $\text{FIO}_2$  just prior to the UEX compared to those who did not require re-intubation ( $0.64 \pm 0.18$  vs.  $0.43 \pm 0.08$ ;  $p=0.031$ ). The mean set breath rate just before the UEX was also significantly different between the two groups of patients ( $13.16 \pm 3.49$  vs.  $8.88 \pm 4.51$ ;  $p=0.046$ ). A comparison of the mean values of PEEP, PH,  $\text{PaO}_2$ ,  $\text{PaCO}_2$  and HCO<sub>3</sub> just before the UEX revealed no statistically significant differences between the patients that required re-intubation and those that did not.<sup>3</sup> Oral intubation, lack of sedation and lack of restraints were confirmed to be risk factors for UEXs. **Conclusion:** The study suggests that the more respiratory support (as evidenced by a high set breath rate and a high  $\text{FIO}_2$ ) the patient requires at the time of the UEX, the more likely they are to require re-intubation. Although the incidence, the re-intubation rate and the predisposing factors for UEXs in the unit are similar to those reported in the literature, the study suggests that the unit needs to pay special attention to some of the measures known to be capable of minimizing the incidence of this potentially lethal complication of mechanical ventilation. In particular, the use of sedation and the care of the endotracheal tube during bed-side procedures are important issues.

Patients on ventilatory support are exposed to several well-documented complications. Amongst them are unplanned extubations. UEXs can lead to many and potentially fatal consequences. Amongst these complications are cardiac arrest, aspiration, additional laryngeal trauma and death.<sup>1,2,3</sup>

Previous studies have shown a variable occurrence rate of UEXs of between 3% and 16%.<sup>1,3,6</sup> A number of factors have been identified to increase the risk of spontaneous extubations. Amongst these are lack of adequate sedation, inadequate restraining, oral intubation and the type of tube fixation used.<sup>4,5</sup>

The strategies that have been reported on and suggested to decrease the risk of self extubation are among others, more comprehensive treatment of agitated patients, more vigilance by nurses and auxiliary staff, verification of tube position daily

and strong attachment of the endo-tracheal tube, particularly for orally intubated patients.<sup>7</sup>

## Study population

All ICU patients who experienced an episode of unplanned extubation during the study period.

## Materials and methods

**Study Location and Patients:** The study was conducted in the multi-disciplinary ICU of the Dr. George Mukhari Hospital, a 1500-bed university-affiliated urban teaching hospital. All patients who experienced an episode of spontaneous extubation during the study period were eligible for the study. The study was approved by the Research, Publications and Ethics Committee of the Medical University of Southern Africa.

## Study Design and Data Collection

This was a prospective, observational study. Every time an UEX occurred, a questionnaire was immediately completed by the attending doctor. For all study subjects the following data was recorded: demographic details, diagnosis, use of sedation, route of intubation, use of restraints, the need for re-intubation and the complications of the event.

## Correspondence:

Dr MJ Mpe

email: lucia@medunsa.ac.za

### Data analysis

Quantitative values were expressed as means - SD. Qualitative data was expressed as percentages. Comparisons amongst patients were done using the student-t test for continuous variables and Fisher's exact test for categorical variables. A p-value of  $\leq 0,05$  was considered statistically significant.

### Results

A total of 233 intubated patients were treated in the ICU during the six months study period. Twenty-four patients (10.3%) experienced an unplanned extubation. This study group consisted of 15 males and 9 female patients, with a mean age of  $45,54 \pm 12.62$  years. One patient had three episodes of UEX and another had two episodes. The total number of UEXs was 27.

Twenty-five of the UEXs were considered self-extubations, whilst two occurred during nursing procedures.

Six of the 24 patients (25%) were re-intubated for respiratory failure. One death occurred peri-reintubation. Although this patient was successfully re-intubated, adequate oxygenation could not be re-established and the patient died of refractory hypoxemia. The two patients who had more than one UEX had self-extubated on all occasions. Of note was that the two patients had been thought to be adequately sedated with midazolam. Haloperidol was added to the midazolam and both patients were subsequently extubated and discharged from the ICU.

All 24 patients were orally intubated and had their endotracheal tubes fixed by an adhesive tape. Sixteen patients (67%), were being given Midazolam, titrated according to the Ramsay sedation scale, prescribed by the attending physician. Twelve patients were restrained as they remained 'uncooperative' despite Midazolam at a dose that was beginning to cause hypotension. Four of the eight patients off sedation were in the process of being weaned off ventilatory support.

All patients who experienced an unplanned extubation had a trial of face mask ventilation for varying time periods post extubation and re-intubation was effected for tachypnoea (breath rate  $>35/\text{min}$ ) and hypoxemia (oxygen saturation  $<90\%$  or  $\text{PaO}_2 < 8\text{KPA}$ ).

Table 1 shows the mean ventilator settings and arterial blood-gas results (ABG's) of the patients prior to the UEX.

Setting + ABGs	Not re-intubated	Re-intubated	P-value
Set Rate (mean)	8.88 $\pm$ 4.51	13.16 $\pm$ 3.49	0,046*
PEEP (mean)	4.83 $\pm$ 2.07	5.67 $\pm$ 1.97	0,396
FIO2 (mean)	0.43 $\pm$ 0.08	0.64 $\pm$ 0.18	0,031*
PH (mean)	7.44 $\pm$ 0.055	7.38 $\pm$ 0.10	0,229
PaCO2 (mean)	4.84 $\pm$ 0.98	5.39 $\pm$ 1.10	0,260
PaO2 (mean)	14.57 $\pm$ 4.60	11.50 $\pm$ 4.07	0,160
HCO3 (mean)	24.67 $\pm$ 4.88	22.98 $\pm$ 5.04	0,480

### Discussion

The 10.3% incidence of UEX observed in our study is an occurrence rate that is within the 3% to 16% found in other studies. In addition, the mortality rate of 4% is comparable to that observed in previous studies (0%-15%).<sup>2,5,7</sup> Twenty-five percent of our patients needed to be re-intubated. Studies have indicated that although cautious clinical evaluation can often avoid immediate re-intubation<sup>1,18</sup>, 31% to 74% of patients will require to be re-intubated after an unplanned extubation.<sup>1,2,8</sup>

The data suggests that the more respiratory support the patients requires at the time of the UEX, the more likely it is for them to require re-intubation, which finding is probably not unexpected.

All of our patients were orally intubated. The predisposing effect of oral intubation on the frequency of UEXs has been suggested by several studies.<sup>1,7</sup> This result can be explained by the high mobility of the endotracheal tube during patients' motions when they are orally intubated. Tindol on the other hand, failed to demonstrate any effect of the route of intubation on the occurrence rate of UEXs, although that study could be criticized for lack of multivariate analysis.<sup>4</sup> We did not have a comparator group for the route of intubation as only one patient was intubated nasally during the study period and this patient did not experience an UEX.

Thirty-three percent of our patients were not sedated, either because they were being weaned off ventilatory support or they were deemed sufficiently cooperative not to require sedative agents. Lack of sedation as a predisposing factor for UEXs is also well recognized. Periods of intermittent withdrawal from sedatives in ICU have also been advocated.<sup>10</sup> A balance would have to be found between the amount of sedation needed to keep the patient calm, whilst not interfering with the weaning process. The use of sedation scales could be helpful in achieving this goal. It is also advisable to reconsider the decision to wean obviously agitated patients as they usually have an underlying abnormality, which may in itself, compromise their ability to be liberated from the ventilator.

Fifty percent of our patients were restrained. The need to restrain such a high number of patients may be a clue to the inadequate management of sedation. While we agree, that restraints on a patient's wrists and chest can be used to prevent UEXs, as suggested by Brandsteter et al<sup>11</sup>, it is also recognized that some determined patients are able to extubate themselves even when they are strongly restrained.<sup>1</sup>

Two of the total number of UEXs in this study occurred during bedside procedures. Both occurred during routine patient positioning by the nursing staff. The importance of this finding lies in the fact that this is preventable if proper care is taken to secure the endotracheal tube during these procedures. Little and colleagues found that bed-side procedures such as portable radiographs and turning of the patients put them at risk of accidental extubation.<sup>12</sup> Other studies found the contribution of these procedures to accidental extubations to be minimal considering the number of such procedures performed daily in the intensive care units.<sup>7</sup>

### Conclusion

Some of the cases of unplanned extubation could be avoided in view of the predisposing factors pointed out. Vigilance by nursing and auxiliary staff during bedside procedures is necessary. The use of sedation needs re-evaluation. A more me-

ticulous management of this form of therapy may help reduce the number of UEXs and could also minimize the need for the use of restraints. The rate of UEXs in an ICU has been suggested as a possible indicator of the quality of nursing and medical care.<sup>7</sup>

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