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Research Article

Endotracheal Cuff Pressure in Different Positions in Patients Posted for Surgery under General Anaesthesia: An Observational Study

Naga Seshu Kumari Vasantha, Lavanya Kaparti, Ravi Madhusudana, Syed Hazarath Nabi*

Department of Anesthesiology, Sri Devaraj Urs Medical College, Kolar, Karnataka, India.

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ABSTRACT

Background: The ideal endotracheal tube cuff pressure to prevent aspiration is 20-30cmH2O. Lower pressures will result in aspiration and high pressures will lead to tracheal mucosal injuries. Change in patient position may also lead to change in cuff pressures. Our study mainly aims at measuring the cuff pressures in supine, Trendelenberg, reverse Trendelenberg, neck flexion and rotation to one side.
Methods: This prospective observational study was conducted after obtaining ethical clearance and patient consent. 50 patients of ASA Classes I and II were included. All patients were intubated with Romson cuffed endotracheal tubes of size 7.5mm for females and 8.5mm for males. The cuff was inflated and cuff pressure set at 28cm H2O using CuffillsR syringe. With head in neutral position, cuff pressure was measured in 15 degree Trendelenberg and reverse Trendelenberg positions. Using angle meter app, the angles were fixed for flexion, extension, and rotation to one side at 30 degrees. The cuff pressure was recorded after 120 seconds after placing the patient in all these positions.
Results: The cuff pressure increased by 12.48cm H2O flexion and the cuff pressure increased to 33.22cm H2O in extension. The cuff pressure increased to 38.10cmH2O on rotation, increased by 10.58cmH2O from neutral position in Trendelenberg position and increased by 8.74cmH2O in reverse Trendelenberg position.
Conclusion: The cuff pressure changed significantly in all the positions.

Introduction

The endotracheal tube cuff pressure is usually maintained about 20 – 30 cmH2O for a proper seal [1]. If the cuff pressure is inadequate, there are chances of micro aspiration. Over inflation of the cuff leading to high cuff pressures causes tracheal complications, especially after long procedures.
The cuff pressures are checked by the anaesthesiologists initially but intermittent or continuous monitoring of cuff pressure is not done routinely. Studies have shown that the cuff pressure of the endotracheal tube varies with change in body position of the patient [2-5]. There is little information about change of cuff pressure with respect to change in body position in patients undergoing surgery. We decided to conduct this study to note the cuff pressure in 5 different positions in patients undergoing surgery under general anaesthesia.

Methods

After obtaining the approval from the institutional ethical committee (SDUMC/KL/IEC/470/2022-23) and registration of our study with CTRI (CTRI/2023/01/049224), the study was conducted in Sri Devaraj Urs Medical College, Kolar from February 2023 to May 2023.

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*Corresponding author.
E-mail address: drlavanyakaparti@yahoo.com

The inclusion criteria were all patients of ASA PS Class 1 and 2, in the age group 18 – 60 yrs, of either sex posted for surgery under general anaesthesia. Patients with known laryngeal pathology, previous neck surgeries, limitation of neck movements, known cardiac pathology, known bronchial asthma and BMI >30 were excluded from the study.

The sample size was estimated to be 50 using the following formula

n= 4SD2/L2

Z2= 4

After the confirmation of the NPO status, the patients were shifted to the operation theatre and standard monitors like SpO2, ECG, NIBP and ETCO2 were connected. The baseline readings were noted. All the patients received inj Fentanyl 2mcg/kg as premedication. The patients were induced with Inj Propofol 2mg/kg and the muscle relaxant used to facilitate intubation was Inj Vecuronium 0.1 mg / kg. When the TOF score was 0, the patients were intubated. The endotracheal tube used had a high volume, low pressure cuff (Romsons^{R} endotracheal cuffed tube).

The male patients were intubated with size 8.5 ETT and female patients with size 7.5 ETT. The endotracheal tube was fixed at 22 cm at upper incisors level in male patients and 20 in female patients.

After confirmation of the correct placement of the endotracheal tube, the patient was connected to the ventilator with the following settings – Tidal volume 8mL/kg, Respiratory rate 12/min, PEEP 5cmH_2O. Anaesthesia was maintained with Oxygen and Nitrous Oxide mixture (40:60) and isoflurane at 0.6%.

The patients were placed in supine position with a pillow of 5cm. The angle between inferior border of the mandible and midline of the neck in neutral position was measured. This was the neutral angle. The angle was measured using Angle meter app.

At the beginning of the study, the pressure in the endotracheal tube cuff was set to 28cmH_2O, measured at the end of expiration.

The cuff pressure was measured using AG Cuffills device.

The endotracheal tube cuff pressure was noted in 5 different positions- neck extension of 30degrees, neck flexion of 30 degrees, lateral rotation of the head to the right, Trendelenberg position 15 degrees and reverse Trendelenberg position 15 degrees. Between each change of position, the patient was put to neutral and pressure readjusted to 28 cm H_2O. This sequence was followed in all patients. The cuff pressures were measured 120 sec after putting the patient in the new position and at the end of expiration.

The cuff pressures were measured by an anaesthesiologist blinded to the study.

At the end of the study, the patients were put in neutral position and cuff pressure readjusted to 28 cm H_2O for the safety of the patient.

Statistical Analysis

Data were expressed as mean ± SD for the cuff pressures. The age categories, sex and diagnosis are expressed as frequency and percentages. Cuff pressures at different positions: Flexion, extension, rotation, Trendelenburg, and reverse Trendelenburg were compared with neutral position. The changes of cuff pressure from neutral position were analyzed by paired t-test with two-tailed. Analysis was performed using Stata version 16. (StataCorp Ltd., College Road, Texas, USA). Statistical significance was considered at $P< 0.05$.

Results

Of the total 50 patients, 28 were male and 22 were female (Table 1) The mean age was 40.26 years.

The mean cuff pressure of the subject in neutral position was adjusted to 28 cm of H_2O. the cuff pressure increased by 12.48 cm of H_2O (mean) on flexion. The minimum change was 4 cm of H_2O and maximum was 27 cm of H_2O. the change was significant with a p value of <0.001. in the extension position the average pressure was 33.22 cm of H_2O, a change of 5.22 cm of H_2O was noted from the neutral position. On rotation of the head, the cuff pressure increased on an average by 38.10 cm of H2O. the minimum pressure noted was 27 and maximum was 57. In the trendelenberg position, the average rise in pressure was 10.58 cm of H_2O and in reverse trendelenberg position the average increase in pressure was 8.74 cm of H_2O (Table 2, Figure 1-2).

There was statistically significant change in cuff pressure at all different positions from the neutral position.

Table 1- Demographic data of the patients included in the study

Mean (SD) Age	40.26 (16.95)
Age categories	
15 – 30 years	17 (34.0%)
31 – 45 years	16 (32.0%)
46 – 60 years	9 (18.0%)
61 – 80 years	8 (16.0%)
Sex	
Male	28 (56.0%)
Female	22 (44.0%)
Diagnosis	
DNS	6 (12.0%)

DNS with Rhinosinusitis	5 (10.0%)
Sinonasal Polyposis	5 (10.0%)
Renal calculi	4 (8.0%)
Prolapsed Intervertebral disc	4 (8.0%)
Chronic Suppurative Otitis Media	4 (8.0%)
AUB	2 (4.0%)
Acoustic schwannoma	2 (4.0%)
Branchial cyst	2 (4.0%)
Dacrocystitis	2 (4.0%)
Epigastric hernia	2 (4.0%)
Malignant otitis externa	2 (4.0%)
orbital cellulitis with sinusitis	2 (4.0%)
Tonsilitis	2 (4.0%)
Others	6 (12.0%)

Table 2- Changes in the pressure at different positions from the neutral position

Position	Absolute measured value			Change in cuff pressure from neutral position			P value#
	Mean (SD) cuff pressure	Minimum	Maximum	Mean (SD) change	Minimum	Maximum	
Neutral	28 (0)	28	28				
Flexion	40.48 (6.17)	32	55	12.48 (6.17)	4	27	<0.001
Extension	33.22 (7.16)	23	60	5.22 (7.16)	- 5	32	<0.001
Rotation	38.10 (5.95)	27	54	10.1 (5.95)	- 1	26	<0.001
Trendelenburg	38.58 (6.44)	27	53	10.58 (6.44)	- 1	25	<0.001
Reverse Trendelenburg	36.74 (6.93)	25	50	8.74 (6.93)	- 3	22	<0.001

#Paired t-test was performed

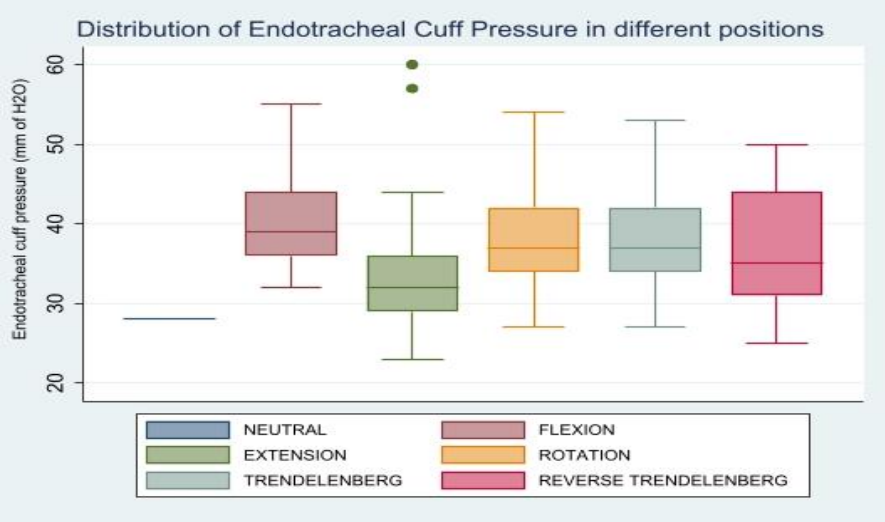

Figure 1- Endotracheal Cuff Pressures at various position

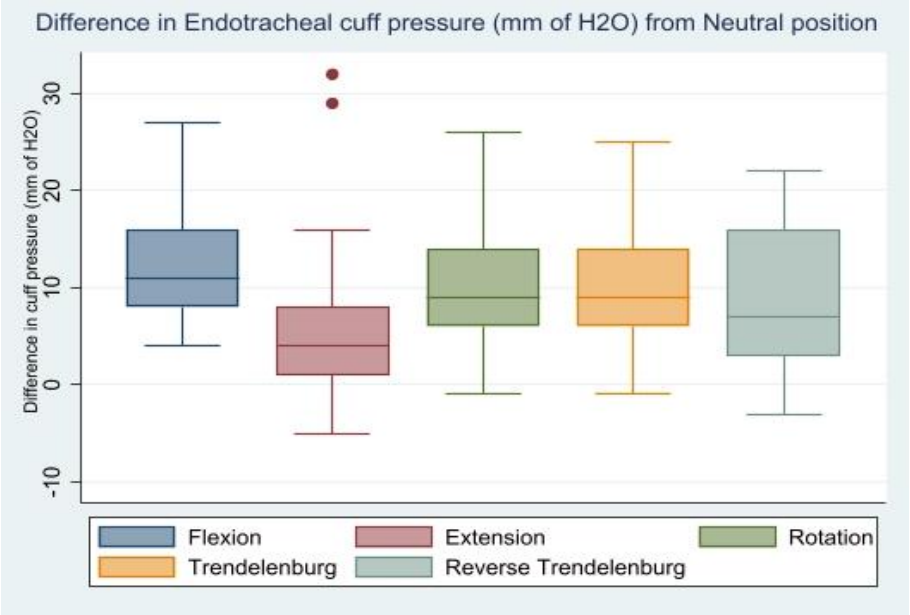

Figure 2- Difference in Endotracheal Cuff Pressures at various position from neutral position

Discussion

Endotracheal tube cuff is inflated to prevent aspiration in patients undergoing surgery under general anesthesia. The recommended cuff pressure is between 20-30 cm of H_2O [6]. If the pressure is below 20 cm of H_2O the glottic seal will be inadequate and can lead to micro aspiration. Increased cuff pressure causes tracheal complications especially after long procedures. Over inflation of the endotracheal tube cuff is known to reduce blood flow to tracheal mucosa leading to tracheal stenosis [8].

The endotracheal tube cuff pressure is measured initially by the anesthesiologist. Routine monitoring of the cuff pressure in the intraoperative period and with change of position is not done. Studies done in critical care patients have shown that cuff pressure varies significantly with change in position [10]. There are a smaller number of studies mentioning the change in the cuff pressures in the intraoperative period. Hence, we decided to conduct this study of monitoring endotracheal tube cuff pressures monitoring in various positions in patients posted for elective surgery.

The tube pressure Kako H et al stated the cuff pressure was changed by head rotation, neck flexion and extension in pediatric population and the major cause for increase in cuff pressure was movement of endotracheal tube [7].

In the study by H.C Kim et al [8] the cuff pressure increased to 38.756 cm of H_2O in flexion when compared to neutral position. In our study the cuff pressure increased to 40.48 +/- 6.17 cm of H2O from 28 cm of H_2O.

Ziyaefard et al, in their study found that cuff pressure to vary between 28-36 cm of H_2O in extension 1 In our study we observed that the change in cuff pressure from neutral position was 52.2+/- 7.16 from neutral value of 28 cm of H_2O.

Kara et al observed that the median intracuff pressure value increased from 25 to 27.20 when neck is rotated to right side. On right side rotation the pressure was 26.73 cm of H20 on an average [9]. As there was no significant difference in the cuff pressure in right and left lateral position of head, we decided to conduct the study in right lateral position. In our study endotracheal tube cuff pressure increased with rotation and mean was 38.10+/- 5.95 cm of H_2O.

Ziyaefard et al [1] noted that the mean in endotracheal tube cuff pressure with trendelenburg position at 10σ was 25.86+/- 2.069 cm of H2O, whereas in our study we observed that the cuff pressure increased by an average of 10.58+/-6.44 in trendelenburg position at 15σ from neutral position at 28 cm H_2O. In the reverse trendelenberg position the mean cuff pressure was 36.74+/- 6.93 cm of H_2O which showed a significant change from neutral position.

Limitations

Firstly, we did not check the endotracheal tube pressure in prone position. Second limitation, we did not check the change in endotracheal tube cuff pressure after prolonged positioning of the patient in various positions.

Conclusion

The cuff pressure varies significantly in all positions as seen in our study. Hence, we should check the cuff pressure after every change in position of the patient.

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