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Research Paper

Assessment of Endotracheal Tube Cuff Pressure in Reducing Postoperative Hoarseness of Voice and Sore Throat after General Anesthesia

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ABSTRACT:

BACKGROUND:

Postoperative hoarseness of voice and sore throat are most common undesirable outcome at postoperative period. They are attributed to mucosal dehydration or edema, tracheal ischemia due to relatively high cuff pressure during endotracheal intubation. However, other demographic and perioperative factors could also have their own influence.

OBJECTIVE:

Our study aimed to assess the cuff pressure with the incidence of postoperative hoarseness and sore throat.

PATIENTS AND METHODS:

This experimental clinical trial included (60) consecutive adult patients undergoing elective surgery who required endotracheal intubation. The patients were divided into two equal groups according to cuff pressure: with low cuff pressure (25 cmH_2O) and high cuff pressure (28 cmH_2O). The incidence of postoperative hoarseness and sore throat during the first 24 to 72 hours post operation was recorded.

RESULTS:

The results showed that none of demographic or clinical factors of the patients had a significant effect on the incidence of hoarseness and sore throat. The overall incidence of hoarseness and sore throat was (16.67%) and (13.33%), respectively. Hoarseness and sore throat were more common in high pressure group (26.67% and 23.33%, respectively) than low pressure group (6.67% and 3.33%, respectively) with significant differences.

CONCLUSION:

It can be concluded from the current study that the high cuff pressure (28 cmH_2O) was associated with increased incidence of postoperative hoarseness and sore throat.

KEYWORDS: Postoperative hoarseness of voice, Postoperative sore throat, Endotracheal tube cuff pressure.

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INTRODUCTION:

There are millions of people who undergo tracheal intubation (TI) and laryngoscopy every year as a part of their airway management in the perioperative period. Nevertheless, intubation is related to adverse results like sore throat, voice hoarseness, dysphagia, arytenoid dislocation, oropharyngeal injuries, hematoma, laceration and broken teeth [1]. Hoarseness is defined as a stained or harsh voice assessed by the patient, while sore throat is defined as a pain in the pharynx or larynx. The incidence of laryngopharyngeal symptoms following endotracheal intubation ranges from (5.7%) to (90%). Such symptoms are often mild and transient and require minimal active interventions or none at all. The majority of symptoms resolve within (12–72) hours, except in cases of injuries to vocal folds or arytenoids [2].

The incidence of post-operative sore throat (POST) following endotracheal intubation ranges from (44%) to (64%) [3]. The exact reason behind symptom emergence is still unexplained. One possible explanation may be attributed to inflammatory processes in the mucosal lining [4].

The inflammation cause is believed to arise from the endotracheal tube size in addition to the cuff's design and pressure. Tracheal lesions were thought

previously to result from a high cuff pressure, i.e. >30 cm H2O, which are highly associated with sore throat development. In many earlier studies, several laryngoscopies have not been significantly correlated with POST [5].

Following an endotracheal intubation, the incidence rate of PoH was 30-49%, while following a laryngeal mask airway (LMA), it was 7.5% [6].

The limitation and monitoring of the pressure of tracheal tube cuff as a manner to decrease postoperative sore throats has been widely inspected since excessive cuff pressure can damage tracheal mucosa through blood flow reduction and direct trauma. Among 509 patients, the prospective, randomized controlled trials compared inflation of tracheal tube cuff by the use of the manometer (pressure 15–25 mmHg) with manual palpations of the pilot balloon. However, during the remainder time of surgery, the cuff pressure was not subsequently monitored. Patients in the manometer group showed a significant decrease in sore throat incidence at 24 hours in comparison with the controls (34% and 44% respectively) [7]. After that, studies on patients with thyroid and maxillofacial surgery reported that the control of tracheal tube cuff pressures reduced symptom severity for 2–6 hours and sore throat incidence for about 24 hours [8].

PATIENTS AND METHODS:

This prospective experimental clinical trial included (60) consecutive adult patients undergoing elective surgery requiring endotracheal intubation in Al-Imamain Al-Kadhumain hospital, Baghdad-Iraq during the period from October 2019 to October 2020. The study protocol was approved by the scientific council of AAIC (Anesthesia and intensive care). From each participant, a written consent was taken before data collection and following explaining the aims of the study.

Adult patients aged (20–50) years, patients undergoing elective abdominal and lower limb surgery (lasting for 1-2 hours) requiring ET intubation, patients who met the criteria of the American Society of Anesthesiologists (ASA) physical status I and II and patients with BMI of <30 kg/m^2 were involved in the study.

While patients with anticipated difficult intubation, patients with neuromuscular diseases, pregnant women, patients with history of recent upper respiratory tract infection, smokers, patients with preexisting lung diseases and patients on steroids (oral or by inhalation) or non-steroidal anti-inflammatory drugs within one week from the surgery or a former surgery within the last 2 weeks were excluded from the research.

All the study patients had the same anesthesia protocols. At operating room, routine monitoring, involving noninvasive arterial blood pressure, electrocardiogram and pulse oximeter were performed. The standardized anesthetic protocol was followed in all the patients and intravenous crystalloid fluid according to 4:2:1 rule was given. Following venous access establishment, the patients were given intravenous midazolam (0.02 mg/kg) with Fentanyl (0.001-0.002 mg/kg). After pre-oxygenation, induction of anesthesia was started using propofol (1 to 2 mg), and rocuronium (0.6 mg/kg) was given to facilitate endotracheal intubation. After endotracheal intubations (tube size 7-7.5mm), maintenance was made by isoflurane (1-1.5 MAC) and induction time and duration of surgery was recorded for every patient. Patients were divided into two groups: First group the cuff was inflated to 25 cmH_2O and the second group cuff was inflated to 28 cmH_2O by using a manometer, and then the endotracheal tube cuff pressure was measured every 10 minutes using the manometer.

The assessment of sore throat and hoarseness intensity was accomplished by asking the patients about these complications during 24-72 hours post surgery.

Statistical analysis

The SPSS version 25 Statistics (IBM SPSS Inc., Chicago, IL, USA) was used for data analysis. Student's t-test was applied to find the difference between two groups for continuous variables. For analyzing the differences between gender, incidence of post postoperative hoarseness and sore throats, the Chi Square test was employed. The ($p<0.05$) value was regarded as statistically significant.

RESULTS:

The overall occurrence of hoarseness & sore throat in this study was 16.67% and 13.33%, respectively as shown in figures (1) and (2). Out of (30) patients in each group, hoarseness was encountered in 2 (6.67%) in the low pressure patients and 8 (26.67%) in the high pressure patients, with a significant difference ($p=0.038$) as seen in figure (3). Similarly, 1 (3.33%) patient was found to have sore throat in low pressure group compared with 7 (23.33%) patients in high pressure group with a significant difference ($p= 0.023$) as shown in figure (4).

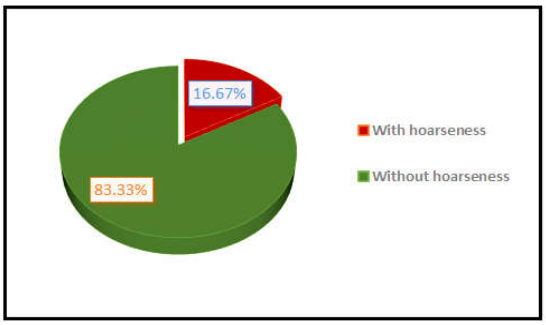

Figure 1: The overall incidence of hoarseness.

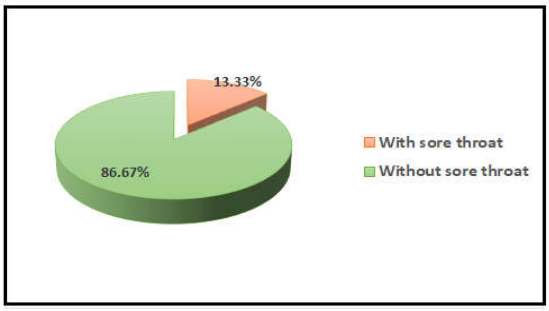

Figure 2: The overall incidence of sore throats

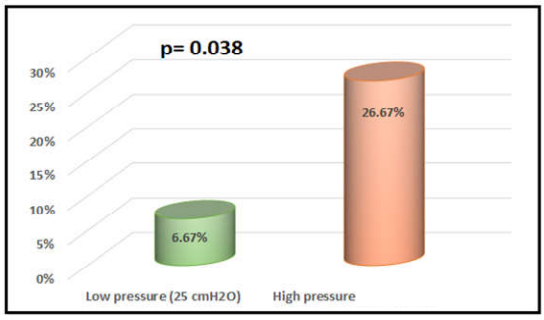

Figure 3: The incidence of hoarseness in high and low cuff pressure.

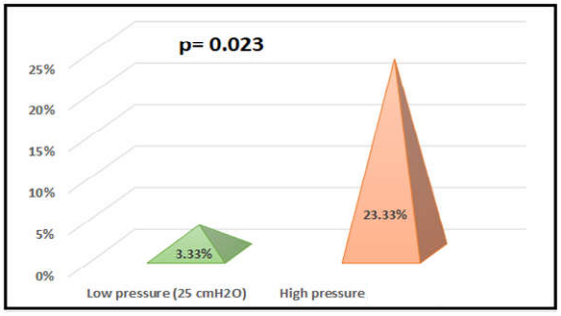

Figure 4: The incidence of sore throat in high and low cuff pressure.

The demographic and clinical factors were evaluated in terms of their association with the occurrence of hoarseness and sore throat in all patients. None of the included factors had a significant association with the development of hoarseness. Although females accounted for 70% of patients who developed hoarseness compared to 60% of patients without hoarseness, the difference was not significant. Likewise, induction time was slightly longer in patients

without hoarseness than those who developed hoarseness (2.26±0.31 minutes versus 1.39±0.14 minutes), with no significant difference as illustrated in table (1).

Table 1: Association of hoarseness with demographic and clinical factors.

Variables	No hoarseness (N=50)	With hoarseness (N=10)	P-Value
Age, yrs. Mean±SD Ranges	 32.44±7.3 21-48	 31.9±2.5 20-50	0.819
Gender Male Female	 20(40%) 30(60%)	 3(30%) 7(70%)	0.553
BMI, kg/m^2 Mean±SD Range	 25.3±3.5 17.6-28	 23.72±2.98 20.1-27.6	0.187
ASA **I** **II**	 30(60%) 20(40%)	 4(40%) 6(60%)	0.244
Duration of surgery, min Mean±SD Range	 41.64±8.13 30-60	 40.9±5.7 30-45	0.800
Induction time, min Mean±SD Range	 2.26±0.31 1-3	 1.39±0.14 1-3	0.290
Cuff pressure, cmH_2O 25 28	 28(56%) 22(44%)	 2(20%) 8(80%)	0.038

For sore throat almost similar results were obtained. Females were more frequent in patients with sore throat than those without sore throat (87.5% versus 59.62%) with no significant difference. Similarly, patients without sore throat had slightly higher BMI (25.34±3.42 kg/m^2) than patients with sore throat (23.1±2.54 kg/m^2) without significant difference as demonstrated in table (2).

Table 2: Association of sore throats with demographic & clinical factors.

Variables	Without sore throat (N=52)	With sore throat (N=8)	P-value
Age, yrs. Mean±SD Ranges	 32.5±7.16 21-50	 31.38±2.56 20-48	0.764
Gender Male Female	 21(40.38%) 31(59.62%)	 1(12.5%) 7(87.5%)	0.128
BMI, Kg/m^2 Mean±SD Ranges	 25.34±3.42 17.6-28	 23.1±2.54 20.1-27.6	0.087
ASA **I** **II**	 31(59.62%) 21(40.38%)	 3(37.5%) 5(62.5%)	0.091
Duration of surgery, min Mean±SD Range	 41.17±8.07 30-60	 43.75±10.26 30-60	0.421
Induction time, min Mean±SD Range	 2.71±0.3 1-3	 2.5±0.4 1-3	0.588
Cuff pressure, cmH_2O 25 28	 29(55.77%) 23(44.23%)	 1(12.5%) 7(87.5%)	**0.023**

DISCUSSION:

The results of overall incidence of hoarseness and sore throat go with many studies such as Higgins and Mezei [9] in Canada who enrolled 5264 patients who underwent ambulatory surgery under general anesthesia. The sore throat incidence rate was found to be 12.1%. In Denmark, Christensen et al. [10] stated that the incidence rate was 14.4%. In a Japanese study, patients were prepared to have general anesthesia by tracheal intubation, the postsurgical hoarseness occurred in 16.1% of patients. However, a Korean study found that the general incidence rate of postoperative sore throats was 57.5% [11].

This diversity between different studies can lead to big variation in risk factors that predispose for hoarseness and sore throat like age and sex of the patients, type of surgery, cuff pressure, BMI of the patients and experience of the anthesiologist.

The most interesting result in the current study was the significantly higher frequency of hoarseness and sore throat in patients with high cuff pressure (28 cmH_2O) than those with low cuff pressure (25 cmH_2O). Almost similar results were obtained by a Chinese study on patients prepared for elective surgery. The researchers divided patients into two group: in the first group, the anesthesiologist inflated the pressure of the cuff blindly in accordance with own expert by the use of the method of pilot balloon palpations without any aid of gauge instrumentations, while the cuff was adjusted to (15-25) cmH_2O in the second group. The incidence of hoarseness, sore throat and blood streaked expectorations 24 hrs. postoperatively in the second group was 3%, 34% and 4% respectively [12].

It was demonstrated that excessive inflations of the cuff can initiate high pressures on layers of tracheal walls, thereby influencing blood perfusions of tracheal mucosa leading to ischemic necrosis of them [13]. The pressure range of human capillary perfusion is from (30-44) cmH2O and the mucosal blood flow decrease in tracheal cartilages occurs at >30cmH2O [14]. When the pressure in the cuff is more than 22 cmH_2O, blood flows in tracheal mucosa start reducing and decreases noticeably as pressures reach 30 cmH_2O. single study reported that when the pressure in the cuff become 50 cmH_2O as long as 15 minutes, possibility of ischemic injury to tracheal mucosa would occur [12]. The mechanism of hoarseness development following high cuff pressure is not very clear, and this needs to be explained since the cuff is below the glottis, and therefore should not make a significant effect on voice change. However, it was the theory that vocal cord edema caused by endotracheal intubations, mechanical abrasion and pressure of the tube with vocal cords are the main important factors [15].

The other most important finding in the present study was that none of the included risk factors were related to the development of hoarseness and sore throats. This was not in agreement with a recent Ethiopian study which reported that female sex beside repeated numbers of trials for intubation as well as using nasogastric tubes were significantly correlated with higher incidence of sore throats [16]. In another work, Sanou et al. [17] revealed that the sore throat incidence was significantly higher in female group than male group. In a Japanese study, increased BMI, depth of tracheal tube and intubation performed by doctors in training were significantly associated with the increased incidence of hoarseness [18]. However, many other studies did not report relationship between BMI and female sex with postoperative hoarseness and sore throat [19]. The variable techniques and skills among anesthetists could be behind this discrepancy.

The higher incidence of postoperative hoarseness and sore throat among females may be attributed to gender differences in stating adverse results, tighter fittings of an endotracheal tube as well as the laryngeal anatomical variation between males and females. In addition, anxiety level and pre-operative psychological status among patients may be involved in pain perception.

On the other hand, obesity and high BMI are frequently reported to be associated with difficult intubation (DI). Juvin *et al*. [20] compared 134 patients with normal body weight with 129 obese consecutive patients in the incidence of DI. The rate of DI was 2.23% in lean patients and 15.5% in obese patients with a highly significant difference. A meta-analysis by Shiga *et al*. [21] including 35 studies with a total of 50760 patients reported that obese patients were 3-time as likely to have DI than lean patients.

CONCLUSION:

It can be concluded from the current study that the high cuff pressure (28 cmH_2O) was associated with increased incidence of postoperative hoarseness and sore throat.

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