

To Evaluate The Incidence Of Post-Operative Swallowing Impairment In Patients Undergoing Prolonged General Anesthesia With Endotracheal Intubation

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KEYWORDS

Endotracheal intubation, prolonged General anesthesia, Swallowing dysfunction, aspiration pneumonia, swallowing assessment scale (SAS)

ABSTRACT

Background: Endotracheal intubation is either oral or nasal placement of a tube to the trachea for airway management. There have been multiple reports of postoperative swallowing dysfunction in patients undergoing surgery. The mechanism of swallowing impairment is multifactorial and includes mechanical causes, cognitive disturbances after surgery and residual effect of narcotics, sedatives and anesthetic drugs. Several studies have been done on swallowing impairment and dysphagia in critically ill patients in ICU, but as per our none has been done to know the swallowing impairment in patients operated electively. Swallowing dysfunction increases risk of pulmonary aspiration which can lead to serious complications. These complications can increase prolong length of ICU stay, increases number of hospital days and morbidities. This study is planned with purpose to evaluate the incidence of swallowing impairment in electively operated patients undergoing prolonged general anesthesia under endotracheal intubation.

Materials and methods: This was a prospective observational study on patients undergoing elective surgery requiring orotracheal or nasotracheal intubation for duration of more than 6 hours. All the patients were given general anesthesia with endotracheal intubation using standard institutional protocol. The surgical procedure was performed as per proposed plan. All the patients were extubated in the operation theatre and shifted to post-operative unit. Patients were assessed 6 hours after extubation with the swallowing assessment scale (SAS) which was adopted from Eckardt Symptom Score scale. The SAS was used for bolus swallowing examination in which, after recording the vitals of the patient, 3 ml of the distilled water was given for swallowing. Patient was examined for any voice change, cough response, or signs of aspiration like tachycardia or fall in saturation. If patient was able to swallow successfully, 50 ml of distilled water was given to the patient for drinking and was evaluated by SAS. Patient was further evaluated six hourly till 24 hours. If the patient fails to pass the bolus swallow examination (BSE) test at any point of time, patient was said to have severe swallowing impairment. The incidence and severity of swallowing impairment were recorded at different time point for each patient.

Results: A total of 208 patients were assessed for the eligibility of the study. 150 patients satisfied the inclusion criteria, and so, were included. Swallowing impairment after BSE with 50 ml of water was present in 14 patients, and thus, the incidence of swallowing impairment after general anesthesia with endotracheal intubation in this study was found to be 9.3%. Blood oxygen saturation was significantly lower in patients with swallowing impairment ($p < 0.05$) at all point of observation, while other hemodynamic parameters (heart rate, respiratory rate, and

blood pressure) were comparable in both group of patients ($p>0.05$). The study shows that swallowing impairment is not significantly associated with age, sex or type of surgical procedure performed ($p>0.05$).

Conclusion: The results indicate that systematic assessment of swallowing difficulties in the patients undergoing prolonged general anesthesia with endotracheal intubation is important to prevent complications associated with swallowing disfunction.

Introduction

Endotracheal intubation is either oral or nasal placement of a tube to the trachea for airway management. This tube, called as endotracheal tube creates an open passage to the upper airways, enabling ventilation of the lungs. The patient is connected to the mechanical ventilator to provide continuous respiration with a flexible endotracheal tube.

During the past several years, an apparent increase in the frequency of swallowing dysfunction after cardiac surgeries have been reported(1-3). Dysfunctional swallowing increases the risk of pulmonary aspiration, and thus is a potentially serious postoperative complication. The mechanism of swallowing impairment is multifactorial and includes mechanical causes, cognitive disturbances after surgery and residual effect of narcotics and anxiolytics drugs (4). Mechanical causes directly related to the duration of intubation and endotracheal tube size, since these tubes causes mucosal inflammation leading to loss of architecture, oropharyngeal muscle atrophy from disuse during intubation, diminished proprioception, decreased laryngeal sensation and laryngeal injury, like edema granuloma and vocal cord paralysis (4, 5). Damage to peripheral or bulbar nerves in traumatic brain injury leading to alteration in cognition and impaired swallowing reflux also causes post-extubation dysphagia (PED) (4).The effect of age on the incidence and severity of swallowing dysfunction after extubation has been both supported and rejected in the literature (6), so, the association remains inconclusive.

Swallowing impairment following extubation may cause aspiration pneumonitis, leading to hypoxemia, bronchospasm or mechanical obstruction of airway due to atelectasis can ultimately leading to malnutrition, lengthened hospital-stay, increased financial burden and increased mortality (4). Pre-existing neurological morbidities like stroke and neuromuscular disease, altered mental status, older age, prolonged ventilatory support, decompensated congestive heart failure, prolonged in-situ tracheostomy or Ryle's tube, surgery of head and neck, and history of recent trans-esophageal echocardiography have been seen to be associated with a high risk of PED (4, 7-9).

Several studies have been done on swallowing impairment and dysphagia in critically ill patients in ICU but none has been done to know the swallowing impairment in patients operated electively. Therefore, this study was done with the purpose to evaluate the incidence of swallowing impairment in electively operated patients undergoing prolonged general anesthesia under endotracheal intubation.

Materials and methods

Study Design

This was a prospective observational study done between (Month) and (Month)after institutional ethics committee approval and registration at the Central Trial Registry- India. Before the enrollment in the study, informed consent was taken from all the patients. Ethics standard was maintained according to the Declaration of Helsinki (2013).

Study participants

The study included 150 patients of ages between 18 and 60 years, of either sex, with ASA physical status I, undergoing elective surgery requiring orotracheal or nasotracheal intubation for duration of more than 6 hours. Patients with pre-existing swallowing difficulty or dysphasia, with oral, neck and throat pathology, or undergoing oral, throat, neck, and esophageal surgeries, requiring intubation for

more than 24 hours, who were confused or incapable of following commands, requiring preoperative oxygen or blood oxygen saturation less than 94%, requiring nil per oral 6 hours after surgery, who were tracheostomized or with Ryle's tube in-situ at the time of examination, were excluded from the study.

Study Intervention

Pre-anesthetic assessment including airway assessment and swallowing examination were done one night prior to surgery. Written and informed consent were taken from all the patients for the enrollment in the study. Patients were kept nil-per-oral according to the standard protocol.

All the patients were given general anesthesia with endotracheal intubation using standard institutional protocol. The surgical procedure was performed as per proposed plan. All the patients were reverted back from general anesthesia and extubated in the operation theatre and shifted to post-operative unit. Patients were assessed 6 hours after extubation with the swallowing assessment scale (SAS) which was adopted from Eckardt Symptom Score scale (10).

The SAS was used for bolus swallowing examination in which, after recording the vitals of the patient, 3 ml of the distilled water was given for swallowing. Patient was examined for any voice change, cough response, or signs of aspiration like tachycardia or fall in saturation. If the patient showed any of the above sign, test was abandoned and next evaluation was to be done after six hours, if the patient was able to tolerate the test at that time. If the test was successful, 50 ml of distilled water was given to the patient for drinking and was evaluated by SAS. Patient was further evaluated six hourly till 24 hours. If the patient fails to pass the bolus swallow examination (BSE) test at any point of time, patient was said to have severe swallowing impairment. Thus, the incidence and severity of swallowing impairment were recorded at different time point for each patient. All the patients were examined by an expert anesthesiologists and supportive medical team.

Outcome Measures

Primary outcome measure: The incidence of swallowing impairment after general anesthesia following prolonged endotracheal intubation

Secondary outcome measures: The effect of age, sex, and duration of intubation on swallowing impairment, the association of hemodynamic parameters with swallowing impairment, and the risk factors associated to the BSE.

Sample Size Estimation

Incidence of swallowing impairment in patients undergoing prolonged intubation is 60%. Hence assuming an error of 15% (equivalent to 9% of margin of error) in the assumed incidence, at a minimum two-sided 95% confidence interval, we would need a sample of 114 patients. In this study we were targeting 150 patients to take care of drop out. Sample size estimated using power analysis and sample size, version 8.0 (SPSS 2008).

Statistical analysis

Data was recorded on a predesigned proforma and managed in a Microsoft Excel spreadsheet. All the entries were double-checked for any possible keyboard error. The data obtained were analyzed using SPSS software version 20.0 for Windows (SPSS, Chicago, IL). Continuous data are presented as means with standard deviations. Categorical data are presented as the percent frequency occurrence. To test the association/ difference in proportions between the variables, Chi-square test/ Fisher exact test was used. To compare the means/ medians between the groups, independent samples t-test/ Mann Whitney U test was used. P value <0.05 was considered as statistically significant.

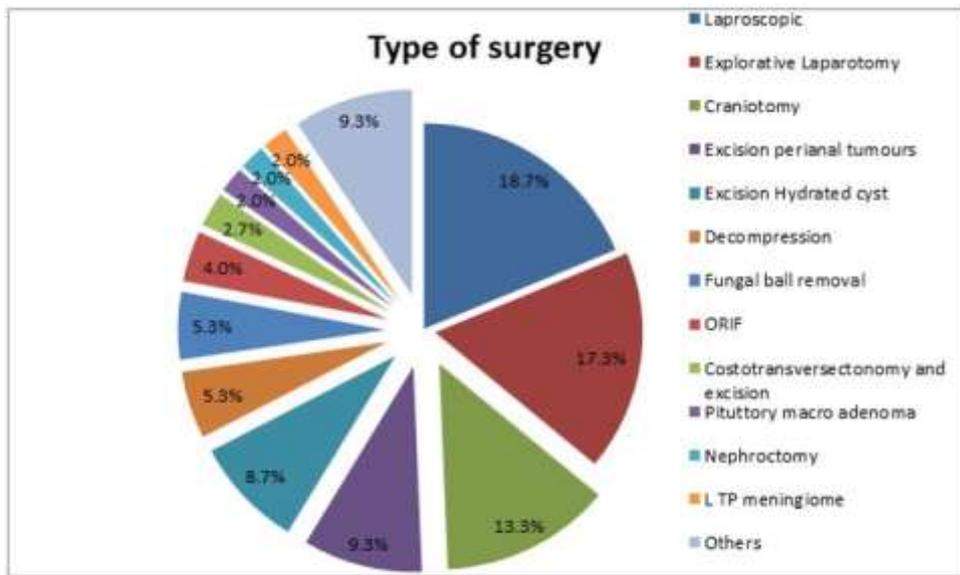
Results

A total of 208 patients were assessed for the eligibility of the study. 150 patients satisfied the inclusion criteria, and so, were included. Demographic parameters of the included patients have been detailed in Table 1.

Table 1: Demographic parameters of the included patients

Demographic parameter		N (%)	Mean ± SD
Age Group (Years)	18 - 30	29 (19.3)	41.89±11.65
	31 - 40	31 (20.7)	
	41 - 50	43 (28.7)	
	51 - 60	47 (31.3)	
Sex Distribution	Male	110 (73.3)	-
	Female	40 (26.7)	-
Duration of Anesthesia	Hours	150 (100)	6.28 ± 0.19

Data are presented either as numbers (percentage) or mean + SD.



LTP meningioma: Lateral temporal parietal lobe meningioma

Figure 1 shows the distribution of patients in the study on the basis of the type of surgery.

Majority of the patients (36.0%) underwent laparoscopic and laparotomy surgeries followed by excision of perianal tumors, excision of hydatid cyst, craniotomy, nephrectomy and other surgeries. Swallowing impairment after BSE with 50 ml of water was present in 14 patients, and thus, the incidence of swallowing impairment after general anesthesia with endotracheal intubation in this study was found to be 9.3%. Table 2 demonstrates the difference in the swallowing impairment according to the age, sex, and duration of intubation.

Table 2: Relationship between swallowing impairment and demographic parameters

Demographic parameters		Bolus Swallowing Examination		P value
		Abnormal (n=14)	Normal (n=136)	
Age Group (Years)	18 – 30	5 (35.7)	24 (17.6)	0.139*
	31 – 40	4 (28.6)	27 (19.9)	
	41 – 50	4 (28.6)	39 (28.7)	
	51 – 60	1 (7.1)	46 (33.8)	
	Age (Mean±SD)	33.93±12.12	42.71±11.33	0.007#
Sex distribution	Male	11 (78.6)	99 (72.8)	0.642*
	Female	3 (21.4)	37 (27.2)	
Duration of intubation	Hours	6.29±0.16	6.27±0.20	0.845#

*Chi square test; #Independent sample t test.

Data are presented either as numbers (percentage) or mean + SD.

Table 3 represents the association of hemodynamic parameters with swallowing impairment. Blood oxygen saturation was significantly lower in patients with swallowing impairment ($p < 0.05$) at all point of observation, while other hemodynamic parameters (heart rate, respiratory rate, and blood pressure) were comparable in both group of patients ($p > 0.05$).

Table 3: Relationship between swallowing impairment and hemodynamic parameters at different time interval

Hemodynamic parameters		Bolus Swallowing Examination		P value#
		Abnormal (n=14)	Normal (n=136)	
Before Surgery	RR (Breath/min)	19.86±1.46	19.05±2.00	0.145
	HR (Beats/min)	78.43±12.36	79.86±16.57	0.754
	SBP (mmHg)	130.71±3.00	126.24±9.57	0.084
	DBP (mmHg)	81.71±3.67	76.97±6.42	0.007
	Saturation (%)	93.57±2.44	93.99±2.73	0.587
12 hours after intubation	RR (Breath/min)	19.86±1.46	19.25±2.11	0.295
	HR (Beats/min)	82.71±9.94	79.34±14.72	0.404
	SBP (mmHg)	126.29±5.70	125.98±6.33	0.862

	DBP (mmHg)	79.86±2.77	79.83±6.75	0.989
	Saturation (%)	92.50±.52	93.76±1.95	0.017
18 hours after Intubation	RR (Breath/min)	20.93±2.16	19.87±2.65	0.152
	HR (Beats/min)	80.64±11.32	78.33±13.95	0.550
	SBP (mmHg)	128.14±4.74	127.97±6.45	0.923
	DBP (mmHg)	83.07±5.88	74.34±6.69	<0.001
	Saturation (%)	92.36±1.45	93.88±2.13	0.010
24 hours after Intubation	RR (Breath/min)	20.00±1.57	19.71±2.53	0.678
	HR (Beats/min)	80.57±13.391	80.29±15.42	0.947
	SBP (mmHg)	134.86±15.41	127.93±7.82	0.005
	DBP (mmHg)	76.86±9.66	75.38±7.85	0.514
	Saturation (%)	90.71±2.89	94.35±2.20	<0.001

#Independent sample t test

RR: Respiratory rate; HR: Heart rate; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure. Table 4 shows the risk factors associated to the BSE. The study shows that swallowing impairment is not significantly associated with age, sex or type of surgical procedure performed ($p>0.05$).

Table 4: Risk factors associated to the Bolus Swallowing Examination

Risk factors		Bolus Swallowing Examination		Odds Ratio	P value
		Abnormal (n=14)	Normal (n=136)		
Age Group	≤40 Years	9 (64.3)	51 (37.5)	3.00	0.051
	>40 Years	5 (35.7)	85 (62.5)		
Sex group	Male	11 (78.6)	99 (72.8)	1.370	0.642
	Female	3 (21.4)	37 (27.2)		
Surgery Group	Laparoscopy & Laparotomy	6 (42.9)	48 (35.3)	1.375	0.575
	Others surgery	8 (57.1)	88 (64.7)		

Data are presented as numbers (percentage).

Discussion

Endotracheal intubation is a crucial procedure done during general anesthesia or for ventilatory support in intensive care units, but the presence of this invasive tube can affect the resumption of oral intake afterwards. Artificial airways can have adverse effects on laryngeal proficiency and

swallowing physiology(5). Literature has evidence of swallowing impairment following prolonged stay in ICU (11-14) but the evidence is lacking in regard to the impairment in patients after prolonged elective surgical procedures under general anesthesia. Therefore, this study was conducted on the patients undergoing prolonged general anesthesia for elective surgeries to find out the incidence of swallowing impairment after orotracheal intubation.

Incidence of swallowing impairment

The incidence of swallowing impairment in our studied population was 14 (9.3%) out of 150 patients. A systematic review (5) was done that reported a variable frequency of dysphagia following endotracheal intubation done in the course of hospitalization, ranging from 3% to 62%. Most of the included studies were of poor quality with high risk of bias involved, which could have been the reason for such variable reporting of incidence of dysphagia. Additionally, the assessment methods for swallowing in the included studies were heterogenous and variable, and no correlation was seen between the duration of intubation and the reported dysphagia frequencies. So, the accuracy of the estimated frequency remains questionable. The results could not be extrapolated to compare to the present study because in most of the included studies of the review, the patients who were considered at high risk of dysphagia according to the history were included, and there was a huge variability in the patient-reported symptoms of dysphagia used.

Demographic profile of studied patients

In the present study the mean age of the patients with swallowing difficulty in the post-operative period was 33.93 ± 12.12 years, while the patients who didn't have any difficulty were significantly older with mean age 42.71 ± 11.33 years ($p=0.007$). The mean age of the total studied patients was 41.89 ± 11.65 years with range of age of the included patients was 18 to 60 years. Charles W. Hogue et al [15] reported that the mean age of patients with swallowing dysfunction was 71.0 ± 2.0 years and patients with no swallowing dysfunction was 63.0 ± 0.4 years ($p<0.001$). Madsen G et al [17] screened the patients with a mean age of 81.4 ± 7.8 years. So, most of the studies done so far have included an older age group patients probably predicting the higher incidence in them, and this may have led to the difference in the mean age of population of our study from others.

In the present study, it was found that the oxygen saturation of patients was significantly lower in patients with abnormal swallowing in post-operative period when compared to patients with normal swallowing function ($p<0.05$) at every point of time till 24 hours of observation. Rest of the hemodynamic parameters (heart rate, systolic blood pressure, diastolic blood pressure, and respiratory rate) were comparable in both the groups. Swallowing difficulty in the immediate post-operative period may cause aspiration pneumonitis and dehydration which could have led to the difference in the oxygen saturation in the two groups studied. Long term effect of such impairment can be malnutrition, frailty, dehydration, and reduced quality of life leading to depression, social withdrawal, and mortality. These all effects lead to increased hospital stay and recurrent hospitalizations, increasing the economic burden of the patients and family.

In this study the association of sex of patient to the development of swallowing impairment was found to be insignificant ($p=0.642$). The results are consistent with the findings of Charles W. Hogue et al (15), but Madsen G et al (17) reported a higher incidence of impairment among females.

There was insignificant association between mean duration of intubation and swallowing difficulty in the present study ($p=0.08$). It was due to the fact that in our study population all the patients were intubated only for 6 -7 hours. Tsai MH et al (18)found an incidence of 61.7% for postoperative swallowing difficulty with prolonged intubation is at the higher end of the evidence for same. This difference in results from our study might be due to the fact of older age group sample (mean age= 63.4 years with 52.3% being ≥ 65 years) of their study.

Risk factors of swallowing impairment

In the present study, the risk factors (age, sex, and type of surgery) were insignificantly associated with the swallowing difficulty developed after extubation ($p>0.05$). Kalb S et al (19) studied the

correlation of various demographic and surgical factors with the occurrence of postoperative dysphagia after anterior cervical spine surgery. The results had wide-range of variations and any firm conclusion could not be drawn from the results. Kang SH et al (20) opined that cervical plating could be a confounding factor for postoperative dysphagia. According to the authors, the common factors which could be associated with postoperative dysphagia are advanced age, female gender, increased number of vertebral levels operated, and prolonged operative time. In this study we were not able to draw any such correlation probably due to inclusion of other non-neurosurgical procedures also.

Conclusion:

The results indicate that systematic assessment of swallowing difficulties in the patients undergoing prolonged general anesthesia with endotracheal intubation is important to ensure affectivity and safety during meals and thereby prevent secondary complications in the patients. However, because the study was conducted over a small sample size, the results need to be tested in a larger and multicenter study.

Limitations of the study:

- The sample size in this study was relatively small, which may have led to type II error.
- Due to the cross-sectional design in this study, no detection of causal relationships is possible.
- Furthermore, because there was no follow-up, possible changes in swallowing difficulties over time, for instance as a result of physical training, were not identified.

Strengths of the study:

- To our knowledge, there are only a few studies previously focused on swallowing difficulties in patients undergoing prolonged general anesthesia with endotracheal.
- The broader perspective enables a focus on several important prerequisites to swallowing impairment that are highly relevant for the population, for instance their sitting position.
- Swallowing impairment assessment was performed in near about all of the patients who fulfilled the inclusion criteria.

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