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A Prospective Study to Evaluate the Laryngotracheal Injuries Following Endotracheal Intubation.

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AIM

The purpose of this research is to assess the laryngotracheal damage caused by endotracheal intubation.

Methods: A 15-month prospective research was carried out at the Department of General Surgery and Anaesthesiology, SCB Medical college and Hospital, Cuttack. This research comprised 50 patients who had been intubated for more than 48 hours, were admitted to a medical ICU, and were above the age of 15. To determine the frequency, kinds of damage, and variables affecting LTI after intubation.

RESULTS

The 50 participants ranged in age from 15 to 70 years old, with 32 men and 18 girls. Most patients (70%) were between the ages of 15 and 29. of 84% of cases, endotracheal tubes of sizes 7.5 and 8 were utilised. Most of the patients (52%) had OP poisoning, followed by metabolic illnesses such as diabetic ketoacidosis and chronic renal disease with encephalopathy. Three-quarters of the patients were intubated for more than ten days. The x-ray was normal in 36 individuals (72%), whereas the abnormality was detected in 14 patients (28%). Four patients (8%) developed granulation tissue in the posterior commissure on 70-degree endoscope, and one patient had bilateral vocal cord fixation. All of the patients with LTI were under the age of 45, and 16 of the 20 instances were men. 16 (80%) of the 20 LTI patients were intubated with endotracheal tubes larger than size 7. 12 (60%) of the total LTI cases were intubated for more than 10 days. In 16 instances (80%), OP poisoning was the cause of LTI.

Conclusion:

The high prevalence of LTI, particularly in instances of OP poisoning, necessitates caution in handling these intubated patients. In addition to employing low pressure, high volume cuffed tubes, patients who need extended intubation should be examined for additional alternative airway managements such as tracheostomy.

Introduction

The reported occurrence of laryngeal injuries resulting from intubation ranges from 63% to 94% according to available literature. Permanent consequences of these injuries are estimated to be between 10% to 20% based on global reports. The adverse effects often seen as a result of

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prolonged intubation include the presence of erythema, ulceration, granulation, fibrous nodules, displacement of the arytenoids, subglottic stenosis, paresis of the recurrent laryngeal nerve, and immobility of the vocal folds [1]. Following the removal of the endotracheal tube, it becomes imperative to do a laryngeal examination in order to evaluate the kind of airway damage in these individuals. Laryngeal damage resulting from endotracheal intubation in the paediatric population remains a significant source of patient morbidity, occurring in both elective and emergency scenarios. The condition has a diverse array of manifestations, ranging from mild laryngeal edoema that resolves without intervention to a potentially fatal blockage of the airway [2]. The presence of co-morbidities such as preterm and cardiovascular abnormalities, as well as the hypoxic status of patients, are factors that influence the tissue healing process. These factors might potentially contribute to an increased likelihood of developing chronic laryngeal lesions associated to intubation [2,3]. There are several risk factors that contribute to the development of laryngeal lesions in children. These risk factors include patient-related factors such as prematurity and cardiopulmonary comorbidities, as well as factors related to the intubation procedure itself, such as the technique used (particularly in emergency situations or when performed by an inexperienced team), the size and type of endotracheal tube used (particularly if it is large or cuffed), the duration of intubation, the presence of infection, and inadequate patient sedation [4-8]. The use of endoscopic techniques to see the larynx is of utmost importance in the evaluation of intubation-related trauma in paediatric patients. This is due to the fact that the intensity of symptoms experienced by these patients may not consistently align with the extent of laryngeal damage that is really present. Laryngeal endoscopy offers enhanced sensitivity in the visualisation of several sub-sites within the larynx and the characterization of associated damage [9]. There are many categorization systems [2] available for characterising the severity of lower incisor root lesions (LIRLs). These systems include a spectrum of manifestations, ranging from moderate erythema and edoema to more severe outcomes such as granulation tissue development, mucosal ulceration, and cartilage exposure. Schweiger et al. (2010) conducted a study in which they categorised injuries based on the affected laryngeal sub-sites and successfully predicted the consequences of these injuries.

Materials and methods

After receiving clearance from the protocol review committee and the institutional ethics committee, a 15-month prospective research was undertaken at the Department of General Surgery and Anaesthesiology, SCB Medical College and Hospital, Cuttack. This research comprised 50 patients who had been intubated for more than 48 hours, were admitted to a medical ICU, and were above the age of 15. Patients with related comorbidities that impede evaluation, those undergoing elective surgical operations, children under the age of 15 hospitalised to a paediatric intensive care unit, and those who had a tracheostomy were excluded from the research.

The need for intubation and duration of intubation were obtained from reliable patient attenders, as well as a medical history to rule out associated comorbid conditions such as chronic obstructive pulmonary disease, bronchial asthma, pulmonary tuberculosis, or any pulmonary disease compromising ventilation.

The study's aims were to determine the incidence, forms of damage, and variables affecting LTI after intubation. The cuff used in the endotracheal tube had a pressure of 20 cm of water. All patients were examined for LTI 15 days after extubation using x-ray neck-anteroposterior and lateral views, 70-degree rigid endoscopy, and flexible nasopharyngo-laryngoscopy (NPL).

Results

A total of 50 patients (Table 1) were inducted into the study of which 32 were males and 18 were females with age ranging from 15 to 70 years. Majority of patients (70%) were between 15-29 years. Endotracheal tube of size 7.5 and 8 were used in 84% of patients.

Table 1: Characteristics and distribution pattern of patients with laryngotracheal injuries.

Demographics		N (%)	%
Age (years)	15-29	35	70
	30-44	10	20
	>45	5	10
Gender	Male	32	64
	Female	18	36
Endotracheal tube dimension			
Size of tube(mm)	7	8	16
	7.5	24	48
	8	18	36
Indication for Intubation			
Poisoning cases			
	Organophosphrus poisoning	26	52
	Cerebro-vascular accidents	6	12
	Hypoxic ischaemic encephalopaty	4	8
Non-poisoning cases	Acute respiratory distress syndrome	4	8
	Metabolic disorders	7	14
	Head injury	3	6
Length of intubation	2-5	16	32
	6-10	16	32
Duration (days)			
	>10	18	36

Most of the patients (52%) had OP poisoning, followed by metabolic illnesses such as diabetic ketoacidosis and chronic renal disease with encephalopathy. Three-quarters of the patients were intubated for more than ten days.

Following intubation, the patient was assessed for LTI using x-ray neck-antero-posterior and lateral views, 70-degree endoscope, and flexible NPL. The x-ray was normal in 36 individuals (72%), whereas the abnormality was detected in 14 patients (28%). Four patients (8%) developed granulation tissue in the posterior commissure on 70-degree endoscope, and one patient had bilateral vocal cord fixation. When the flexible NPL was conducted, 14 instances (28%) of subglottic stenosis and 1 case of granulation tissue in the posterior wall of the upper third of the trachea were discovered (Table 2).

Table 2: Laryngotracheal findings in various investigative modalities.

Investigation	**findings**	N(%)	
X-ray	Normal	36	72
	Abnormal	14	28
	Normal	44	88
Rigid endoscopy	Bilateral vocal cord fixation	2	4
	Granulation tissue in posterior commissure	4	8
Flexible	Normal	29	58
Nasopharyngo-laryngoscopy			
Sub-glottic stenosis		14	28
Bilateral vocal cord fixation		1	2
Granulation tissue in posterior commissure		5	10
Granulation tissue in posterior wall of trachea		1	2

All the patients with LTI were under the age of 45, and 16 of the 20 instances were men. 16 (80%) of the 20 LTI patients were intubated with endotracheal tubes larger than size 7. 12 (60%) of the total LTI cases were intubated for more than 10 days. In 16 instances (80%), OP poisoning was the cause of LTI. However, none of the characteristics were significantly linked with the LTI (Table 3).

Table 3: Associations of laryngotracheal injuries with various factors of interest.

FACTORS	**SUB FACTORS**	**INJURY**	
		Present(N=20)	**Absent (N=30)**
Age	15-29	16(80)	19 (63.33)
	30-44	4 (20)	6 (20)
	>45	0	5 (16.67)
Gender	Male	16 (80)	16 (53.33)
	Female	4 (20)	14 (46.67)
Size of tube	7	4 (20)	4 (13.33)
	7.5	10(50)	14 (46.67)
	8	6 (30)	12(40)
Duration of intubation	2-5 days	4(20)	12 (40)
	6-10 days	4(20)	12 (40)
	>10 days	12 (60)	6 (20)
Cause of intubation			
	OP poisoning	16 (80)	10 (33.33)
	ARDS and CVA	1 (5)	5 (16.67)
	Metabolic disorder	0	7(23.33)
	Others (head	3 (15)	8 (26.67)

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	injury,hypoxic ischemic encephalopathy)		

Discussion

Patients needing mechanical breathing via artificial airways are prevalent in the ICU. In the international literature, LTI after intubation has a reported frequency of 60% to 90%, with lifelong sequelae at around 15%. Laryngeal injuries may range from mucosal injuries such as vocal cord erythema, edoema, granulations, or ulcerations to persistent sequelae such as vocal cord palsy, arytenoids displacement, and subglottic stenosis [11-23]. Furthermore, tracheal injuries may range from granulations in the early stages to tracheal stenosis in the later stages [24]. LTI seen in this research included subglottic stenosis, granulation tissue in the posterior commissure, vocal cord fixation, and granulation tissue in the tracheal wall.

The cause of laryngeal stenosis after intubation is multifaceted. The most common mechanisms of injury associated with laryngotracheal intubation are duration of intubation, tube size, 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 genders [25]. In the current research, the majority of patients who sustained LTI were younger than 45 years old, and male patients were more prevalent. The patient's age has a significant impact on the location and degree of stenosis.

Although neonates are predisposed to subglottic involvement, these instances were omitted from our study. Adults are more prone to posterior commissure lesions, which is consistent with the findings of the current investigation. Despite this, combined stenoses account for about one-third of all laryngeal stenoses at any age [26-28].

The incorrect diameter of the endotracheal tube and the difficulties in keeping the patient immobilised for a prolonged amount of time are well-known risk factors for airway injury. Because the glottis is configured in the form of a 'V,' the posterior region of the larynx, particularly the posterior commissure, comes into touch with the endotracheal tube, and friction is greater in this area when the patient moves often. This is mostly to blame for the injuries in this region. Furthermore, the tube's stress on the mucosa produces prolonged ischemia, which leads to ulceration, granulation tissue growth, and, eventually, stenosis.

An adult patient's tube size is generally determined by the physician's examination of neck morphology and external laryngeal features [17]. There is no standard formula to use as a reference for tube size. Adults often wear 8mm rings, whereas thin-built adults wear 7 or 7.5mm rings [17]. Following these measures may be impossible in an emergency such as OP poisoning. LTI were identified more often in patients who had been intubated for more than 10 days. Thus, the length of intubation is another factor that contributes to LTI after intubation. In an agitated condition, the frequent motions of the neck produce friction of the larynx and tracheal mucosa. Reflected deglutition motions may cause tracheal damage in patients who are not sedated. The longer the intubation, the greater the danger of damage.

The most prevalent cause of intubation-induced LTI was found to be OP toxin intake in the current investigation. This might be attributed to atropine-induced decreased secretions in the larynx and trachea, as well as enhanced mucosal sensitivity to frictional damage generated by the ventilator via the endotracheal tube [29]. if a result, effective sedation, and paralysis of these individuals, if needed, may limit the occurrence of LTI. Furthermore, the correct dose of a specialised antidote (atropine) will reduce the patient's risk of dryness and irritation.

LTI were assessed in the research using x-ray neck, 70-degree rigid endoscopy, and flexible NPL. Many oto-rhino-laryngology clinics provide flexible trans-nasal endoscopy [30]. With the application of topical/nebulized local anaesthetic, flexible NPL is typically well tolerated in most patients, allowing examination of vocal cord mobility and other symptoms of LTI.

In the current investigation, flexible NPL revealed 80% of LTI whereas 70-degree endoscopy recognised only 20% of lesions below the vocal cords. As a result, flexible NPL was discovered to be a more trustworthy technique for measuring the LTI. Due to the intraluminal nature of these lesions, a non-invasive modality such as flexible NPL was chosen over computed tomography or magnetic resonance imaging. Prior to flexible NPL, a simple inquiry such as an x-ray neck was preferable to check the adequacy of the airway, which would ease starting with the scopy.

Conclusion

Because of the high occurrence of LTI, especially in cases of OP poisoning, these intubated patients must be handled with care. In addition to using low pressure, high volume cuffed tubes, patients who need prolonged intubation should be evaluated for alternate airway management options such as tracheostomy. Because treating these LTI is challenging and associated with significant morbidity and mortality, thorough training of emergency workers in the intubation approach and its subsequent care is critical, especially in a tertiary referral hospital.

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