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STUDY OF TRACHEAL MUCOSA DAMAGE AFTER EXTUBATION: OUR EXPERIENCES IN TERTIARY CARE CENTRE.

ENT

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ABSTRACT

Background: Even after several advancement of airway management, tracheal intubation with conventional endotracheal tube is gold standard. Endotracheal intubation remains is the most common cause of tracheal mucosa damage (TMD). These TMD are challenging to manage and are associated with significant morbidity and mortality. Hence, the present study was done to find out the incidence, types of TMD and to study the factors affecting the same. **Methods:** A prospective study was conducted on patients who were intubated for more than 48 hours and admitted in medical and surgical intensive care units (ICU) in a tertiary care centre. All patients following after intubation and just before extubation were evaluated for TMD by fiberoptic bronchoscope. **Results:** Sixty patients were included in the study. Majority of the patients 34 (72.4%) were found normal while 13(27.6%) patients were having TMD following extubation in the form of erythema, edema, ulceration, or necrosis. Majority of these patients were aged less than 45 years, with duration of intubation for more than 10 days, with tube size more than 7 mm. Acute respiratory distress syndrome (ARDS) was associated with 6 (12.8%) incidence of TMD. **Conclusions:** A high incidence of TMD especially in cases of acute respiratory distress syndrome need to be cautious in managing these intubated patients. Those patients requiring prolonged intubation should be considered for early tracheostomy with low pressure, high volume cuffed tubes. As the morbidity and mortality of these patients are very high, so an awareness and adequate training of the emergency personnel in the intubation technique and post intubation care of the endotracheal tube is important especially in a tertiary care hospital.

KEYWORDS

Endotracheal Intubation, Fiberoptic Bronchoscopy, Tracheal Mucosa Damage.

INTRODUCTION

Even after several advancement of airway management, tracheal intubation with conventional endotracheal tube is gold standard**.** Endotracheal intubation remains is the most common cause of tracheal mucosa damage (TMD). These TMD are challenging to manage and are associated with significant morbidity and mortality. Endotracheal intubation is the optimum method for protecting the patency of the airway and maintaining oxygenation and ventilation in patients requiring advanced life support.[1,2]

While the indications for intubation are varied, it is commonly used for ventilatory assistance, relief of upper airway obstruction and to aid in tracheobronchial toileting.[3,4] Although it is lifesaving procedure but can result in serious complication which can be fatal to life..[5]

Approximately 10% of patients have demonstrable laryngeal pathologies even a day after intubation for surgery.[6] With longer term intubation and mechanical ventilation for critical illness, the incidence of TMD approaches 90%, with long-term sequelae occurring in 11% of patients.[7] The incidence of postintubation laryngotracheal stenosis that requires surgical correction is 1 in 204,000 adults and 4.9 in 100,000 in children per year.[8]

With the help of high-volume low pressure cuffed endotracheal tubes, patient can be ventilated up to 3 weeks.[9] The presence of endotracheal tube in direct contact with larynx and trachea can provoke injuries to its mucosa and submucosal layer which in turn can lead to ulcerations, granulation tissue and stenosis.[10] These injuries may be temporary in the beginning which can become a permanent sequelae later.[11]

Hence, the present study was done to find out the incidence, types of TMD and to study the factors affecting the tracheal damage.

METHODS

After approval from Institutional Ethical Committee, this observational prospective study was conducted between November 2022 to March 2023 on the patients intubated for more than 48 hours and admitted in medical and surgical ICU at a tertiary care hospital in Sasaram, Bihar.

Inclusion Criteria

All patients aged between 18 to 70 years intubated for more than 48 hours were included in the study.

Exclusion Criteria

Patients with associated comorbidities which interfere in examination like chronic obstructive-pulmonary disease (COPD), asthma, Covid positive cases and pulmonary tuberculosis, age less than 18 years and more than 70 years, those who underwent Cardio Pulmonary Resuscitation (CPR) and tracheostomy were excluded from the study.

History was taken from relatives or next to kin of patient regarding the need for intubation and duration of intubation, medical/surgical history to rule out associated co-morbid conditions like chronic obstructive-pulmonary disease (COPD), asthma, pulmonary tuberculosis, Covid, or any pulmonary disease compromising the ventilation.

The aim and objectives of this study was to find the incidence, types of injury and to study the factors influencing TMD following intubation.

The degree of tracheal mucosa damage was evaluated by using fiberoptic bronchoscopy after intubation (T0) and before extubating (T1). Hypothetically no injury observed at T0 but present at T1 or the worsen injury observed at T0 and exacerbating at T1 was studied. Bronchoscopy through the endotracheal tube allowed a visualization of the tracheal mucosa in front tube. The severity was graded into five categories (no injury, erythema, edema, ulceration, or necrosis). Fiberoptic bronchoscopy was performed by anaesthesiologist blinded for the study. The exact position of ET tube and the pressure of the cuff were checked daily and maintained between 22 and 28 cm H2O to avoid inadvertent mobilization and under or over-inflation of cuff respectively. If a tracheostomy was required, the bronchoscopy was performed before its realization.Informed consent was taken prior to the study and ethics committee clearance was obtained from the Institutional ethics committee.

RESULTS

A total of 60 patients (Table 1) were inducted into the study of which majority of patients (60%) were between 18-30 years. Out of 60 patients, 36 were males and 24 were females with age ranging from 18 to 70 years. Endotracheal tube of size 7, 7.5 and 8 were used in 23.3%, 60% and 16.7% of patients respectively.

Majority of the patients (40%) were acute respiratory distress syndrome followed by metabolic disorders like diabetic ketoacidosis and chronic kidney disease 10(16.7%) and CVA 8 (13.3). Total 26 (43.3%) of the patients were intubated for more than 10 days. (Table1)

Table 1: Characteristics and distribution pattern of patients with tracheal mucosa damage.

Demographic		N (%)
Age (years)	18-30	36 (60)
	31-45	15 (25)
	>45	9 (15)
Gender	Male	36 (60)
	Female	24 (40)
Endotracheal tube dimension		
Size of Endotracheal tube	7	14 (23.3)
	7.5	36 (60)
	8	10 (16.7)
Indication for intubation		
Surgical Case	Planned surgery	10 (10.7)
	Emergency surgery	7 (11.7)
Medical Case	Head injury	3 (5)
	*CVA	8 (13.3)
	Encephalopathies	6 (10)
	**ARDS	16(40)
	Metabolic disorders	10(16.7)
Length of intubation		
Duration (days)	2-5	16(26.7)
	6-10	18(30)
	>10	26 (43.3)

*CVA= Cerebrovascular accident, **ARDS= Acute respiratory distress syndrome

Findings On Fibreoptic Bronchoscopy

Patient were evaluated for TMD following intubation based on fiberoptic bronchoscopy. Of these, three participants had no fiberoptic bronchoscopy at T1, before extubating due to unavailability of trained anaesthesiologist in fiberoptic bronchoscopy (n = 3), self-extubating (n = 1), death of the patient (*n* =9). Consequently, 47 participants were analyzed on the primary end point. The occurrence or worsening of mucosal damage was observed in 20 (22.5%) participants. No injury seen at T0 in any patient. Three participants developed erythema of tracheal mucosa in 12%, edema in 7%, ulceration in 2% and necrosis in 1%. Individual data are presented in Table 2.

Table 2: Laryngotracheal findings in various investigative modalities.

Type of Injury	T0 (n-60)	T1 (n=47) n (%)
No injury	60	34 (72.4)
Erythema	0	6 (12.8)
Edema	0	4 (8.5)
Ulceration	0	2 (4.2)
Necrosis	0	1 (2.1)
Overall injury	0	13 (27.6)

Factors influencing TMD

Out of 13 (27.6%) TMD cases, the patients with aged less than 45 years had 12 (25.6%) incidence and 9 (19.1%) males were affected. Among the cases of TMD, 9 (19.1%) cases were intubated with endotracheal tubes of size of 7.5. Intubation for more than 10 days had 10 (21.2%) of the total cases of TMD. ARDS associated with TMD in 6 cases (12.8%). However, none of the above factors were associated with the TMD at T0 (Table 3).

Table 3: Associations of tracheal mucosa damage with various factors of interest.

Factors	Sub factors	Final participant for analysis	Injury	
			Present(%)	Absent(%)
Age (years)	18-30	28	9 (19.1)	19 (40.4)
	31-45	14	3 (6.4)	11 (23.4)
	>45	5	1 (2.1)	4 (8.5)
Gender	Male	27	9 (19.1)	18 (38.2)
	Female	20	4 (8.5)	16 (34)
Size of Endotracheal tube	7	11	2 (4.2)	9 (19.1)
	7.5	27	9 (19.1)	18 (38.2)
	8	9	2 (4.2)	7 (14.9)
Surgical Case	Planned surgery	8	1 (2.1)	7 (14.9)
	Emergency surgery	6	1 (2.1)	5 (10.6)
Medical Case	Head injury	2	0	2 (4.2)
	*CVA	6	2 (4.2)	4 (8.5)
	Encephalopathies	5	1 (2.1)	4 (8.5)
	**ARDS	11	6 (12.8)	5 (10.6)
	Metabolic disorders	9	2 (4.2)	7 (14.9)
Duration (days)	2-5	11	1 (2.1)	10 (21.2)
	6-10	16	2 (4.2)	14 (29.8)
	>10	18	10(21.2)	8 (17)

*CVA= Cerebrovascular accident, **ARDS= Acute respiratory distress syndrome

DISCUSSION

Patients requiring ventilation through artificial airways in the ICU is common. TMD following intubation have a reported incidence of 60% to 90% and permanent sequelae are reported to be about 15% in the world literature. The laryngeal injuries can be mucosal injuries like vocal cord erythema, edema, granulations or ulcerations to a more permanent sequelae like vocal cord palsy, arytenoids dislocation and subglottic stenosis.[1,6,11,16- 28] In addition, the tracheal injuries can be granulations in the initial stages to tracheal stenosis in the later stages.[29] In the present study, TMD observed were no injury, erythema, edema, ulceration, or necrosis in the tracheal wall.

Gadag RP et al[1] found that x-ray was normal in 22 patients (73.3%) while the abnormality was picked up in 8 (26.6%) patients which was similar to our finding 13 (27.6%). In the present study, fiberoptic bronchoscope was able to detect 27.6% of TMD in comparison to previous study of Gadag RP et al.[1] with 70-degree endoscopy which detected only 25% of the lesions below the vocal cords. Thus, fiberoptic bronchoscope was found to be a more reliable modality in evaluating the TMD.

The etiology of laryngeal stenosis following intubation is multifactorial[2]. The mechanism of injury commonly associated with laryngotracheal intubation include duration of intubation, size of tube, pressure and rubbing of the shaft against the larynx, repeated intubation, foreign body reaction to the tube, use of a stylet during intubation, route of intubation, nursing care, and anatomic differences between the genders.[3-5]In the present study, majority of patients who sustained TMD were aged less than 45 years and were more common among male patients. Age of the patient plays an important role influencing site and degree of stenosis.

Neonates show predisposition for subglottic involvement but in our series, those cases have been excluded. It is an established entity that adults are more prone for posterior commissure lesions which is in concurrence with the present study. Nevertheless, combined stenoses account for about one-third of all laryngeal stenoses at any age.[6-9]

The inappropriate diameter of the endotracheal tube and the difficulty in keeping the patient immobilized for a longer period are well known predisposing factors to the development of airway injuries.[10] The posterior part of larynx specially the posterior commissure comes in contact with endotracheal tube due to the configuration of glottis being in the shape 'V' and the friction is more in this portion when the patient moves frequently.[11] This is largely responsible for injuries in this area. Additionally, the compression on the mucosa by the tube causes prolonged ischemia which leads to ulceration followed by granulation tissue formation and later stenosis.[12]

The determination of tube size of an adult patient is usually based on the physicians assessment of neck morphology and external features of the larynx.[13] There is no standard formula to serve as a guide to appropriate tube size. A size of 8mm is generally used for adults and 7 or 7.5mm for thinly built adults.[14-15] Following these measurements may not be possible in an emergency like OP poisoning.

TMD were found more commonly among patients intubated for more than 10 days. Thus, the duration of intubation is also a factor contributing to TMD following intubation. The constant movements of the neck in an agitated state cause friction of the larynx and tracheal mucosa. In the patient without sedation, reflected movements of deglutition can incite tracheal injury. The longer the duration of intubation, more the risk of injury.[16-17]

In the present study, it was found that OP poison consumption was the most common cause of intubation induced TMD. This probably could be due to atropine induced reduced secretions in larynx and trachea associated with increased vulnerability of the mucosa to frictional injuries caused by ventilator through the endotracheal tube.[18]Therefore, proper sedation and paralysis of these patients wherever required can reduce the incidence of TMD.[19]Additionally, the appropriate dosage of specific antidote (atropine) will also minimize the risk of dryness and irritability of the patient.

Limitations of the study are the difficulties faced during the intubation, the standardization of the qualification of the personnel who intubated, and their skills could not be ascertained as those details were unavailable. Incidence of TMD also depends on frequency of suctioning which was not included in this study.

CONCLUSION

A high incidence of TMD especially in cases of acute respiratory distress syndrome need to be cautious in managing these intubated patients. Those patients requiring prolonged intubation should be considered for early tracheostomy with low pressure, high volume cuffed tubes. As the morbidity and mortality of these patients are very high, so an awareness and adequate training of the emergency personnel in the intubation technique and post intubation care of the endotracheal tube is important especially in a tertiary care hospital.

REFERENCES:

1. Gadag RP, Sreedevi NM, Kizhakkilott N, Muthuraj V, Dange PS, Dandinarasaiah M. A clinical study on tracheal mucosa damage following endotracheal intubation. Int J Otorhinolaryngol Head Neck Surg 2021;7:313-9.
2. Benjamin B. Prolonged intubation injuries of the larynx: endoscopic diagnosis, classification, and treatment. Ann Otol Rhinol Laryngol. 2018;127:492-507.
3. Rangachari V , Sundararajan I, Sumathi V , Kumar KK. Laryngeal sequelae following prolonged intubation: A prospective study. Indian J Crit Care Med. 2016:10.
4. Sarafoleanu C. Laryngo-tracheal trauma. Problems in management. Pneumologia. 2005;54:119-22.
5. Heidegger T, Starzyk L, Villiger C. Fiberoptic intubation and laryngeal morbidity: a randomized controlled trial. Anesthesiology. 2007;107:585-90.
6. Esteller-Moré E, Ibañez J, Matiñó E. Prognostic factors in laryngotracheal injury following intubation and/or tracheotomy in ICU patients. Eur Arch Otorhinolaryngol. 2005;262:880-3.
7. 10. Frioui S, Khachnaoui F. Severe tracheal stenosis after prolonged intubation. Pan Afr Med J. 2017;28:247.
8. Greaney D, Russell J, Dawkins I, Healy M. A retrospective observational study of acquired subglottic stenosis using low-pressure, high-volume cuffed endotracheal tubes. Paediatr Anaesth. 2018;28:1136-41.
9. Walner D, Loewen M, Kimura R. Neonatal subglottic stenosis-incidence and trends. Laryngoscope. 2001;111:48-51.
10. Yamanaka H, Hayashi Y, Watanabe Y, Uematu H, Mashimo T. Prolonged hoarseness and arytenoid cartilage dislocation after tracheal intubation. Br J Anaesth. 2009;103:452-5.
11. House CJ, Noordzij JP, Murgia B, Langmore S. Laryngeal injury from prolonged intubation: a prospective analysis of contributing factors. Laryngoscope. 2011;121:596-600.
12. Brodsky MB, Levy MJ, Jedlanek E, Pandian V, Blackford B, Price C, et al. Laryngeal injury and upper airway symptoms after oral endotracheal intubation with mechanical ventilation during critical care: a systematic review. Crit Care Med. 2018;46(12):2010-17.
13. Hsu CL, Chen KY, Chang CH, Jerng JS, Yu CJ, Yang PC. Timing of tracheostomy as a determinant of weaning success in critically ill patients: a retrospective study. Crit Care. 2005;9:R46-52.
14. Marston AP, White DR. Subglottic Stenosis. Clin Perinatol. 2018;45:787-804.
15. Kandakure VT, Mishra S, Lahane VJ. Management of post-traumatic laryngotracheal stenosis: our experience. Indian J Otolaryngol Head Neck Surg. 2015;67:255-60.
16. Schiff BA. The relationship between body mass, tracheal diameter, endotracheal tube size, and tracheal stenosis. Int Anesthesiol Clin. 2017;55:42- 51.
17. Wackym P, Snow J. Ballenger's Otorhinolary- ngology: Head and Neck surgery. USA: People's Medical Publishing house; 2016.
18. Hulse EJ, Haslam JD, Emmett SR, Woolley T. Organophosphorus nerve agent poisoning: managing the poisoned patient. Br J Anaesth. 2019;123:457-63.
19. Verma S, Smith M, Dailey S. Transnasal tracheoscopy. Laryngoscope. 2012;122:1326-30.