

Analysis of Delayed Extubation among Surgical Patients: A One-year Prospective Observational Study

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Abstract

Context: Endotracheal intubation is the gold standard of a secure airway under general anaesthesia and extubation at the end of surgery is a norm. However this does not happen in all the patients. Delayed extubation after surgery occurs in small percentage of patients due to various reasons which would have been decided preoperatively or sometimes intraoperatively. But sometimes its unexpected due to unanticipated complications in perioperative period. *Aim:* This study was conducted to analyze prevalence and causes of delayed extubation among surgical patients. *Setting and Design:* It was a one year prospective observational study of patients with delayed extubation after surgical procedures. *Results:* Prevalence of delayed extubation among surgical patients operated under anesthesia was 4.32%. Preoperative variable which showed higher percentage of delayed extubation were age above 40 years, male gender, ASA PS II and above. Among operative variables, delayed extubation was seen more in surgical procedures like intraabdominal surgeries and head and neck surgeries and patients under general anesthesia. Delayed extubation was planned in 70.32% of surgical patients. Intraoperative events like hypotension, blood loss, starting of inotropes and duration of surgery also has an influence on delayed extubation. *Conclusion:* Delayed extubation, though not frequent, will be required in some surgical patients. It has its own morbidity and mortality. Prolonged intubation and mechanical ventilation after delayed extubation is more harmful as it is associated with complications.

Keywords: Delayed extubation; General anesthesia; Surgical patients.

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Introduction

Endotracheal intubation is the gold standard of maintaining patent and protected airway under general anesthesia and extubation after surgery is the norm. However, this may not be possible in all

surgical cases, as in a small percentage of surgical patients extubation has to be delayed. Delayed extubation is removal of the endotracheal tube outside the operative room in the postoperative period after surgical procedure. Such patients are shifted to the postanesthesia care unit (PACU) or

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Intensive Care Unit (ICU) with endotracheal tube for postoperative care.

The need for delayed extubation cannot always be predicted in the preoperative period as it also depends on the perioperative events. Mortality and morbidity can occur during anesthesia and they are influenced by many nonanesthetic factors as well.¹ Prevalence of delayed extubation depends on the level of care, expertise and facilities. It is associated with its own complications like postoperative pulmonary complications, increased length of stay in hospital and increased cost burden on patients.

Delayed extubation is routinely seen in cardiac and neurosurgical cases and studies are reported on delayed extubation in these specialties. Literature is scanty with regard to the prevalence, causes and outcome of delayed extubation among other surgical specialties. Hence, we conducted a clinical audit in our hospital to find out the prevalence and analyze causes and outcome of delayed extubation among surgical patients.

Materials and Methods

This is a prospective observational study conducted in the department of anesthesiology from February 2018 to January 2019. After institutional ethical committee clearance for study, all adult surgical patients who had delayed extubation were included. We excluded patients aged below 18 years. Cardiac and neurosurgery patients were also excluded as these patients are routinely shifted to ICU with endotracheal tube after the surgery. We divided the variables into preoperative, intraoperative, postoperative and outcome variables.^{1,2}

Preoperative variables were age, gender, American society of anesthesiologist physical status (ASA PS). Operative variables were elective or emergency surgery, type of surgical procedure and anesthesia, airway related issues like difficult intubation, duration of surgery. Intraoperative events like hypotension, blood loss, inotropes, arrhythmias, intraoperative myocardial infarction and cardiac arrest, if any were also noted.

Postoperative events like delayed recovery from anesthesia and neuromuscular blockade, inadequate reversal or residual neuromuscular blockade, inadequate respiratory efforts, stridor, laryngospasm, postthyroidectomy nerve injury or tracheomalacia if any were noted. We also noted the reason for shifting with an endotracheal tube

and whether it was planned or unplanned in the preoperative period. The decision of shifting the patients with the endotracheal tube was taken only by the treating consultant and we did not have any influence over it.

Data was analyzed using SPSS software version 20. Mean and standard deviation was used for continuous data and number and percentage for categorical data was used.

Results

Prevalence of delayed extubation was around 4.32% among surgical patients. Among 3587 patients who underwent surgery after meeting the inclusion and exclusion criteria, we had 155 delayed extubation. Preoperative variables are described in Table 1. The median age of the patients was 55 years with the youngest patient of 19 years and the eldest patient of 85 years. We had 35 (22.58%) patients belonging to age below 40 years and 120 (77.41%) patients in above 40 years of age. Percentage of delayed extubation was higher in male patients (67.1%) in our study. Patients belonging to ASA PS class II and above were around (68.38%) in the delayed extubation group.

We saw delayed extubation more common among elective surgical procedures. The type of surgical procedures done in patients with delayed extubation were intraabdominal surgeries or intraabdominal with transthoracic approach surgery in 63 (40.64%) patients, head and neck and maxillofacial surgeries in 61 (39.35%) patients and 31 (20%) patient underwent other procedures such as orthopedic surgery, hernioplasty, debridement's, Transurethral Resection of Prostate (TURP) and laparoscopic surgery.

Surgical procedures were done under general anesthesia with or without epidural anesthesia in 151 patients. In four patients, surgery was started under regional anesthesia but later patients were intubated due to intraoperative complications. Airway management in 44 (39.8%) patients were difficult and delayed extubation was anticipated here as these patients were either undergoing head and neck surgery or maxillofacial surgeries.

Duration of surgery was less than 4 hours in 57 (36.77%) patients, was between 4 and 8 hours in 83 (53.54%) patients and was more than 8 hours in 15 (9.67%) patients, (Table 2).

Table 1: Preoperative variables

S. No	Preoperative variables	No of cases (cohort = 155)	
1.	Age (years) (median)	55 (19-85)	
2.	Distribution of age	<i>n</i> (%)	
	< 40 years	35 (22.58)	
	> 40 years	120 (77.41)	
3.	Gender	<i>n</i> (%)	
	Male	104 (67.1)	
	Female	51 (32.9)	
4.	ASA PS	Elective <i>n</i> (%)	Emergency <i>n</i> (%)
	I	31 (20)	18 (11)
	II	63 (40)	14 (9)
	III	14 (9)	13 (8.4)
	IV	0	2 (1.3)

Delayed extubation was planned in 109 (70.32%) patients and 46 (29.67%) patients had unplanned delayed extubation. Patients who had planned or unplanned delayed extubation were shifted to

either ICU or PACU. All the ICU patients were mechanically ventilated. Eighteen (11.6%) patients were shifted to PACU where they were connected to T-piece and spontaneous ventilation.

Table 2: Operative variables

S. No		No of patients	Percentages (%)
1.	Type of surgery		
	Elective	108	69.67
	Emergency	47	30.32
2.	Type of Surgical procedure	<i>n</i> = 155	
	Intraabdominal/intrathoracic surgery	63	40.64
	Head and neck/maxillofacial surgery	61	39.35
	Others	31	20.00
3.	Type of anesthesia	<i>n</i> = 155	
	GA+ETT+IPPV with or without EA	138	89.03
	GA+DLT+IPPV with or without EA	13	8.38
	SA	4	2.58
4.	Airway management	<i>n</i> = 155	
	Easy	107	69.03
	Difficult	44	28.38
	Nil	4	
5.	Duration of surgery	<i>n</i> = 155	
	< 4 hours	57	36.77
	4-8 hours	83	53.54
	> 8 hours	15	9.67
6.	Type of delayed extubation	<i>n</i> = 155	
	Planned	109	70.32
	Unplanned	46	29.67
7.	Shifted to	<i>n</i> = 155	
	ICU	137	88.38
	PACU	18	11.61

Intraoperative events which lead to delayed extubation were the risk of airway oedema (42.58%) which was anticipated in most of the head and neck surgery and maxillofacial surgery, hypotension

(31.6%), blood loss > 1000 ml (18.1%), starting of inotropes (20%) in the intraoperative period. Other cardiovascular related causes were arrhythmias (4.5%), intraoperative cardiac arrest (2.6%) and

intraoperative myocardial infarction (1.3%), (Table 3). In few cases, delayed extubation was decided at the time of extubation when there were complications like delayed recovery from anesthesia (10.3%), stridor (3.9%), residual neuromuscular blockade

(3.9%), laryngospasm (3.2%), postobstruction pulmonary oedema (1.9%), postthyroidectomy nerve injury (3.2%) and tracheomalacia (1.9%). Delayed extubation was done due to long duration surgery in 10.3% of patients.

Table 3: Problems during the intraoperative period

Problems encountered	Present	Percentages (%)
Airway oedema	66	42.58
Hypotension	49	31.60
Blood loss > 1000 ml	28	18.10
Inotropes	31	20.00
Arrhythmias	7	4.50
Cardiac arrest	4	2.64
Laryngospasm	5	3.20
Stridor	6	3.90
Nerve injury	5	3.20
Residual NM blockade	6	3.90
Tracheomalacia	3	1.90
Pulmonary oedema	3	1.90
Delayed recovery from anesthesia	16	10.30
Intraoperative MI	2	1.30
Unanticipated difficult airway	1	0.64
Long duration surgery	15	9.70

There were 10 (6.45%) deaths among the delayed extubation patients. Tracheostomy was required in six patients. Reintubation was required in nine patients within 24 hours of extubation, (Table 4). Causes of reintubation were drowsiness, tachypnea and hemodynamic instability postextubation. We did not follow up on whether there was readmission, any complications or death after discharge from ICU or PACU. We also noted how long it took to extubate the patients in the postoperative period,

25 (17.9%) patients were extubated in less than 24 hours, 86 (61.8%) patients took between 24 and 48 hours for extubation and 28 (20.1%) patients took more than 48 hours to extubate, (Table 5). Causes of delay of more than 48 hours to extubate were reduced level of consciousness in 12 (42.85%) patients, hemodynamic instability in 8 (28.57%) patients, pneumonia in 5 (17.85%) patients and sepsis in 3 (10.7%) patients.

Table 4: Outcome of delayed extubation

		Percentages (%)
Extubated	139/155	89.67
tracheostomy	6/155	3.87
Death	10/155	6.45
Reintubation required in 24 h	9/142	6.25
Time to extubate	<i>n</i> = 139	%
< 24 h	25/139	17.98
24–48 h	86/139	61.87
> 48 h	28/139	20.14

Table 5: Showing time taken to extubate patients

Time to extubate	<i>n</i> = 139	Percentages (%)
< 24 h	25/139	17.98
24–48 h	86/139	61.87
> 48 h	28/139	20.14

Discussion

In this prospective observational study, the prevalence of delayed extubation was around 4.32%. Delayed extubation was seen in higher percentage in age above 40 years, male patients, and ASA PS class II and above. Studies show that age, gender and ASA PS has an influence on ICU admission and mortality among surgical patients.^{2,3} In a study done by Anastasian et al. found that age, ASA PS class and long duration of surgery had an influence on the decision to delay extubation in multilevel spine surgery. They noted that there was an association with long duration of surgery and large volume of crystalloid infusion in prone position which lead to airway and tissue oedema due to which extubation was delayed in these patients.⁴ Our study showed higher percentage of delayed extubation among male patients. Head and neck malignancies and intraabdominal surgeries being more common among male patients might be one of the reasons.

Advancing age is associated with comorbidities like hypertension, diabetes mellitus and cardiovascular diseases along with lesser physiological reserves to deal with postoperative complications.² We had higher percentage of delayed extubation among patients with age above 40 years. Delayed extubation was more commonly seen in intraabdominal surgery (40.64%) and head and neck surgeries (39.35%) under general anesthesia. Planned delayed extubation was when intraoperative events like blood loss and hypotension and risk of airway oedema were anticipated and planned in the preoperative period. Unplanned delayed extubation was if there were any adverse events in the intraoperative period.

Duration of surgery had an effect on delayed extubation. We noted 63.21% of surgeries which lasted more than four hours had delayed extubation. In a study done among spine surgeries by Li F et al., intraoperative factors like long duration surgery, significant blood loss and blood transfusion, larger volume of crystalloid and colloid infusion are risk-factors for delayed extubation. Early blood transfusion may also increase the risk of delayed extubation. It was also noted patient factors did not affect extubation time and it is intraoperative factors which had an impact on extubation time.⁵

In our study, 70.3% of the patients were planned delayed extubation and only 29.7% of the patients had unplanned delayed extubation. There is an association between type of surgery and anesthesia and delayed extubation. Misal US et al. said the selection of anesthetic technique and anesthetic

drugs determines the duration of unconsciousness. Time to emergence increases with increasing duration of anesthesia.⁶ Exposure to general anesthetic drugs for long duration is associated with longer time to recover from anesthesia which would have led to delayed extubation in few cases.

In head and neck surgery or maxillofacial surgery extubation was delayed due to risk of airway oedema and difficult airway. Singh et al. in the study reported that primary tracheostomy should be considered for patients who have maxillofacial free-flap reconstruction and bilateral neck dissection, or those with oropharyngeal tumors who need additional access procedures. Delayed extubation is safe after free-flap reconstruction and unilateral neck dissection in patients who do not have conditions such as obstructive sleep apnoea or poor lung function.⁷ Coyle et al. said overnight intubation patients in head and neck surgery had better results like shorter mean stay in the intensive care unit than tracheotomized patients.⁸ Most of the extubation in head and neck surgeries were done over airway exchange catheter. Twohig EM et al. suggested that staged extubation is always better in head and neck surgeries.⁹

Lanuti et al. said restricted intraoperative fluid balance, limited blood loss anesthetic technique and epidural use permit most patients undergoing oesophageal resection to be safely extubated immediately postresection in the operating room. We had 15 cases of oesophagostomies who had delayed extubation due to blood loss and prolonged duration of surgery and one lung ventilation and required elective postoperative mechanical ventilation.¹⁰

In a study done by Anastasian et al. said that handoffs by treating anesthesiologists in case of surgeries extending beyond duty hours were associated with delayed extubation after general anesthesia for a broad range of surgical procedures. End time of surgery in odd hours has led to delayed extubation among surgical patients. As the number of anesthesiologist present during odd hours are less in number, extubation is delayed among long duration surgery to avoid complications.⁴

In a study done by Schurner et al. anesthesia related complications were 37%, which were intubation-related and extubation related. In our study, 20 % of patients had extubation related complications which caused unplanned delayed extubation. Extubation related problems in our study were stridor, laryngospasm, postthyroidectomy nerve injury, residual neuromuscular blockade or postobstructive pulmonary oedema.¹¹

Quinn et al. investigated factors associated with unplanned postoperative admissions to the Intensive Care Unit (ICU). They suggested higher ASA PS class, case duration of more than four hours and advanced age are associated with unplanned ICU admission.¹² The preoperative, operative and postoperative variables are interrelated in causing delayed extubation and ICU admissions among surgical patients. Manjula et al. said factors which served as significant predictors of anesthesia intensive care unit admissions were males aged more than 60 years, ASA Grading III or IV, abdominal explorations, emergency operations, history of intraoperative arrhythmias, major blood loss, hypotension requiring inotropic support. They concluded that ICU admission and patient outcome depends on multiple factors.¹³ Delay in extubation can lead to complications like postoperative complications, increased length of stay and financial burden on the patients. Zettervall et al. said delay in extubation in aortic aneurysm repair lead to postoperative respiratory complications, increased length of stay and increased cost on patients.¹⁴ Delayed extubation can be due to various reasons which are unavoidable but prolonged mechanical ventilation and ICU stay is more dangerous as it can lead to complications and morbidity.

Conclusion

In conclusion, our findings suggest that delayed extubation is seen mainly in the age above 40 years, male gender, with ASA PS II and above coming for head and neck or maxillofacial and intraabdominal surgeries and when there are intraoperative complications. Delayed extubation is multifactorial. But most of our patients could be extubated in the postoperative period. It is done mainly to avoid postoperative airway-related complications and hemodynamic instability. Delayed extubation can reduce mortality and morbidity, however prolonged intubation and mechanical ventilation is associated with complications like postoperative pulmonary complications, increased length of stay in ICU and hospital and increased cost on patients.

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