

## ORIGINAL RESEARCH

## INTENSIVE CARE

# A retrospective analysis of the incidence and determinants of self-extubation in a tertiary care surgical intensive care unit

Muhammad Asghar Ali<sup>1</sup>, Saima Rashid<sup>2</sup>, Khalid Maudood Siddiqui<sup>3</sup>,  
Muhammad Saad Yousuf<sup>4</sup>

**Author affiliations:**

1. Muhammad Asghar Ali, FCPS, Assistant Professor, Department of Anesthesiology, Aga Khan University, Stadium Road, Karachi, Pakistan; E-mail: [asghar.ashraf@aku.edu](mailto:asghar.ashraf@aku.edu); ORCID {0000-0001-7576-8936}
2. Saima Rashid, FCPS, Assistant Professor, Department of Anesthesiology, Aga Khan University, Stadium Road, Karachi, Pakistan; E-mail: [saima.rashid@aku.edu](mailto:saima.rashid@aku.edu); ORCID {0000-0001-5630-2161}
3. Khalid Maudood Siddiqui, FCPS, Associate Professor, Department of Anesthesiology, Aga Khan University, Stadium Road, Karachi, Pakistan; E-mail: [khalid.siddiqui@aku.edu](mailto:khalid.siddiqui@aku.edu); ORCID {0000-0003-2641-6824}
4. Muhammad Saad Yousuf, FCPS, Senior Instructor, Department of Anesthesiology, Aga Khan University, Stadium Road, Karachi, Pakistan; E-mail: [saad.yousuf@aku.edu](mailto:saad.yousuf@aku.edu); ORCID: {0000-0001-7565-869X}

**Corresponding Author:** Dr. Khalid Maudood Siddiqui, **Phone:** +92 21 34864623; **E-mail:** [khalid.siddiqui@aku.edu](mailto:khalid.siddiqui@aku.edu)

## ABSTRACT

**Background & Objective:** Self-extubation is reported as one of the most common adverse events in the adult intensive care units worldwide. We aimed to find out the incidence and determinants of self-extubation in surgical intensive care unit of our tertiary care hospital.

**Methodology:** It was retrospective analysis of the data acquired from the hospital databases, about the patients who self-extubated during admission to surgical intensive care unit (SICU) of Aga Khan University Hospital, Karachi, Pakistan, during six calendar years, from January 01, 2010, through December 31, 2016. Data collection form was used to collect personal details, drugs used for sedation, sedation agitation score, pain score, nurse-patient ratio and the use of any restraint at the time of extubation. SPSS was used to analyze data applying the central limit theorem to calculate the mean and standard deviation for quantitative variables and the Chi-square test was conducted using a  $P < 0.05$  for qualitative variables. Multivariate logistic regression analysis was performed to identify the independent risk factors for self-extubation

**Results:** A total of 618 patients were admitted to the SICU who required mechanical ventilation during the study period. An overall 2.1% incidence of self-extubation was calculated with a documented thirteen self-extubation episodes. The mean age of patients was  $38.46 \pm 16.97$  y with majority of them being males. Most, 9 (69.2%), of the patients were not restrained at the time of self-extubation. Nurse to patient ratio was 1:1. Majority of patients 7 (53.8%) were not on any sedative drug infusion and the mean sedation agitation score at that time was  $4.46 \pm 2.02$  while mean pain score was  $5.31 \pm 2.72$ . Reintubation was performed in 10 (76.9%) of the patients, who had self-extubated.

**Conclusion:** This study revealed that the incidence of self-extubation was 2.1% in SICU and there was strong correlation between absent physical restraint and self-extubation incidence during the weaning period.

**Key words:** Mechanical ventilation; Reintubation; Self-extubation; Sedation; Surgical Intensive Care Unit; Tertiary Care Hospital

Ali MA, Rashid S, Siddiqui KM, Yousuf MS. A retrospective analysis of the incidence and determinants of self-extubation in a tertiary care surgical intensive care unit. *Anaesth. pain intensive care* 2023;27(3):260–263; **DOI:** [10.35975/apic.v27i3.2231](https://doi.org/10.35975/apic.v27i3.2231)

**Received:** October 03, 2022; **Reviewed:** April 04, 2023; **Accepted:** April 19, 2023

## 1. INTRODUCTION

Self-extubation is reported as one of the most common events in the adult intensive care units worldwide.<sup>1</sup> The incidence of self-extubation varies from 4% to 14%.<sup>2,3,4</sup> Self-extubation can compromise the patient's health and complicates the safe and gradual process of mechanical ventilation weaning.<sup>5</sup> The most common consequence of self-extubation is the need to reintubate within an hour in 85% to 90% of the cases.<sup>6</sup>

The presence of a tube inside the trachea is very uncomfortable and irritant for the patient. It is very difficult for an intensivist to maintain a balance between sedation and deep-sedation, because deep sedation can easily prevent self-extubation but at the cost of increased incidence of ventilator associated pneumonia,<sup>7</sup> and prolonged mechanical ventilation.<sup>8</sup> On the other hand, light sedation is associated with a higher incidence of patient agitation, self-extubation, and the ventilator-patient asynchrony.<sup>9</sup>

The aim of this study was to examine the incidence and determinants of self-extubation in surgical intensive care patients admitted in a tertiary care center in Pakistan. The results are expected to help develop a risk stratification scheme to identify patients at risk for self-extubation.

## 2. METHODOLOGY

Exemption for patient consent was obtained from the institutional Ethical Review Committee. The files of patients, who self-extubated in the surgical intensive care unit (SICU) of Aga Khan University Hospital, Karachi, Pakistan, during six calendar years, inclusive of January 01, 2010, through December 31, 2016, were examined. Self-extubation was defined as a deliberate action taken by the patient to remove the endotracheal tube from his or her trachea. Patients with tracheostomy or having an accidental extubation were excluded from the study.

A predesigned data collection form was used to collect personal details and data relevant to drug addiction, diagnosis, surgical procedure, and route of intubation. The drugs used for sedation, sedation agitation score, pain score, and nurse-patient ratio and the use of physical restraints at the time of extubation were also noted.

### Statistical analysis

The collected data was entered onto Statistical Package for the Social Sciences (SPSS) version 19. The software was then used to analyze data applying the central limit theorem to calculate the mean and standard deviation for quantitative variables; the Chi-square test was conducted using a  $P < 0.05$  to be significant for qualitative variables. Multivariate logistic regression analysis was performed to identify the independent risk factors for self-extubation

## 3. RESULTS

A total of 618 patients were admitted to the SICU who required mechanical ventilation during the study period. A total of 13 (2.1%) self-extubation episodes were recorded. The mean age of the patients was  $38.46 \pm 16.97$  y, with majority of them being males. Out of thirteen, 3 (23.1%) patients required complete mechanical ventilation and 10 (76.9%) required assist-control mode of mechanical ventilation, which was adjusted to the patient's need, preserves diaphragmatic contraction and allows spontaneous breathing effort. Patients were shifted to SICU after major surgery or due to perioperative complications (Table 1).

**Table 1: Demographic, Sedation Agitation Score and Pain Score Statistics of the Self Extubated Patients**

Variables	Mean $\pm$ SD	Range
Age (y)	$38.46 \pm 16.978$	(16-80)
Sedation Agitation Score	$4.46 \pm 2.025$	(1-6)
Pain score at time of self extubation	$5.31 \pm 2.720$	(1-9)
Total self-extubations	13 (2.1%)	
Mechanical ventilation	3 (23.1%)	
Assist-control ventilation	10 (76.9%)	

*Due to hypoxia and dyspnea, reintubation was performed in 10 (76.9%) patients who had self-extubated.*

The mean sedation agitation score at the time of extubation was  $4.46 \pm 2.02$ , while mean pain score was  $5.31 \pm 2.72$  (Table 1).

Most of the patients 10 (76.9%) were on assist-control mechanical ventilation at the time of self-extubation and 9 (69.2%) of them were not restrained at that moment (Table 1). Nurse to patient ratio was also found to be 1:1. Majority of the patients 7 (53.8%) were not on any sedative infusion, while others received either propofol infusion or combined propofol and nalbuphine infusions (Table 2).

**Table 2: Frequency of drug used for sedation**

Drugs used for sedation	Frequency (%)
None	7 (53.8)
Propofol	3 (23.1)
Propofol with nalbuphine	3 (23.1)

## 4. DISCUSSION

Self-extubation refers to a removal of endotracheal tube by the patient deliberately. Its incidence differs from 4% to 14%,<sup>2,3,4</sup> and is responsible for almost 68% to 95% of

all unplanned extubations.<sup>10</sup> Because of the diversity in the studied ICU population,<sup>5</sup> and differences in the data collection and calculation method, it is difficult to ascertain the precise range of incidence. Our study shows that the incidence of self-extubation in our ICU was 2.1%. This relatively low incidence can be elucidated by the optimal nurse-to-patient ratio in our hospital. As nursing care is the major contributing factor that can increase the probability of self-extubation during the absence of bedside nurse. It was found that an ICU nurse with an experience of more than 4 y can decrease the incidence of self-extubation by 2.6%.<sup>11</sup>

Among numerous risk factors, agitation is responsible for 50–74% of the unplanned extubation, while in comparison to non-agitated patients, the self-extubation rate increases by 26%.<sup>11,12</sup> It is associated with various factors which include failure to communicate, and nursing and ventilator procedures. Patients with a Glasgow Coma Scale of 9–12 were also found to be at increased risk of self-extubation.<sup>13</sup> Many studies have concluded that the primary cause of self-extubation in ICU was inadequate sedation.<sup>12,14</sup>

Inadequate sedation and pain leads to higher frequency of self-extubation among postsurgical patients.<sup>3</sup> The key for optimal sedation is tolerance to the endotracheal tube, while maintaining consciousness. On a subjective scale, the optimal sedation level on Ramsay Sedation Score (RSS) is 2 to 3 but the sedation requirements may vary with the condition of the patient. So, regular assessment is necessary to achieve an optimal level of sedation.<sup>15</sup> However, in our ICU setup, the overall mean sedation agitation score at the time of self-extubation was  $4.46 \pm 2.02$  while mean pain score was  $5.31 \pm 2.72$ . It is also necessary to prevent over-sedation in ventilated patients and utilize standard weaning protocol, since this has been related with an increased rate of nosocomial infections and reintubations, and hence prolongs the mechanical ventilation and ICU stay.<sup>11</sup>

Other factors that increase the risk of self-extubation include male sex, older age, postsurgical and sedation given as per need rather than as a continuous infusion.<sup>16</sup> In a retrospective study, it was found that 47% of self-extubations were between ages of 30–50 y, while the mean age was 65 y.<sup>17</sup> The increased incidence of self-extubation was found during the period of off sedation but it has been suggested that the incidence of ventilator-associated pneumonia (VAP) in ventilated patients would be decreased during those periods. Sedation free periods have also been used in ICU as one of the strategies in preventing VAP.<sup>18</sup> The other advantage of using this strategy is to assess neurological status at a cost of reducing sedation levels. Studies have found the increased incidence of agitation and self-extubation in patients receiving benzodiazepines.<sup>17</sup> In the present study, the mean age of patients was 38.46 y with majority

of them being males. The lower rates of self-extubation in patient's age less than 30 y might be due to no comorbidities and they remain intubated for much shorter times. Majority of the patients who were self-extubated had no sedative drug infusion, while others received either propofol infusion or combined propofol and atracurium infusions. Thus, no relation between the incidence of self-extubation and the drugs used for sedation was found.

Self-extubation can compromise airway due to the sudden removal of inflated cuff endotracheal tube which could cause hypotension, arrhythmias, bronchospasm, aspiration, and laryngeal bleeding or edema.<sup>6</sup> However, it can shorten the duration of intubation and weaning in most patients who do not require re-intubation.<sup>6,11</sup> Reintubation occurs in 45% of patients who self-extubated and is associated with an increased mortality compared to patients who self-extubated successfully.<sup>6,13</sup> In about 85–90% of cases, reintubations occur within an hour of self-extubation,<sup>5</sup> due to many factors which include; increased fraction of inspired oxygen concentration ( $\text{FiO}_2$ ), a decreased ratio of arterial oxygen tension to fraction of inspired oxygen concentration ( $\text{PaO}_2/\text{FiO}_2$ ), assist or control mode ventilation, female gender, decreased consciousness related to sedative medications, sepsis, increased bronchial secretions, tachycardia, temperature above  $37.5^\circ\text{C}$ , pH greater than 7.45, and poor pulmonary compliance.<sup>6,11</sup>

It was found that reintubation in most patients is due to hypoxia and dyspnea, which necessitate reassessment of the protocols related to nursing and sedation in ICU. In a previous study, an interesting finding was observed that the outcome of the patients who suffered self-extubation is better than those with accidental extubations.<sup>19</sup>

Physical restraints are often used to prevent self-extubation in patients who have delirium and agitation. A quality improvement initiative found a 6% decline in the self-extubation episodes by using restraints in agitated patients, which was most likely due to an increase in sedation.<sup>20</sup> Most of the patients in our setup were not restrained at the time of self-extubation as restraining in itself can increase the risk for self-extubation by worsening agitation and delirium.<sup>17</sup>

## 5. LIMITATIONS

The study has some limitations like it was a retrospective study and based on the data acquired from a single surgical intensive care unit. This affects the ability of the study to be extrapolated to other patient populations such as medical, neurosurgical, and cardiothoracic critically ill patients. Further, multicentered studies with larger sample size are required to study this topic with more authenticity.

## 6. CONCLUSION

The study demonstrated a lower incidence of self-extubation which was found to be due to an optimal nurse-to-patient ratio and adequate sedation. No relation was found between the extubation and the drugs used for sedation. There is a need to analyze other measures to prevent the occurrence of self-extubation, which include effective nursing and sedation protocols, providing staff education and increase patient surveillance during nursing staff shift change, and implementation of alternative approaches instead of physical and pharmacological restraints.

## 7. Availability of data

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

## 8. Competing Interest

The authors have no conflict of interest to declare.

## 10. Authors contribution

MAA: Original concept and Literature search

SR: Data Collection

KMS: Data Analysis and Manuscript Review

MSY: Manuscript writing:

## 11. References

- Moons P, Sels K, De Becker W, De Geest S, Ferdinande P. Development of a risk assessment tool for deliberate self-extubation in intensive care patients. *Intensive Care Med.* 2004;30(7):1348-1355. [PubMed] DOI: [10.1007/s00134-004-2228-2](https://doi.org/10.1007/s00134-004-2228-2)
- de Moura EB, de Araújo Neto JA, De Oliveira Maia M, Lima FB, Bomfim RF. Assessment of the impact of unplanned extubation on ICU patient outcome. *Crit Care.* 2011;15(Suppl 1):P169. DOI: [10.1186/cc9589](https://doi.org/10.1186/cc9589)
- Singh PM, Rewari V, Chandralekha, Arora MK, Trikha A. A retrospective analysis of determinants of self-extubation in a tertiary care intensive care unit. *J Emerg Trauma Shock.* 2013;6(4):241-245. [PubMed] DOI: [10.4103/0974-2700.120363](https://doi.org/10.4103/0974-2700.120363)
- Dasgupta S, Bhattacharya D, Singh SS, Chaudhuri A, Choudhury SD. Airway accidents in critical care unit: A 3-year retrospective study in a Public Teaching Hospital of Eastern India. *Indian J Crit Care Med.* 2016;20(2): 91-96. [PubMed] DOI: [10.4103/0972-5229.175946](https://doi.org/10.4103/0972-5229.175946)
- Denny J, Pantin E, Denny J, Grubb W, Tse J, Chyu D, et al. Self-Extubation in the Surgical Intensive Care Unit and Restraint Policy Change: A Retrospective Study. *Open Med J.* 2009;1:10-14. DOI: [10.2174/18742203014010010](https://doi.org/10.2174/18742203014010010)
- Kiekkas P, Aretha D, Panteli E, Baltopoulos GI, Filos KS. Unplanned extubation in critically ill adults: clinical review. *Nurs Crit Care.* 2013;18(3):123-134. [PubMed] DOI: [10.1111/j.1478-5153.2012.00542.x](https://doi.org/10.1111/j.1478-5153.2012.00542.x)
- Nseir S, Makris D, Mathieu D, Durocher A, Marquette CH. Intensive Care Unit-acquired infection as a side effect of sedation. *Crit Care.* 2010;14(2):R30. [PubMed] DOI: [10.1186/cc8907](https://doi.org/10.1186/cc8907)
- Gommers D, Bakker J. Medications for analgesia and sedation in the intensive care unit: an overview. *Crit Care.* 2008;12 Suppl 3(Suppl 3):S4. [PubMed] DOI: [10.1186/cc6150](https://doi.org/10.1186/cc6150)
- Wunsch H, Kress JP. A new era for sedation in ICU patients. *JAMA.* 2009;301(5):542-544. [PubMed] DOI: [10.1001/jama.2009.24](https://doi.org/10.1001/jama.2009.24)
- Bouza C, Garcia E, Diaz M, Segovia E, Rodriguez I. Unplanned extubation in orally intubated medical patients in the intensive care unit: a prospective cohort study. *Heart Lung.* 2007;36(4):270-276. [PubMed] DOI: [10.1016/j.hrtlng.2006.10.002](https://doi.org/10.1016/j.hrtlng.2006.10.002)
- King JN, Elliott VA. Self/unplanned extubation: safety, surveillance, and monitoring of the mechanically ventilated patient. *Crit Care Nurs Clin North Am.* 2012;24(3):469-479. [PubMed] DOI: [10.1016/j.ccell.2012.06.004](https://doi.org/10.1016/j.ccell.2012.06.004)
- Woods JC, Mion LC, Connor JT, Viray F, Jahan L, Huber C, et al. Severe agitation among ventilated medical intensive care unit patients: frequency, characteristics and outcomes. *Intensive Care Med.* 2004;30(6):1066-1072. [PubMed] DOI: [10.1007/s00134-004-2193-9](https://doi.org/10.1007/s00134-004-2193-9)
- Chang LC, Liu PF, Huang YL, Yang SS, Chang WY. Risk factors associated with unplanned endotracheal self-extubation of hospitalized intubated patients: a 3-year retrospective case-control study. *Appl Nurs Res.* 2011;24(3):188-192. [PubMed] DOI: [10.1016/j.apnr.2009.09.002](https://doi.org/10.1016/j.apnr.2009.09.002)
- Mion LC, Minnick AF, Leipzig R, Catrambone CD, Johnson ME. Patient-initiated device removal in intensive care units: a national prevalence study. *Crit Care Med.* 2007;35(12):2714-2720. [PubMed] DOI: [10.1097/01.ccm.00000291651.12767.52](https://doi.org/10.1097/01.ccm.00000291651.12767.52)
- Svenningsen H, Egerod I, Videbech P, Christensen D, Frydenberg M, Tønnesen EK. Fluctuations in sedation levels may contribute to delirium in ICU patients. *Acta Anaesthesiol Scand.* 2013;57(3):288-293. [PubMed] DOI: [10.1111/aas.12048](https://doi.org/10.1111/aas.12048)
- Balon JA. Common factors of spontaneous self-extubation in a critical care setting. *Int J Trauma Nurs.* 2001;7(3):93-99. [PubMed] DOI: [10.1067/mtn.2001.117769](https://doi.org/10.1067/mtn.2001.117769)
- Tung A, Tadimeti L, Caruana-Montaldo B, Atkins PM, Mion LC, Palmer RM, et al. The relationship of sedation to deliberate self-extubation. *J Clin Anesth.* 2001;13(1):24-29. [PubMed] DOI: [10.1016/s0952-8180\(00\)00237-3](https://doi.org/10.1016/s0952-8180(00)00237-3)
- Koenig SM, Truitt JD. Ventilator-associated pneumonia: diagnosis, treatment, and prevention. *Clin Microbiol Rev.* 2006;19(4):637-657. [PubMed] DOI: [10.1128/CMR.00051-05](https://doi.org/10.1128/CMR.00051-05)
- Bhattacharya P, Chakraborty A, Agarwal P. Comparison of outcome of self-extubation and accidental extubation in ICU. *Indian J Crit Care Med.* 2007;11(3):105-108. DOI: [10.4103/0972-5229.35081](https://doi.org/10.4103/0972-5229.35081)
- Frezza EE, Carleton GL, Valenziano CP. A quality improvement and risk management initiative for surgical ICU patients: a study of the effects of physical restraints and sedation on the incidence of self-extubation. *Am J Med Qual.* 2000;15(5):221-225. [PubMed] DOI: [10.1177/106286060001500507](https://doi.org/10.1177/106286060001500507)