A PROSPECTIVE, OBSERVATIONAL STUDY OF LARYNGEAL SEQUELAE IN PROLONGED INTUBATION

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ABSTRACT

Endotracheal intubation has achieved widespread use and refinement in standard treatment for respiratory failure. The aim of the study is to observe the most common structures that get injured in prolonged intubation and to assess the structural changes in the larynx after prolonged intubation in patients who are admitted at Chettinad Hospital and Research institute. 58 patients were included in this study that were admitted to the hospital or attended the ENT outpatient department. The study was conducted from November 2017 to May 2019. Structural changes in the larynx were assessed in the patients who were intubated for more than 48 hours using video laryngoscopy. The findings were documented and subjected to statistical analysis. In the study, based on the data collected from 58 patients who were under intubation for more than 48 hours, underwent video laryngoscopy to assess the anatomical changes in larynx. It is concluded that – As the number of days of intubation increased in our study group, the prevalence of structural changes in larynx also increased. Hence, it is ideal to keep the patients under intubation for not more than 48 hours. If the patient needs continuous ventilatory support, it is better to shift to other modes of assisted ventilation.

KEY WORDS: Endotracheal, Laryngoscopy, Ventilatory support
INTRODUCTION

Advancements and improvements in the treatment of critical illness have resulted in more patients who require prolonged airway and ventilatory support \(^{(1)}\). The duration of intubation has always been controversial and depends on the clinical condition of the patient. Traditionally, prolonged intubation is defined as being more than seven days \(^{(2)}\). This period of intubation may cause temporary or permanent laryngeal damage. Certain studies have indicated the complications of prolonged endotracheal intubation, which include synecchiae, cicatrices, granuloma, ulcerations, lacerations, the formation of membranes, fibrous tissue formation in the arytenoid cartilages or inter arytenoid space, cricoarytenoid subluxation or ankylosis, vocal fold paresis or paralysis, and subglottic stenosis \(^{(3)}\). These complications can be attributed to multiple factors like endotracheal tube size, endotracheal tube irritation, natural torque of the endotracheal tube, and "pushpull" phenomena which can cause problems much earlier than is commonly surmised. Hence, in the present study, the authors will be assessing the common anatomical structures that get injured after intubation for more than 48 hours in Chettinad hospital.

MATERIALS AND METHODOLOGY

The study was started after obtaining permission from the ethical committee. Informed consent was obtained from the patients who fulfill the inclusion criteria. If the patients were not in a state to give consent, the consent of their relatives was obtained. A detailed history was taken and then laryngeal examination was carried out using video laryngoscopy.

The study was conducted at the Department of Otorhinolaryngology, Intensive Care Unit at Chettinad Hospital and Research Institute, Kelambakkam. 58 patients were included in this study who was admitted to the hospital. The study was conducted from November 2017 to May 2019. The study is a prospective observational study.

RESULTS AND ANALYSIS

The following are the results and analysis based on the study:
- The changes in the arytenoids like congestion was observed in about 33% in the patients who got extubated after 3 days, 35.7% in the patients who got extubated after 4 days of intubation, 100% in patients who were extubated after a period of 7 days. Multiple injuries in the arytenoids were about 14.3% in the patients who were extubated after 4 days, 16.7% in the patients who were extubated after 5 days, 20% in the patients who were extubated after 6 days and about 50% in the patients who were extubated after 10 days.

- The changes in the inter arytenoids like congestion of the inter arytenoids were about 26.7% in patients who were extubated after 3 days, 78.6% in the patients who were extubated after 4 days, 66.7% in the patients who were extubated after 5 days, 100% in the patient who was extubated after 7 days and 50% in the patients who were extubated after 10 days. More than one complications in the inter arytenoid region were noticed in about 6.7% in the patients who were extubated after 3 days, 40% in the patients who were extubated after 6 days, 50% in the patients who were extubated after 10 days. Ulceration was observed in 3.3% of the cases in our study.

- The changes in the aryepiglottic fold like congestion were about 13.3% after 3 days of extubation, 42.9% in the patients who were extubated after 4 days, 16.7% in the patients who were extubated after 5 days, 100% in the patient who was extubated after 7 days, 50% in the patient who were extubated after 10 days. Multiple injuries in the aryepiglottic fold had a prevalence of about 3.3% in the patients who were extubated after 3 days, 16.7% in the patients who were extubated after 5 days, 20% in the patients who were extubated after 6 days.

- The changes in the true vocal cord like congestion were about 6.7% in the patients who were extubated after 3 days, 21.4% in the patients who were extubated after 4 days, 16.7% in the patients who were extubated after 5 days, 60% in the patients who were extubated after 6 days, 100% in the patients who were extubated after 7 days of intubation. Phonatory gap was seen in 3.3% in the patients who were extubated after 3 days, 100% in the cases who were extubated after 7 days.

- Vocal cord paresis was observed in 50% (1 case) of the patients who were extubated after 10 days. Multiple injuries to true vocal cord were seen in 16.7% of the 64 patients who were extubated after 5 days, 20% in the patients who were extubated after 6 days, 50% in the patients who were extubated after 10 days. With respect to false vocal cords, congestion was present in about 10% of the patients who were extubated after 3 days, 14.3% in patients who were extubated after 4 days, 33.3% in the patients who were extubated after
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5 days, 40% in the patients who were extubated after 6 days, 100% in the patients who were extubated after 7 days, 50% in the patients of the patients who were extubated after 10 days.

- As far as the anterior commissure was involved, congestion was present in 6.7% of the patients who were extubated after 3 days, 35.7% in the patients who were extubated after 4 days, 83.3%, 20%, 100% and 50% in the patients who were extubated after 5 days, 6 days, 7 days and 10 days respectively. In posterior commissure, 33.3% injuries were observed in patient’s extubated after 5 days and 20% injuries were observed in the cases extubated after 6 days.

**DISCUSSION**

The duration of intubation has always been controversial and depends on the clinical condition of the patient. Traditionally, prolonged intubation is defined as being more than 7 days. This period of intubation may cause temporary or permanent laryngeal damage. In the study, the authors are observing the laryngeal structures to assess their changes in patients who are intubated for more than 48 hours.

In a study conducted by B. Maruthi Rao, et al the laryngeal structures vulnerable to injuries are –

1. Mucous membrane and muco perichondrium covering the medial surface of arytenoid cartilages and their vocal processes.

2. Cricoarytenoid joints and adjoining parts of cricoid cartilage below.

3. Posterior glottic/inter arytenoid regions.

4. Supraglottic structures, i.e. false vocal cords may become edematous (Reversible).

5. Overinflation of the cuff of the endotracheal tube may cause mucosal injury and ciliary loss in the trachea.

6. Subglottic stenosis.

Lindholm (4) reported that prolonged intubation causes injuries to the larynx and trachea. His study established that the size and unfavorable shape of the tube and too much laryngeal activity contributed to complications. The period for which the tube may be left in place has been a source of dispute among different authors and no agreement exists except that the "safe" period is longer in children.

Tonkin and Harrison (5) evaluated 166 patients intubated for a mean period of 29 hours, of these 4.2% had severe and 13.3% moderate trauma and all recovered with no permanent damage. This would suggest that with shorter periods of intubation there will be a small but significant number of less severe injuries. Blood circulation in the mucosa and muco perichondrium can be interrupted when the pressure from the endotracheal tube exceeds capillary pressure.

This may cause edema/hyperemia/ulceration of mucosa/ necrosis, ultimately leading to erosion of perichondrium and cartilage. Concerning our study, there was a case that was observed to have granuloma in the anterior commissure. The increasing size of an ET tube (i.e., from 7.5 to 8) was a significant risk factor for true vocal cord (TVC) erythema, ulceration, and delayed immobility. Recommendations resulting from the study include the following (5):

1) Avoidance of the size 8 ET with prolonged intubation (no patients with a size 7.5 ET had delayed TVC immobility).

2) If after prolonged OETI a patient experiences hoarseness or aphonia or is unable to speak, examine the larynx to rule out the delayed onset of TVC granulomas or immobility.

3) If a patient requires long-term airway support and has OETI, perform a tracheostomy within 1 to 2 weeks after OETI.

The study was conducted at Chettinad Hospital and Research Institute, with a group of 58 patients, 17 patients were under OETI with size 8 ETT, and 26 patients were with size 7.5 ETT.

Gaynor and Greenberg showed a high incidence of laryngeal injury in insulin dependent diabetics who were intubated for 4 days and recommended early tracheotomy for these patients.

V. Rangachari, I. Sundararajan, V. Sumathi, K. Krishna Kumar (6) (2006) conducted a prospective study on laryngeal sequelae following prolonged intubation in South Indian population. About 51 patients were included in the study. Laryngeal abnormalities were seen in 41 patients on the day of extubation. They have concluded that laryngeal injury post extubation is directly related to the duration of intubation. In our study conducted at Chettinad Hospital and research institute, there was a similarity with the above study. As the days of intubation increased more than 48 hours, the prevalence of injuries in the larynx substantially increased.

Jackson C in his study observed the classic "contact ulcer", which affirms to be caused by the high pressures exerted by the endotracheal tube against the posterior part of the larynx and due to mechanic abrasion. (7)

In the present study ulceration was observed in the inter arytenoid region in one case who was intubated for three days. In a sample of 82 patients, it was observed that in 77 patients (94%), some form of laryngeal damage was visualized in the initial laryngoscopy. Of these 76 (98.7%) had presented ulceration in the mucous in the posterior portion of both true vocal folds, exactly the area where the tracheal pipe makes direct contact with the larynx. (8) It was verified that the ulcer proceeds to the advent of laryngeal granuloma (9).
A possible etiology for vocal fold immobility resulting from intubation includes recurrent nerve injury from compression. Both Brandwein et al. and Cavo found the recurrent laryngeal nerve vulnerable to compressive injury between the inflated cuff of the endotracheal tube and the thyroid cartilage. \(^{10,11}\) Additional possible etiologies for vocal fold immobility after prolonged intubation include myopathy/myositis of the intrinsic laryngeal muscles or arytenoid dislocation.

In a study done by Kikura M, Suzuki K it was observed that the risk and the incidence of paralysis of the vocal folds had amplified with the duration of the intubation. The risk further augmented for the duration of the orotracheal intubation between 3-6 days and was seven times bigger for the duration between 6-9 days \(^{12}\).

In the current study changes in the vocal cord-like vocal cord congestion were observed in 9 patients, 4 patients had vocal cord edema. The prevalence of vocal fold paresis was observed in one case which was intubated for 10 days. On follow up endoscopic examination patient improved. We suggest that cricoarytenoid joint inflammation could also explain vocal fold immobility after intubation. On follow up endoscopic examination, the patient recovered completely.

In a study conducted by Whited RE, it was observed that 2% of stenosis of the larynx in patients with orotracheal intubation was between three and five days and 5% of stenosis of the larynx with orotracheal intubation were between six and ten days. This study showed that the gravity of the larynx illness directly was related to the duration of the orotracheal intubation \(^{13}\).

The present study does not have issues on reporting of laryngeal stenosis or subglottic stenosis mostly due to ideal intubation. In our hospital during the study period, patients were under oro endotracheal intubation (OETI) for a maximum period of 10 days. The occurrence of laryngeal complications was found to be increased in patients who were intubated for more than 48 hours. As the number of days of intubation increased, there was a substantial increase in the changes in the laryngeal structures like vocal cord congestion, vocal cord edema, vocal cord paresis, arytenoids congestion, hematoma, etc.

**CONCLUSION**

The study is based on the data collected from 58 patients who were under intubation for more than 48 hours underwent video laryngoscopy to assess the anatomical changes in larynx. The following are concluded:
As the number of days of intubation increased in our study group, the prevalence of structural changes in larynx also increased. The minimal number of structural changes in larynx was observed in the patients who were intubated for 3 – 4 days and the maximum in patients intubated for up to 10 days in our study group.

Ulceration was observed in the inter arytenoid region in one case who was intubated for three days, in the study conducted at our hospital.

Left vocal fold paresis was observed in one patient who was intubated for 10 days.

Other changes like vocal cord congestion were observed in 9 patients, 4 patients had vocal cord edema.

Inter arytenoid congestion was the most common structure found to be injured which was prevalent in about 43.1% of patients.

Hence, it is ideal to keep the patients under intubation for not more than 48 hours until and otherwise indicated.

If the patient needs continuous ventilatory support, it is better to shift to other modes of assisted ventilation.

REFERENCES


