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Comparison of Endotracheal Cuff Pressure Changes with Head and Neck in Extension Position

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ABSTRACT

Background: The cuff of the endotracheal tube is inflated when general anesthesia is administered to provide a sufficient seal and avoid micro-aspiration. Complications may arise from overinflating the cuff, which lowers mucosal perfusion. The present study investigates how variations in head and neck posture affect intracuff pressure.

Methods: It is parallel group research that is not randomized. Included were fifty adult patients, ages twenty to sixty, who were scheduled for elective GA surgery with endotracheal intubation. Patients having neck extension surgery have to be in one of the categories. Patients in Group 1 underwent head and neck procedures while in a neutral supine posture. A manometer was used to measure intracuff pressure first with the head and neck in the neutral supine position and then with the head and neck extended. The head and neck were instantly put back in neutral. At 15 and 30 minutes, the intracuff pressure was measured again.

Result: The findings indicated a considerable rise in pressure between the neutral and extension positions. Although there was no discernible difference between the groups, a considerable incremental pressure rise was seen in both the neck in the neutral position and the neck extended.

Conclusion: Cuff pressure rises noticeably with head extension and then progressively over time. Continuous monitoring and management of the endotracheal tube's cuff pressure is necessary when the head position is altered for extended surgical operations.

Key-words: Cuff pressure, Endotracheal tube, Head and neck position, General anesthesia

INTRODUCTION

When administering general anesthesia, a cuffed endotracheal tube is frequently inserted. To avoid microaspiration—a main pathogenic mechanism for ventilator-associated pneumonia—the endotracheal tube cuff is inflated with air to provide a sufficient seal [1].

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Maintaining proper cuff pressure is crucial to preventing aspiration of secretions that sit above the cuff from entering the lungs.

When the pressure produced by the endotracheal tube cuff is increased above 30 cmH_2O, it typically transfers to the tracheal mucosa, causing ischemia through the compression of tracheal mucosal vessels. This can result in complications such as laryngeal nerve palsy, a sore throat, hoarseness, subglottic mucosal injury, tracheal rupture, tracheal stenosis, and sore throat [2,3].

The length of exposure and cuff pressure have a direct impact on the incidence of tracheal ischemia [4]. Because the pressure inside the cuff is a dynamic process that can be changed by several factors, such as changes in head and neck position, body temperature, and the makeup of inhaled gases like nitrous oxide, there can be significant

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variation in the intracuff pressure during the endotracheal intubation period [5,6].

The patient's head and neck movements may cause the tracheal-intubated ETT to shift. ETT cuff pressure might vary because of head and neck movement as well as ETT displacement [6,7]. An ETT's pilot balloon pressure is thought to be a reliable indicator of the cuff pressure applied to the tracheal mucosa. Kako *et al.* discovered that intracuff pressure increased with changes in head and neck position in pediatric patients, more often with head flexion, as compared to the neutral position. Neck extension was more often associated with a pressure drop [1]. Athiraman *et al.* investigated how changes in head position in neurosurgery patients affected the pressure in the endotracheal cuff [2].

MATERIALS AND METHODS

Source of Data- The institute's ethical committee approved this trial study. Fifty adult patients aged between 20 years - 60years scheduled for elective surgery under GA with Endotracheal intubation admitted at A.J. Institute of Medical Sciences & Research Centre, Mangalore for 24 months (from July 2020-22) were included in the study. The consort flow chart is shown.

Study Design- It was a non-randomized parallel-group study. One of the groups had to have patients undergoing surgery that required neck extension.

Groups

Group 1: Patients undergoing general anaesthesia for surgeries with head and neck in the supine neutral position.

Group 2: Patients undergoing general anaesthesia for surgeries requiring head and neck in extension position.

Inclusion criteria

- Adult patients aged 20 to 60 years old.
- Patients of either gender with ASA 1 or ASA 2.
- Patients undergoing elective surgical procedures require endotracheal intubation while under general anaesthesia.

Exclusion criteria

- Patients coming for emergency procedures.
- Patients with ASA >3
- Patients who are pregnant.
- Patients with known laryngeal or tracheal pathology.
- Patients with neck pain, history of neck surgery, limitation of neck movement.
- Patients intubated with uncuffed endotracheal tubes.
- Patients on tracheostomy.

Methodology

Group 1: After inflation of the ETT, the patient's head and neck were positioned straight and naturally with a 5 cm high pillow, and this posture was defined as a neutral posture. The intracuff pressure was first measured with the head and neck of the patient in a supine neutral position, by a manometer. The reading was recorded. Subsequently, the intracuff pressure was measured with the head and neck in extension. Head and neck are put back to a neutral position after noting the intracuff pressure.

Group 2: Group contains subjects who undergo surgeries that require neck extension position. After inflation of the ETT, the patient's head and neck were positioned straight and naturally with a 5 cm high pillow, and this posture was defined as a neutral posture. The intracuff pressure was first measured with the head and neck of the patient in a supine neutral position, by a manometer. The reading was recorded. Surgery needs to take place with the head and neck in extension. The intracuff pressure was measured with the head and neck in extension. The intracuff pressure was further measured at 15 mins and 30 mins.

Statistical Analysis- Data analysis was performed using SPSS version XX. Continuous variables were expressed as mean ± SD or median (IQR). The unpaired t-test was used for parametric data, the Mann–Whitney U test for non-parametric data, and the Chi-square test for categorical variables. A p-value<0.05 was considered statistically significant.

RESULTS

Table 1 shows the comparative values for the two groups are shown as mean and standard deviation. The unit is in the year. The data were parametric and were compared using t t-test.

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Table 1: Comparision of Age Between the Two Groups

	N	Mean, SD	SE Mean	Median	95% CI for difference for means	p-value
Group A	25	39.92, 8.13	1.62	39	-5.346 to 8.226	0.671
Group B	25	41.36, 14.78	2.956	43		

N=number of patients, SD= standard deviation, CI= Confidence interval, SE= standard error of mean

The comparative values for the two groups are shown as mean and standard deviation. The unit is in Kg. The data were parametric and were compared using the Unpaired t-test (Table 2).

Table 2: Comparision of Weight Distribution Between the Two Groups

	N	Mean SD	Median	SE	95% CI difference or means and medians	p-value
Group A	25	63.72, 13.66	61	2.73	-1220 – 1.97	0.121
Group B	25	58.4, 9.88	58	1.97		

N=number of patients, SD= standard deviation, CI= Confidence interval, SE= standard error of mean

The comparative values for the two groups are shown as percentages. The data was compared with the Chi-square test (Table 3).

Table 3: Comparison of ASA-PS Status Between the Two Groups

	ASA-PS 1	ASA-PS2	N	p-value	Chi-square value
Group A	20(80%)	5(20%)	25	0.0689	3.3
Group B	14(56%)	11(44%)	25		
Total	34(68%)	16(32%)	50		

N=number of patients

The comparative values for the two groups are shown as percentages. The data was compared with the Chi-square test (Table 4).

Table 4: Comparison of Gender Between the Two Groups

	Male	Female	N	p-value
Group A	11	14	25	0.5713
Group B	13	12	25	
Total	24	26	50	

N=number of patients

The comparative values for the two groups are shown as median. The unit is in mmhg. The data were non-parametric and were compared using the Mann-Whittney test (Table 5).

Table 5: Baseline Systolic Blood Pressure

	N	Median	SE	95% CI for difference of median	p-value
Group A	25	110	2.44	110-120	0.243
Group B	25	120	3	110-130	

N=number of patients, SD= standard deviation, CI= Confidence interval, SE= standard error of mean

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DISCUSSION

The findings indicated a considerable rise in pressure between the neutral and extension positions. All individuals showed an incremental increase in neck extension. Neck extension is utilized in routine surgery to improve the visibility of the operative field. Maintaining cuff pressures at optimal levels is essential throughout these positioning procedures [8].

A painful throat, hoarseness, rupture of the subglottic, laryngeal nerve palsy, tracheal stenosis, and tracheal damage can all arise from over-inflating the pressure of the cuff on the mucosal wall, which may also impair the perfusion of the mucosa and the underlying tissues [9]. Furthermore, the pressure inside the cuff is dynamic and adjustable by changes in the size and structure of the trachea, the patient's temperature, and the mix of anesthetic gases, except the potential for over or underinflation when the balloon is initially inflated [10].

In this study, we investigated how head and neck postures relate to intracuff pressure. For head and neck surgeries and some otolaryngological procedures that need extended neck extension, this could be particularly crucial. Even while the intracuff pressure was within a clinically acceptable range when the cuff was first inflated with the neck and head in a neutral posture, this increase in excessive intracuff pressure might be the consequence of airway pressure causing later mucosal injury [11].

In the present investigation, we observed that head extension resulted in a statistically significant rise in intracuff pressure at 0 minutes in both group A (median pressure increase of 26 to 34 mmHg) and group B (median pressure increase of 26 to 30 mmHg). In addition, there was a statistically significant rise in intracuff pressure in Group B when the head was held in extension at 15 and 30 minutes (median pressure increase from 26 to 32 mmHg) [12].

There was no statistically significant difference in cuff pressure between groups A (neck in neutral position) and B (neck in extended position) at intervals of 15 and 30 minutes. The mean difference in cuff pressure was 1.96 mmHg at 15 minutes and 2 mmHg at 30 minutes. Research by Kako *et al.* [1] examined the association between endotracheal tube intracuff pressure and head and neck position in the pediatric population. They found that variations in head and neck posture result in notable variations in intracuff pressure. In a few cases, this led to a notable rise in intracuff pressure. When the neck was extended, the intracuff pressure increased from a mean of 18.2 to 21 mmHg [13-17].

CONCLUSIONS

A considerable rise in cuff pressure is caused by head extension, and this trend continues over time. For this reason, when the head position is altered during lengthy surgical operations, the endotracheal tube's cuff pressure needs to be regularly checked and controlled to avoid difficulties. It is necessary to regularly measure the endotracheal tube cuff pressures intermittently or continuously. It is necessary to do more research in large groups in all head positions to evaluate intracuff pressure. More research is required to either include in-line intracuff pressure manometers in the endotracheal tube or create the perfect intracuff pressure measuring device. Equipment makers might be able to identify these issues and create a device that is essential to avoiding difficulties from ETT intracuff pressure and ensuring safe airway management.

CONTRIBUTION OF AUTHORS

Research concept- Sunil Kumar K, Santhosh NV
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Supervision- Sunil Kumar K, Santhosh NV
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