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Demographic Evaluation of Laryngo-Tracheal Stenosis Following Prolonged Endotracheal Intubation

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The overall aim of the present study was to evaluate demographic pattern of laryngo-tracheal stenosis following prolonged endotracheal intubation. Prolonged trans-laryngeal intubation is associated with increased laryngeal injury, glottic and sub-glottic stenosis, infectious complications and tracheal injury such as tracheomalacia and tracheal stenosis. Several studies assessing the laryngeal complications are available in Caucasoid populations. Minimal data is available in the literature related to Iran. It was a prospective analytical study in Otolaryngology- Head and Neck Surgery Department, Ahwaz Jondishapour University of Medical Sciences, from 2005 until 2007 (19 months) in Ahwaz, Iran. This is a prospective study of 98 patients (61 patients were male), who were intubated for more than 48 h in Imam Khomeini, Golestan and Razi Hospital critical care unit with different causes and were referred to Otolaryngology emergency ward with respiratory distress. All patients underwent laryngeal video endoscopy and laryngeal computed tomography scan by an otolaryngologist surgeon who was blinded to the intubation variables. Twenty five patients had been presented by laryngo-tracheal stenosis and the most common site of that was sub-glottic area (sixteen patients). Statistical analytic findings showed that from several factors (such as tube size ($p = 0.088$), skill of intubating doctor (consultant or registrar; $p = 0.146$), duration of intubation ($p = 0.002$) and emergency intubation ($p = 0.240$) only prolonged intubation ($p = 0.002$) was associated with higher incidence of laryngo-tracheal stenosis. In conclusion, Laryngo-tracheal stenosis after prolonged endotracheal intubation is directly associated with duration of intubation. The most common site of laryngeal stenosis was sub-glottic area.

Key words: Demographic, prolonged Intubation, laryngotracheal stenosis

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INTRODUCTION

Prolonged trans-laryngeal intubation is associated with increased laryngeal injury, glottic and sub-glottic stenosis, infectious complications and tracheal injury such as tracheomalacia and tracheal stenosis (Cummings, 2005; Granja *et al*., 2002). Converting intubation to a tracheotomy also may facilitate suctioning, feeding and mobility; promote early return of speech and decrease the work of breathing (Granja *et al*., 2002). Meticulous surgical technique, aggressive treatment of postoperative infections and the use of the high-volume, low-pressure cuffed tube help minimize the risk of tracheal stenosis (Rajagopalan *et al*., 2002). Evidence suggests that the risk of long-term airway complications significantly increases with trans-laryngeal intubation beyond the tenth day (Granja *et al*., 2002; Panda *et al*., 1999). Tracheal stenosis and sub-glottic stenosis are complications predisposed by previous endotracheal tube intubation, high tracheostomy or cricothyroidotomy and trauma to the airway. Patients at increased risk for tracheal stenosis include children and patients tracheotomized for closed head trauma. 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. With the advent of high volume low-pressure tubes, it is common for the patients to be ventilated through the endotracheal tube for up to three weeks. The complication of intubation depends on multiple factors and can also at times be a major source of morbidity to the patient during recovery. Laryngeal complications after prolonged intubations have varied incidence rates in the literature. Hoarseness of voice, cough, dysphagia, aspiration and stridor can develop after extubation, immediately. Laryngeal evaluation of such patients becomes necessary to assess the nature of airway injury. Common injuries following long-term intubation can manifest in the form of erythema, ulceration, granulomas, arytenoid dislocations (Cummings, 2005; Rangachari *et al*., 2006; Kastanos *et al*., 2000) sub-glottic stenosis and vocal fold immobility; (Rajagopalan *et al*., 2002; Panda *et al*., 1999). While several studies assessing the laryngeal complications are available in Caucasoid populations; minimal data is available in the literature related to Iran. Therefore we retrospectively evaluated the etiologic risk factors of laryngo-tracheal stenosis in patients after prolonged intubation to determine the association with risk factors. The medical ethics committee of the Otorhinolaryngology-Head and Neck surgery department approved the study and informed consent was obtained from all subjects. The most references recommended that the conversion from trans-laryngeal intubation to tracheotomy be made as early as possible to minimize the duration of trans-laryngeal intubation (Cummings, 2005; Hsu *et al*., 2005; Granja *et al*., 2002; Heffner, 2001; Valsh and Shorten, 1999).

MATERIALS AND METHODS

In this prospective analytical study 98 (sixty one patients were male) patients who were referred to ENT emergency wards of Imam Khomeini, Golestan and Razi University Hospitals with respiratory distress were included from April 2005 until March 2007. All ninety eight patients have age >20 years old, extubated at the intensive care unit of above named Hospitals after at least 48 h of intubation were included in the study. Laryngeal examination with a rigid 70° and direct laryngeal video-endoscopy was done for all patients. Subjects were evaluated by chief resident of otolaryngology ward who was blinded to the intubation variables using the 70° telescopes. Anesthesia (10% Lidocaine spray) was offered to patients with active gag reflexes. The tip of the rigid telescope was immersed in hot water to prevent fogging of the lens. With one hand holding the tongue of the subject, the examiner inserted the telescope through the oral cavity. A color video camera and color monitor were used for visual feedback. Using the image on the monitor, the examiner guided the telescope to view the laryngeal surface of the epiglottis, the anterior commissure, the subglottic area and the pyriform fossae. The images obtained on the color monitor were video recorded. Laryngeal computed tomography scan (CT scan) was done for all patients for evaluation of sub glottic stenosis. The association of laryngeal findings with demographic details along with intubation variables nature of intubation (emergency or elective), size of endotracheal tube, skill of intubating personnel (Consultant/Resident) and cuff pressure during the intubated period, total period of intubation were studied. The results were analyzed by using SPSS (version: 13) statistical software. Parametric (normally distributed) data were analyzed using t-test for group comparisons. Nonparametric (skewed) data were analyzed using Kruskal-Wallis test. Univariate correlation between presence of laryngeal complications and parametric variables was done using Spearman's coefficient of correlation. Chi-square test was used to analyze datum and p value of (<0.05) was accepted as being statistically significant.

RESULTS AND DISCUSSION

Laryngeal abnormalities were seen in thirty six of the ninety eight patients during examination on post extubation period by ENT surgeon with helping laryngeal rigid endoscopy and laryngeal CT scan. At the end of laryngeal rigid endoscopy, physical examination and CT scan findings reveal that twenty five patients had laryngo-tracheal stenosis. Vocal cord granuloma was the most common feature in the set of abnormal findings on laryngeal rigid endoscopy in six patients; other abnormalities were arytenoids dislocation in three patients and unilateral vocal cord palsy in two patients. Figure 1 shows the laryngeal sequelae distribution among the patients under investigation. All of individual factors such as age, sex, height and weight had not any significant analytical relationship with laryngeal complication. Table 1 shows data regarding intubation variables and their association with the laryngeal sequelae on laryngeal endoscopy in patients. Multivariate and Univariate analysis of the intubation variables showed that between several factors include: larger endotracheal tube size ($p = 0.088$), skill of intubating doctor (consultant or registrar; $p = 0.146$), nature of intubation (Table 2), (elective or emergency; $p = 0.240$) and prolonged intubation ($p = 0.002$)(Table 3).

The presence of laryngeal complications (laryngo-tracheal stenosis) associated with the laryngeal rigid endoscopy and CT scan findings after extubation was related only to the duration of intubation significant factors ($p = 0.001$). The most common site of laryngeal involvement was sub-glottic stenosis. Twenty five patients had tracheolaryngeal stenosis, with laryngeal CT scan and endoscopy findings. In this study the most common site of laryngeal stenosis was sub-glottic area (sixteen patients).

Laryngeal injuries following intubation have a reported incidence from 60% to 90% and permanent sequelae are reported to be about 15% in the world literature (Cummings, 2005; Rangachari *et al*., 2002). The time to switch over from endotracheal tubes to tracheostomy is controversial (Panda *et al*., 1999) Current data suggest that ventilation through high volume low-pressure endotracheal tubes are the method of choice of artificial airway up to 3 weeks (Hsu *et al*., 2005). The laryngeal injuries can vary from mucosal injuries like vocal cord erythema, edema, granulations and ulcerations to more permanent sequelae like vocal cord palsy(Heffner, 2001) arytenoids dislocation (Cummings, 2005; Granja *et al*., 2002) and sub-glottic stenosis (Kastanos *et al*., 2000; Santos *et al*., 1999; Whited *et al*., 1994). In this study vocal cords and the

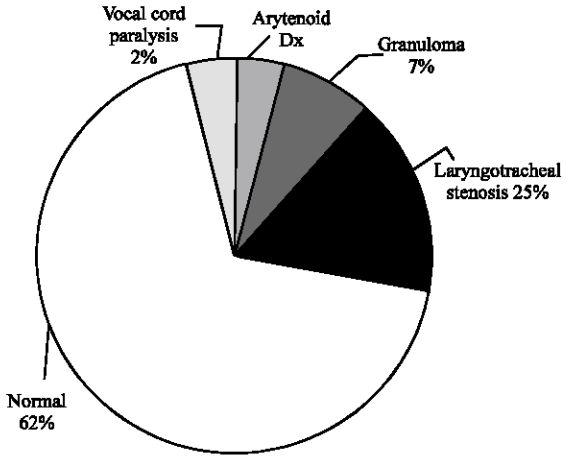

Fig. 1: Laryngeal sequelae distribution

Table 1: Statistics intubation attributes

Variable	p-value
Intubating doctor	0.146
Nature of intubation	0.240
Tube size	0.088
Duration of intubation	0.002

Table 2: Intubation nature and laryngeal complication

Nature of intubation	Laryngo-tracheal stenosis	Other complication
Elective	4	---
Emergency	8	5
Consultant	5	3
Resident	8	3

Table 3: Intubation duration and laryngeal complication

Intubation duration	Laryngo-tracheal stenosis	Other complication
Less than 7 days	----	6
Between 7 and 14 days	6	3
More than 14 days	19	2

arytenoids were not the only components of the larynx involved in injuries. There were patients with vocal cord paralysis, arytenoids dislocations or tracheal and sub-glottic stenosis in this study population. Laryngeal injuries are seen in patients intubated with larger size endotracheal tube. The determination of tube size of an adult patient is usually based on the physician's assessment of neck morphology and external features of the larynx. There is no standard formula to serve as a guide to appropriate tube size. A size eight endotracheal tube is generally used for adults and size 7 or 7.5 for small built adults. In this study the size of endotracheal intubation tube had not any significant statistical relation with tracheolaryngeal stenosis ($p = 0.088$) Kastanos *et al*., (2000) showed increased incidence of laryngeal injuries with higher cuff pressures. In our study population, 90% of the patients had a standard cuff pressure of 30 cm H_2O. The cuff restricts the flow of blood through the tracheal tissues thus causing ischemic

damage. The use of high-volume, low-pressure endotracheal tubes are also a routine practice in this intensive care unit. These tubes have a cuff with a large resting volume and diameter and a thin compliant wall that allows a seal with the trachea to be achieved without stretching its wall. This reduces the risk of injury to tracheal tissues; thereby reducing the risk of significant cuff-induced complications following prolonged intubation. The association of more laryngeal complications with emergency intubations is an expected occurrence. Intubations done in the emergency sitting have the disadvantages of less preparation, inadequate patient sedation and less co-operation on the part of the patient that can be responsible for higher occurrence of laryngeal injuries. In this study the emergency intubating had not any significant statistical relation with tracheolaryngeal stenosis ($p = 0.240$). The skill of the intubating physician also plays an important role in the genesis of laryngeal injuries. The residents and trainees with less skill and experience have comparatively greater association with complications than the consultants. Use of appropriate tube size and monitoring of duration of intubation is essential in the prevention of laryngeal complications ($p = 0.002$). Only about 20% of the patients had permanent sequelae. This study shows that, at the post extubation period, duration of intubation was the only predictor of post extubation laryngeal sequelae. Use of appropriate tube size and monitoring of duration of intubation is of paramount importance. A systematic laryngeal examination after extubation, whenever indicated, decreases the secondary sequelae by initiating appropriate measures when necessary. It is highly suggested to early otorhinolaryngology consultation for the patients who are intubated in Intensive Care Unit (ICU) for any etiologies it seems to large analytical studies with bigger cohorts are needed to define the role of medical disorders and other parameters in producing laryngeal complications in patients with prolonged intubation.

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