

Laryngeal Morbidity Associated with Fiberoptic Tracheal Intubation under General Anaesthesia with and without use of Muscle Relaxant

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Abstract

Objective: The objective of this study was to compare the incidence of laryngeal morbidity after fibre optic tracheal intubation performed under general anaesthesia with versus without muscle relaxant in patients undergoing elective neurosurgical procedures.

Design: Prospective, Randomised.

Patients: 100 patients scheduled for elective neurosurgical procedures of age between 15 and 60 years.

Intervention: Patients were assigned to one of the two Groups [Group MR (with muscle relaxant) or Group Non-MR (without muscle relaxant)]. After confirmation of adequate mask ventilation under General Anaesthesia, patients received either intravenous Rocuronium 1mg/kg (Group MR) or Saline (Group Non-MR) prepared in identical syringes and same volume.

Measurements: The number of attempts before successful intubation and their duration, number of failures, total intubation time, and events during the whole procedure were recorded. On the first postoperative day, an experienced blinded ENT surgeon assessed hoarseness and vocal cords by oral/indirect laryngoscopy. Data are presented as mean (SD) or number (%).

Results: Fifty two patients were in Group MR and 48 patients were in Group Non-MR. The two groups were comparable with respect to age, sex and weight of the patients. Hoarseness was observed in 50% of patients in the MR group vis a vis 54.2% patients in the Non-MR group ($p=0.95$). Vocal cord sequelae were seen in 27% of patients in Group MR and 50% of patients in Group Non-MR ($p<0.018$).

Conclusion: We conclude that although vocal cord sequelae associated with fiberoptic intubation with the use of muscle relaxant is significantly lower than without muscle relaxant, there is not much of difference observed in overall laryngeal morbidity. Authors recommend using muscle relaxant while doing fibre optic tracheal intubation under general anaesthesia, unless contraindicated so that the intubation is easier, better tolerated and associated with less laryngeal morbidity.

Keywords: Fiberoptic intubation; Muscle relaxants; Laryngeal morbidity; Hoarseness; Vocal cord sequelae

Introduction

Optimal airway management by the anaesthesiologists is very important in neurosurgical patients. Difficult intubation and mask ventilation are often encountered [1] and fibre optic intubation without muscle relaxants is the preferred method for the management of the anticipated difficult airway recommended by American Society of Anaesthesiologists [2] this allows rapid return of spontaneous ventilation if required [2]. It also gives anaesthesiologist more time for intubation and can be adopted as a good training module for trainee anaesthesiologists.

Although awake fiberoptic intubation is considered as the safest technique, however, severe laryngeal trauma during awake fiberoptic intubation has been reported [3]. This technique requires full cooperation from the patient and may remain a lifetime dreadful experience for the patient. Tracheal intubation with muscle relaxants is associated with a lower incidence of minor vocal cord sequelae (8%) [4]. There is no comparative study available till date in neurosurgical patients in relation to laryngeal morbidity after fiberoptic intubation with or without use of muscle relaxant.

Aim and Objectives

Comparative evaluation of the incidence of laryngeal morbidity after fibre optic tracheal intubation performed under general

anaesthesia with or without muscle relaxant in patients undergoing elective neurosurgical procedures.

Materials and Methods

After approval from institutional ethical committee, a prospective, randomised study was conducted. 100 patients scheduled for elective neurosurgical procedures, with ASA physical status I and II and aged between 15 and 60 years were included in the study. The patients with history of difficult intubation, preexisting laryngeal pathology, congenital or acquired abnormalities of upper airway, tumours, polyps, trauma, abscess, inflammation and foreign body in upper airway, cardiovascular, respiratory, hepatic, renal, or neuromuscular diseases

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(ASA physical status III-V), nonconsenting patients, those with history of gastroesophageal reflux, patients with coagulation disorders and patients with failed extubation trial postoperatively, were excluded from the study. Patient's age, sex, weight, height, Mallampatti class, mouth opening, and thyromental distance was assessed during preanaesthesia check-up. On arrival in operation theatre, Electrocardiography (ECG), pulse oximetry (SPO₂), non-invasive blood pressure (NIBP), and capnography (EtCO₂) were monitored. Baseline values of NIBP, heart rate (HR), saturation (SPO₂) were recorded and these variables were then monitored every 2 minutes during induction of anaesthesia. Patients were preoxygenated with 100% O₂ via face mask for 3 minutes. General anaesthesia was induced with 2 µg/kg fentanyl, followed by 2 mg/kg propofol intravenously. Anaesthesia was maintained with infusions of propofol 3 mg/kg/hr and fentanyl 1 µg/kg/hr. Patients were assigned to one of the two Groups [Group MR (with muscle relaxant) or Group Non-MR (without muscle relaxant)] by a computer generated block randomization, consisting of 20 patients each. After confirmation of adequate mask ventilation, patients received either intravenous Rocuronium 1 mg/kg (Group MR) or Saline (Group Non-MR) prepared in identical syringes and volume. Fiberoptic intubation was attempted 3 minutes later by an experienced consultant anaesthesiologist with previous experiences of >50 successful fibre optic bronchoscopies. The procedure was performed with patients head placed in neutral position. The following factors were standardized: tube size (men: ID=8.5 mm; women: ID=7.5 mm), type of tube (Portex), the fiberscope (Fujinon 100 series 5 mm fibre optic bronchoscope, Fujinon corporation, Japan) and use of lignocaine gel. No intubation stylet or stomach tube was used. The tube was advanced through the glottis with the bevel facing posteriorly to facilitate smooth introduction of tube into trachea [5]. We stopped any attempt that lasted >3 minutes, desaturation (SpO₂ <92%), or esophageal intubation. In such cases, 100% oxygen for 3 minutes with supplementary bolus of propofol 0.5 mg/kg and fentanyl 0.5 µg/kg were administered prior to next attempt. The number of attempts before successful intubation and their duration, number of failures, total intubation time, and events during the whole procedure were noted. The duration of one attempt was defined as the time between inserting the fiberoptic bronchoscope into the oral cavity and successful tracheal intubation (verified by three expiratory CO₂ waveforms during mechanical ventilation). Total intubation time was defined as the sum total of duration of all intubation attempts and maximum of 3 attempts were allowed. Failure to intubate was defined as inability to place the tracheal tube into trachea after 3 attempts. In such cases direct laryngoscopy was performed and laryngoscopic Cormack Lehane grade and position of vocal cords (open or intermediate) was noted. Events such as patients movement, cough, bronchospasm or laryngeal stridor, mucosal or dental trauma, esophageal intubation and desaturation (SPO₂ <92%) were noted during the fibre optic intubation. Mucosal or dental trauma was defined as presence of blood at the tip of fiberoptic bronchoscope, oropharyngeal bleeding, or dental avulsion. The presence of bronchospasm, laryngeal stridor or mucosal or dental trauma was considered as indicator of stopping the procedure. Hemodynamic disturbances were defined as deviation of mean arterial blood pressure or heart rate more than 20% from baseline values. The hemodynamic disturbances were treated by drugs like atropine for bradycardia, esmolol for tachycardia, and mephenteramine for hypotension. The standard protocol was followed for the maintenance of anaesthesia with Oxygen/Nitrous Oxide/Isoflurane/fentanyl/vecuronium technique. Postoperatively, patients were examined by indirect laryngoscopy by the ENT surgeon for the oropharyngeal and laryngeal morbidity.

Assessment of Vocal Cord Sequelae and Post-Operative Hoarseness

On the first postoperative day at 3 hours post-extubation, an experienced blinded ENT surgeon (unaware of the patient's group assignment) assessed hoarseness and vocal cords by oral/indirect laryngoscopy. In case of pathological findings, examinations were repeated every 24 hours until complete restitution or discharge from the hospital. The grade of hoarseness was recorded as follows: [6,7]

Grade of hoarseness

- 0=no hoarseness
- 1=hoarseness noticed by patient
- 2=hoarseness obvious to the observer
- 3=aphonia

Vocal cord sequelae was assessed as follows: [6,7]

Vocal cord sequelae

I. Location:

1. Unilateral (left or right vocal cord)
2. Bilateral (both vocal cords)

II.Type of sequelae:

1. Thickening of vocal cords (localized swelling of the vocal process of the arytenoids cartilage)
2. Edema (swollen mucosa at the vocal folds)
3. Erythema (redness of the mucosa with surrounding inflammatory swelling)
4. Hematoma (caused by bleeding into the vocal cords)
5. Granuloma of vocal folds (granulation tissue)
6. Arytenoids dislocation or luxation.

Vocal cord sequelae and hoarseness was managed as per the advice of the ENT surgeon.

Statistical Analysis

Statistical analysis was done using software SPSS- version 15. Statistical techniques applied were Chi-square/ Fischer t-test for comparing categorical variables. The comparison between groups at each point of time was carried out by applying student t-test (independent samples) for continuous variables. The change over period of time was seen by using repeated measure analysis followed by post-hoc comparison by LSD (least square deviation) method. The log transformation was also applied to make data normally distributed. Data are presented as mean (SD) or number (%). P<0.05 was considered as significant.

Results

100 patients were enrolled in the study. 52 patients were in Group MR (fiberoptic intubation under general anaesthesia with muscle relaxant) and 48 patients were in Group Non-MR (fiberoptic intubation under general anaesthesia without muscle relaxant). All the patients were successfully intubated in both the groups. The two groups were comparable with respect to age, sex, weight of the patients, and duration of surgery. Most of the patients were operated in prone

position. Duration of each intubation attempt, number of attempts and total intubation time was significantly more in patients without muscle relaxant (Table 1). Hemodynamic changes were similar in two groups. (p=0.5)

Hoarseness was observed in 50% patients in MR group as compared to 54.2% patients in the Non-MR group. (p=0.95) There was no case of permanent hoarseness in our study. Vocal cord sequelae were seen in 27% patients in Group MR and 50% patients in Group Non-MR (p<0.018). In most of the cases, VCS was bilateral but minor (erythema) and self-limiting and did not require any active intervention (Table 2).

Coughing was present in 85.4% patients of Group Non-MR while there was no coughing in the MR group. Patient movements at the time of intubation have been described in Table 3.

Discussion

Injury to the airway during intubation is a well-recognized complication of anaesthesia [8-19]. Laryngeal injury represents 33% of all airway injury claims. Vocal cord paralysis, hematoma or granulomas of vocal cords are frequent laryngeal injuries [8-19].

	Group MR (With MR) n=52	Group Non-MR (Without MR) n=48	p-value
Age (yrs)	37.6 (12)	35.9 (12)	0.5
Weight (kgs)	62.2 (11)	61 (11)	0.5
Sex			
Male	28 (53.8)	30 (62.5)	0.4
Female	24 (46.2)	18 (37.5)	
Duration of surgery (min)	207 (73)	217 (81)	0.5
Duration of attempts (sec)	50 (16)	68.3 (31)	0.0001
Number of attempts	1.1 (0.3)	1.5 (0.6)	0.0001
Total intubation time (sec)	60.1 (37)	133 (100)	0.0001
Airway pressure (cm H ₂ O)	16.4 (2.5)	16.5 (2.8)	0.82
End tidal carbon dioxide	33.2 (1.8)	33.7 (2.1)	0.23
Surgical position			
Prone	47 (90.4)	45 (93.8)	0.6
Supine	4 (7.7)	3 (6.3)	
Others	1 (1.9)	0 (0)	

Table 1: Table showing Demographic and intraoperative data [Mean (SD)].

	Group MR (With MR) n=52	Group Non-MR (Without MR) n=48	p-value
1. Grade of hoarseness			
0	26 (50)	22 (45.8)	0.95
1	21 (40.4)	21 (43.8)	
2	5 (9.6)	5 (10.4)	
3	0 (0)	0 (0)	
2. Location of VCS			
Absent	38 (73.1)	24 (50)	0.05
Unilateral	1 (1.9)	3 (6.3)	
Bilateral	13 (25)	21 (43.8)	
3. Type of VCS			
Erythema	14 (26.6)	20 (41.7)	0.09
Edema/Thickening	0 (0)	3 (6.3)	
Hematoma	0 (0)	1 (2.1)	
Granuloma	0(0)	0(0)	

Table 2: Table showing details of hoarseness and vocal cord sequelae in the two study groups [N (%)].

	Group MR (With MR) n=52	Group Non-MR (Without MR) n=48	p-value
1. Coughing			
Present	0 (0)	41 (85.4)	0.001
Absent	52 (100)	7 (14.6)	
2. Patient movements			
Present	1 (1.9)	34 (70.8)	0.001
Absent	51 (98.1)	14 (29.2)	
3. Esophageal intubation			
Present	0 (0)	2 (4.2)	0.14
Absent	52 (1000)	46 (95.8)	
Present	Present	Present	
4. Desaturation (SpO ₂)			
Present	1 (1.9)	3 (6.2)	0.27
Absent	51 (98.1)	45 (93.8)	
5. Mucosal and dental trauma			
Present	1 (1.9)	0 (0)	0.33
Absent	51 (98.1)	48 (100)	

Table 3: Table showing events during fiberoptic intubation in the two study groups [N (%)].

Hoarseness

Incidence of hoarseness after general anaesthesia varies from 14.4% and 50% [8-19]. It leaves patients dissatisfied and can affect patient's activities even after discharge from the hospital. Prolonged or even permanent hoarseness can occur in 1% of patients [16]. Menke et al. [6,7] reported that adding Atracurium to Propofol-Fentanyl induction regimen decreased the incidence of postoperative hoarseness and its duration. An induction technique without Atracurium was associated with 44% of patients with postoperative hoarseness, while adding Atracurium significantly reduced this incidence to 16%. Jones et al. [20] reported postoperative hoarseness in 32% patients after short term intubation using muscle relaxants. Combes et al. [21] and Yamanaka et al. [22] had similar observation. In the present study, although incidence of hoarseness (50%) was lesser in the MR group compared to 54.2% patients in the Non-MR group, the difference was not statistically significant (p=0.95) The overall incidence of postoperative hoarseness in our study population is slightly greater than the incidences reported previously probably due to prolonged duration of surgery and patients getting operated in the prone position.

Vocal cord sequelae

Kambik et al. [23] examined vocal cord sequelae in 1,000 patients postoperatively using the indirect mirror technique and reported 6.2% direct lesions. These were mainly hematoma or lacerations of the vocal cords. Similar results were reported by Peppard et al. [24] in a cohort of 475 patients. The authors of both studies speculated that poor muscle relaxation at the time of intubation may have been causative for many of the observed laryngeal injuries, although this assumption still has not been proved by any randomized controlled trial. Heidegger et al. [4] reported 8.5% incidence of minor vocal cord sequelae after awake fiberoptic intubation and 9.3% incidence of the same after tracheal intubation with neuromuscular blocking agents and mentioned that fiberoptic intubation without neuromuscular blocking agents is safe.

However, Menke et al. [6] reported that without using muscle relaxant, incidence of vocal cord sequelae was 42% as compared to 8% with using muscle relaxant. Menke et al. [7] in their other study reported vocal cord sequelae with muscle relaxant to be 27%. In our study, vocal cord sequelae was present in 27% of patients in MR group

and 50% in Non-MR group ($p < 0.018$). In most of the cases, VCS was minor (erythema) and self-limiting.

There are several risk factors for laryngeal injury and postoperative hoarseness after anaesthesia. These are tracheal tube size, cuff inflation and design, demographic factors such as sex, type of surgery and duration, nasogastric tube insertion, and head and neck position. [9,14,17,25]. We standardized the size of tracheal tube for males and females. The use of smaller diameter tube is associated with lesser incidence of hoarseness after anaesthesia [14]. The use of cuff manometer and periodic measurement of cuff pressure would reduce mucosal damage and therefore incidence of hoarseness. Low pressure and high volume cuff was used in both the groups, known to cause less hoarseness. No intubating stylet or stomach tube was used in our study. The incidence of resistance to passage of tracheal tube through the vocal cord (rail roading) is found to be higher using the thinner fiberoptic as compared to thicker fiberoptic. The adult fibre optic bronchoscope (Fujinon 100 series 5mm fiberoptic bronchoscope, Fujinon corporation, Japan) used in our study was same in the two groups. Longer duration of intubation was found to be a strong predictor to increase the duration of hoarseness after tracheal intubation [22]. A longer duration of anaesthesia may also produce greater airway injury [20]. In our study, the Non-MR group patients required longer duration of intubation and had more hoarseness and vocal cord sequelae. Duration of individual attempts of intubation (50 ± 16 sec. vs 68 ± 31 sec: $p = 0.0001$) and number of attempts (1.1 ± 0.3 vs 1.5 ± 0.6 ; $p = 0.0001$) were also significantly more in patients who were intubated without muscle relaxant in our study. Duration of surgery/ anaesthesia in the two groups is comparable in our study [$p = 0.5$].

Yamanaka et al have found age to be a significant factor for postoperative hoarseness after tracheal intubation [22]. Mean of age is comparable in the two groups in our study ($p = 0.5$).

In our study, undesirable events like coughing and patient movements were present more common in Non-MR Group patients, which was statistically significant. Coughing and patient movements while intubation might cause mucosal damage leading to higher incidence of hoarseness and vocal cord sequelae. Cough or movements of the patient can increase difficulties of tracheal intubation, promote esophageal intubation, and can trigger other serious complications, such as bronchospasm, laryngospasm, mucosal or dental trauma, or laryngeal injury. Two episodes of esophageal intubation were there in patients in group Non-MR. Desaturation ($SpO_2 < 92\%$) occurred in 3 patients in group Non-MR and 1 patient in group MR. Masso et al. [26] concluded in their study that use of muscle relaxant in patients with apparently normal airways is associated with a lower failure rate, decreased intubation time, and fewer attempts when performing lightwand tracheal intubation. Similar results have been found in our study with fiberoptic tracheal intubation. Bonnin et al. [27] reported 5 episodes of desaturation (SpO_2 under 90%) occurred during fiberoptic intubation in Propofol group compared with none in Sevoflurane group. Episodes of desaturation in our study might be due to the use of Propofol in our study. There were no significant differences in heart rate, mean arterial blood pressure, and peripheral oxygen saturation between two groups in our study ($p = 0.5$).

Limitations

The sample size is small in our study. It is the time bound nature of the study carried out in a single superspecialised centre. The person doing fibre optic cannot be blinded as the presence or absence of vocal cord movement is obvious.

Conclusion

In our study on 100 neurosurgical patients undergoing fibre optic intubation with or without muscle relaxant, it was observed that incidence of hoarseness was lower (50% patients) in muscle relaxant group although statistically not significant ($p = 0.95$) Vocal cord sequelae was significantly lower, 27% patients in muscle relaxant group than in non-muscle relaxant group (50% patients) ($p = 0.018$). Duration of each intubation attempt, number of attempts, total intubation time, coughing and patient movements were significantly more in patients who were intubated without muscle relaxant. Authors recommend using muscle relaxant while doing fibre optic tracheal intubation under general anaesthesia, unless contraindicated so that the intubation is easier, better tolerated and associated with less laryngeal morbidity.

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