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THE CHANGES OF ENDOTRACHEAL TUBE INTRACUFF PRESSURE DUE TO CHANGE IN HEAD AND NECK POSITION IN MRM SURGERY

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ABSTRACT

Introduction: The safety margin of tracheal tube cuff pressure lies between excessive and insufficient pressure. Specifically, insufficient pressure can lead to air leakage, which lessens the effect of mechanical ventilation and results in the leakage of inhalation anesthetics, while excessive pressure can cause serious injury and affect blood flow to the tracheal mucosa, resulting in cough, hoarseness of voice prolonged intubation may cause tracheal stenosis, fistula, or tracheal rupture. Movement of the head and neck and the resulting displacement of the tracheal tube can alter cuff pressure.

Material and Methods: We collect this sample size by using purposive sampling method. We select the individual who full fill the inclusion criteria and also give consent for participating in study.

Result: In this study 59 (59%) female and 41 (41%) males. This study shows that 20 to 30 ET Cuff Pressure after change in Head and Neck Position in 41 (41%) cases and above 30 ET Cuff Pressure after change in Head and Neck Position in 59 (59%).

Conclusion:

It has been observed that change in average ETT cuff pressure was in between 6 cm of H2O after every 15 minutes interval, and every time when the ETT cuff pressure was found to be more than 25 cm of H2O, we reduced to within normal limits (25 cm of H2O) with the help of digital manometer. On the basis of the present study we arrived to the following conclusion that repeated reducing of ETT cuff pressure to within normal range (25 cm of H2O) lead to lesser complication of sore throat and hoarseness of voice as compared to the previous studies done for the same. Hence we can conclude that, ETT cuff pressure measuring manometer - (AG Cuffill) is an important tool to regulate ETT cuff pressure during intraoperative period, and it also helps to reduce post-operative complications like sore throat and hoarseness of voice

Keywords: ET cuff Pressure, Head and neck position, post operative complication

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1. INTRODUCTION

The safety margin of tracheal tube cuff pressure lies between excessive and insufficient pressure. Specifically, insufficient pressure can lead to air leakage, which lessens the effect of mechanical ventilation and results in the leakage of inhalation anesthetics[1],while excessive pressure can cause serious injury and affect blood flow to the tracheal mucosa, resulting in cough, hoarseness of voice prolonged intubation may cause tracheal stenosis, fistula, or tracheal rupture[2-3]. Movement of the head and neck and the resulting displacement of the tracheal tube can alter cuff pressure[4]. Cuff shape design has advanced substantially in recent years. For example, a recent developed endotracheal tube (taper guard, covidien) has tapered cuff that seal the trachea better in compression to previously introduced ETT[5,6]. Appropriate endotracheal tube (ETT) cuff pressure is required for positive pressure ventilation during general anesthesia. Appropriate cuff pressure is 20 to 30cmH2O, and when the pressure is low, adequate ventilation may be impaired due to gas leakage[7–10]. Conversely, when the pressure is high, the airway mucosa may be pressed upon which can cause various complications[7-11]. The ETT cuff pressure can be affected by several issues such as patient factors (e.g., differences in the size of the trachea and the position of the ETT cuff), anesthetic factors (e.g., intra-operative use of high airway pressure and nitrous oxide), and cuff related factors (e.g., differences in cuff compliance, diameter, thickness and geometry)[12–19]. Modified Radical Mastoidectomy surgery for CSOM is a widely performed procedure requiring a specific surgical position that can facilitate exposure of operative site. However, this position can affect the ETT cuff pressure during surgery and increase post operative airway complications[20]. Use of an endotracheal tube with a tapered-shaped cuff (Taper Guard TM ETT, Covidien, Athlone, Ireland) improved the sealing effect compared to the ETT with a conventional cylindrical shaped cuff (Mallinckrodt ETT, Covidien, Athlone, Ireland)[17]. Lower cuff pressure was required with Taper Guard ETT to obtain an adequate seal compared to conventional ETT[18].However, in some recent studies, Taper Guard ETT has been shown to increase the cuff pressure more than the conventional ETT after a position change during surgery[22, 23]. If it is below the recommended cuff pressures the glottis seal is inadequate and it may lead to microaspiration[24]. Increased cuff pressure leads to tracheal complications, though often associated with long procedures, these complications may occur even after a short duration of anesthesia[25]. The safety margin of endotracheal tube (ETT) cuff pressure is determined between over-inflation and under-inflation. Under-inflation can cause air leakage, which lessens the effect of mechanical ventilation and produces a leakage of inhalation anesthetics. ETT cuff pressure below 20 cmH2O is a risk factor of ventilator associated pneumonia[26,27]. However, over-inflation of the ETT cuff can cause early signs and symptoms like sore throat and hoarseness of voice and prolonged intubation can cause serious injuries and affect blood flow to the tracheal mucosa[28], resulting in tracheal stenosis[29]. After tracheal intubation, ETT can be displaced by movement of the patient's head and neck[30]. Movement of the head and neck and the displacement of ETT can cause a change inETT cuff pressure[31, 32]. There was a report on the effect of position change from supine to prone on cuff pressure[33]. To decrease the incidence of post-operative complications associated with change in ET tube intracuff pressure, few studies showed (Jung TH et al., Liu Jet et al.,) [24] that measurement of ET tube intracuff pressure intra-operatively is necessary.

2. MATERIALAND METHODS

The proposed study was conducted on patient of either sex aged 18 - 65-year ASA physical status I-II, schedule for MRM surgery in at Nehru Hospital in BRD Medical College Gorakhpur.

Sample Size Calculation:

SAMPLE SIZE- For the sample size we using the formula = $4pq/d^2$P= 60% (Proportion of patient undergoing MRM Surgery for CSOM) Allowable error = 10

Total sample size=96

SAMPLING METHOD- we collect this sample size by using purposive sampling method. We select the individual who full fill the inclusion criteria and also give consent for participating in study. After approval from ethical committee and obtaining informed consent from all patient.

Study Design-prospective observational study

Methodology: -

All the patients underwent a detailed pre-operative anaesthetic check up with history, general physical examination, airway assessment and systemic examination one night before surgery. All the routine investigations including, complete blood count, blood sugar, renal function test, liver function test, coagulation profile, blood grouping and Rh typing, ECG for patients over 40 years of age and chest X ray were obtained. Patient's informed consent was taken. Patients were premeditated with T. Alprazolam 0.25mg and T. Ranitidine 150mg at 10pm one night before surgery and at 7am on the day of surgery. On the arrival of the patient to operating room, an 18-gauge intravenous catheter was inserted and 6ml/kg/hr crystalloid infusion was started. All the monitors including, oxygen saturation (SpO2), non-invasive blood pressure, electrocardiography will be connected and the baseline values were recorded. Pre- oxygenation with 100 percent oxygen was done for 3 minutes. General anaesthesia

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was induced with IV Fentanyl 1.5mcg/kg, propofol 2-2.5mg/kg followed by vecuronium bromide 0.1mg/kg to facilitate orotracheal intubation. The trachea was intubated with cuffed endotracheal tube of appropriate size. After intubation, ET cuff was inflated manually. We as observer, measured the cuff pressure and brought down the cuff pressure to 25cm of H2O that is within the normal range.

- We measured the cuff pressure of every patient using AG cuf fill manometer just after intubation and note their1st readingof cuff-pressure kept at 25cm of H2O.
- 1st reading of cuff-pressure of every patient considered as their baseline cuff pressure.
- Then we noted down the cuff-pressure change of endotracheal tube after change in head and neck position according to operative site.
- If any change occurs reding cuff pressure we noted down this pressure change and manipulated the cuff pressure with the help of AG Cuf fill manometer towards patient base line (25cm of H2O)
- For every 15 minutes we measured the cuff pressure if any change in cuff pressure, we change the cuff pressuree with in normal range (25 cm of H20)
- And repeated this procedure every 15 minutes till the end of surgery and just before extubation and made a chart.

After surgery got over, we looked for post operative complications in the form of

1. Sore throat
2. Hoarseness of voice

The above image is AG cuff fill manometer which is a FDA and CE approved device, used in the present study to measure the intra cuff pressure of the endotracheal tube. It is an easy to use, compact, intuitive device and is the smallest cuff inflator and pressure regulator available. It is suitable for use with all endotracheal tubes and tracheostomy tubes. It can be used for up to 100 times on one battery. It is non- replaceable. This device shuts off automatically, has 10 cc volume and has a male luer lock that fits standard one-way valve on endotracheal tubes.

INCLUSION CRITERIA-

1. Patient of any gender schedule for elective MRM surgery for csom
2. Age 18 to 65 year
3. Patient with ASA physical status I and II

EXCLUSION CRITERIA-

1. Refusal or consent denied from patient,
2. Patient with ASA physical status more than 2
3. Emergency surgery patient
4. Patient with uncontrolled HTN, DM, CVA and Previous history of sore throat
5. Difficult airway
6. Patient with facial trauma

OBSERVATIONS AND RESULT

Table 1: Gender Distribution

Gender	No. of patients	Percent	Valid Percent
Female	59	59.0	59.0
Male	41	41.0	41.0
Total	100	100.0	100.0

Table 1 shows that 59 (59%) female and 41 (41%) males were participated in our study.

Table 2: Age Distribution

Age	no of patients	percent	valid percent
10 to 20 years	27	27.0	27.0
21 to 31 years	42	42.0	42.0
32 to 42 years	23	23.0	23.0

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43 to 53 years	4	4.0	4.0
54 to 64 years	4	4.0	4.0

Table2 shows that more cases in 21 to 31years age group, while 27 (27%) cases in 10 to 20 years age group, 42 (42%) cases in 21 to 31 years age group,23 (23%) cases in 32 to 42 years age group and only 4 (4%) cases in 43 to 53 years and 54 to 64 years age groups each.

Figure 1: Diagnosis

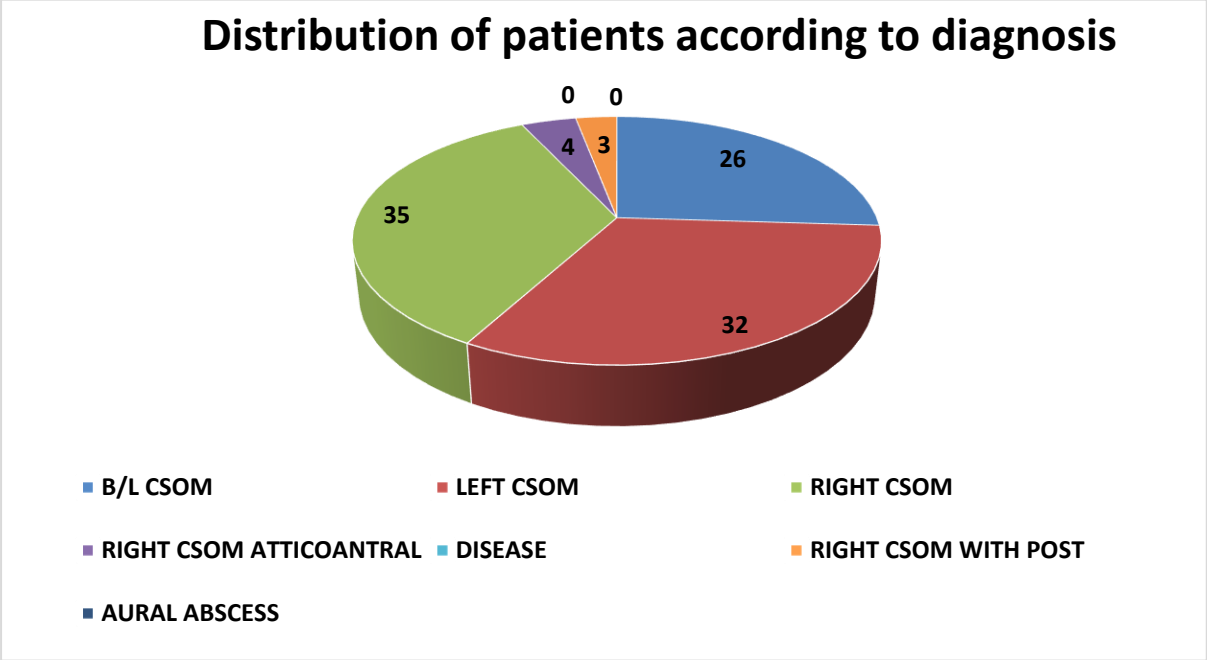

Figure 1 shows that out of 100cases, 26 (26%) cases were B/L CSOM, 32 (32%) cases were left CSOM, 34 (34%) cases were right CSOM, 4 (4%) cases were right CSOM atticoantral disease, 3 (3%) cases were right CSOM with post aural abscess in our study.

Figure 2: Distribution of participants according to surgery

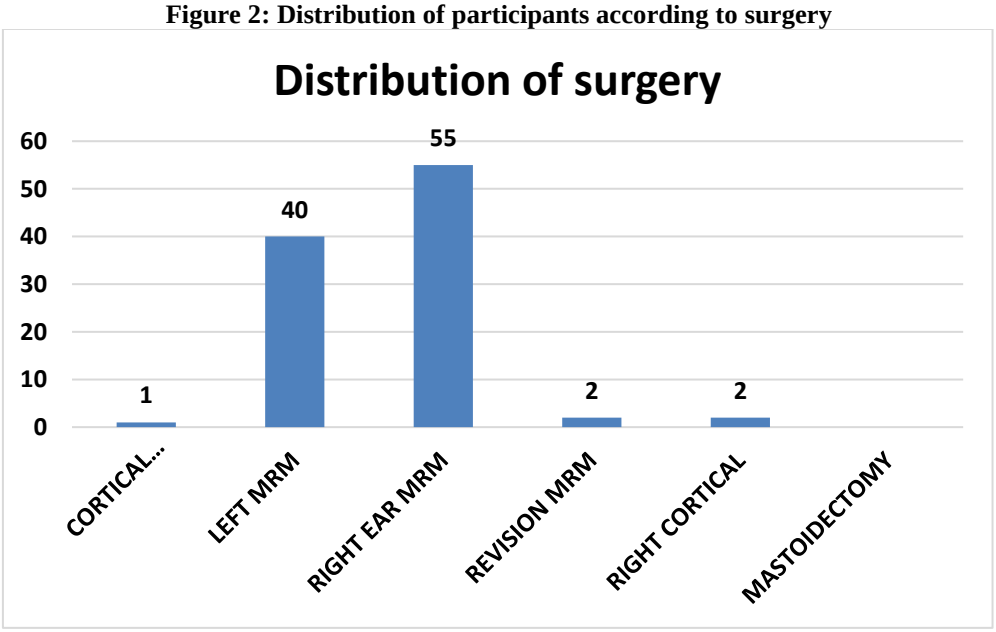

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Figure 2 shows that out of 100 cases of surgery, only one case of cortical mastoidectomy, 40 (40%) cases of left MRM, , 55 (55%) cases of right Ear MRM and 2% case of revision MRM 2% case

Table 3 :Post-operative sore throat

st-operative re throat	No of patients	Percent	Valid Percent
NO	80	80.0	80.0
YES	20	20.0	20.0
Total	100	100.0	100.0

Table 3 shows that post-operative sore throat was present in 20(20%) cases in our study.

Figure 3: Post operative hoarseness of voice

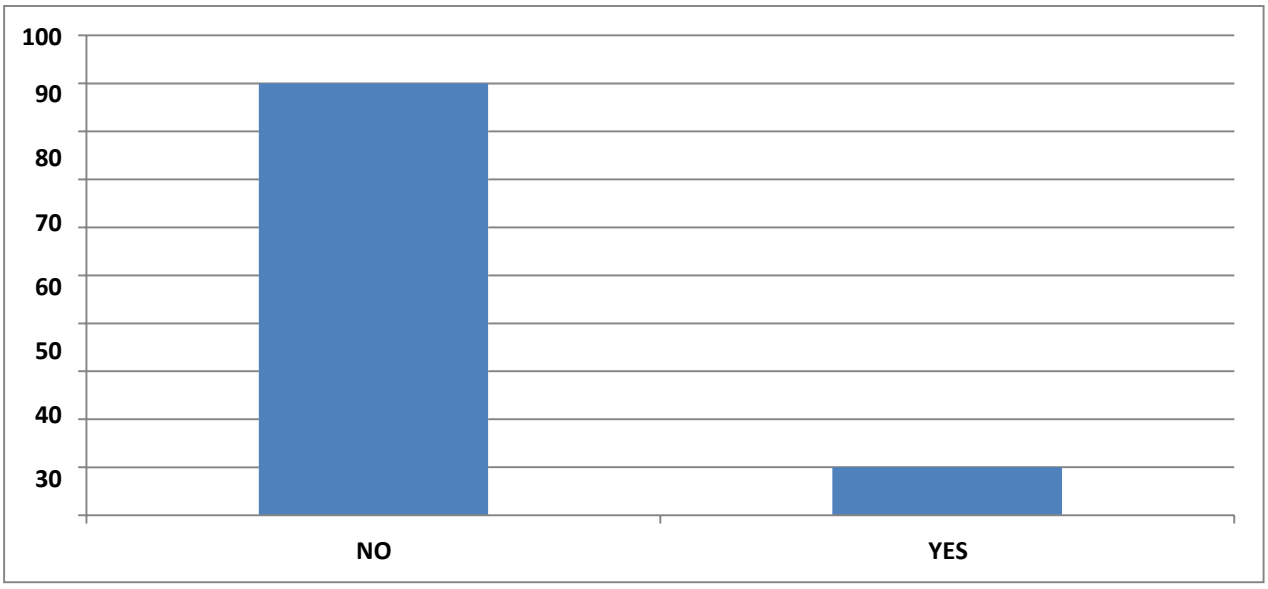

Figure 3 shows that post operative hoarseness of voice was present in only 10 (10%) cases in our study. post operative hoarseness of voice absent in 90 (90%) cases in our study

Table 6: ET-Cuff Pressure After Intubation of the participants

ET-Cuff Pressure After Intubation	No of patients	Percent	ValidPercent
20-30	29	29.0	29.0
>30	71	71.0	71.0
Total	100	100.0	100.0

Table 6 shows that 20 to 30 ET Cuff pressure after intubation in 29 (29%) cases and above 30 ET Cuff Pressure after Intubation in 71 (71%). Most of the cases ET C0uff Pressure after Intubation in above30.

Table 7: ET-Cuff Pressure after change in Head and Neck Position of the participants

ET-Cuff Pressure after change in Head and Neck Position	No of patients	Percent	Valid Percent

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20-30	41	41.0	41.0
>30	59	59.0	59.0
Total	100	100.0	100.0

Table 7 shows that 20 to 30 ET Cuff Pressure after change in Head and Neck Position in 41 (41%) cases and above 30 ET Cuff Pressure after change in Head and Neck Position in 59 (59%). Most of the cases ET Cuff Pressure after change in Head and Neck Position in above30.

Table 8: Intra operative ET Cuff Pressure change in various interval

ET Cuff Pressure												
ET-Cuff Pressure	**After intubation**	**After change in head and Neck position**	**15 min**	**30 min**	**45 min**	**60 min**	**75 min**	**90 min**	**105 min**	**120 min**	**135 min**	**150 min**
<20	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
20-30	**29 (29%)**	**41 (42%)**	**37 (37%)**	**44 (44%)**	**40 (40%)**	**35 (35%)**	**51 (51%)**	**58 (58%)**	**38 (38%)**	**46 (46%)**	**51 (51%)**	**57 (57%)**
>30	**71 (71%)**	**59 (58%)**	**63 (63%)**	**56 (56%)**	**60 (60%)**	**65 (65%)**	**49 (49%)**	**42 (42%)**	**62 (62%)**	**54 (54%)**	**49 (49%)**	**43 (43%)**

Table 8 shows that 20 to 30 ET Cuff pressure after intubation in 29 (29%) cases and above 30 ET Cuff Pressure after Intubation in 71 (71%). After change in head and neck position 20 to 30 ET Cuff Pressure 41 (41%) and more than 30 59 (59%), 20 to 30cm H_2O after 15 Minute in 37 (37%) cases and above 30 ET Cuff Pressure After 15 Minute in 63 (63%). 20to30ETCuff Pressure after 30 Minute in 44 (44%) cases and above 30 ET Cuff Pressure after 30 Minute in 56 (56%) cases. 20 to 30 ET Cuff Pressure after 45 Minute in 40 (40%) cases and above 30 ET Cuff
Pressure After 45 Minute in 60 (60%) cases. 20 to 30 ET Cuff Pressure after 60 Minute in 35 (65%) cases and above 30 ET Cuff Pressure after 60 Minute in 65 (65%) cases. 20 to 30 ET Cuff Pressure after 75 Minute in 51 (51 %) cases and above 30 ET Cuff Pressure after 75 Minute in 49 (49%) cases. 20 to 30 ET Cuff Pressure after 90 Minute in 58% cases and above 30 ET Cuff Pressure after 90 Minute in 42% cases. 105 Minute in 38% cases and above 30 ET Cuff Pressure after 105 Minute in 62% cases. ET cuff pressure 20-30 after 120 min in 46% cases and above 30 ET Cuff Pressure after 120 minutes in 56% cases. 20 to 30 ET Cuff Pressure after 135 Minute in 51 (51%) cases and above 30 ET Cuff Pressure after 135 Minute in 49 (49%) cases. 20 to 30 ET Cuff Pressure after 150 Minute in 57% cases and above 30 ET Cuff Pressure after 150 Minute in 43 (43%) cases.

4. DISCUSSION

In this study 59 (59%) female and 41 (41%) males were participated in our study. In the study of **Kara H et al[33].,** 61.3% female participants were involved. **Kim, H.J. et al[29]** reported 44% female and 56% male in their study. In this study more cases were in 21 to 31 years age group, while 27 (27%) cases in 10 to 20 years age group, 42 (42%) cases in 21 to 31 years age group, 23 (23 %) cases in 32 to 42 years age group and only 4 (4%) cases in 43 to 53 years and 54 to 64 years age groups each. In the study of **Kim, H.J. et al[29]** mean age was 35.2±13.8 years and more common age group was 30 to 40 years. It has been observed from the above study that out of 100 cases, 26% were bilateral CSOM, 42% were Right CSOM and 32% were Left CSOM. We have observed that post operative complication in the form of sore throat and hoarseness of voice in studies patient, despite of regular monitoring of ET-cuff pressure in every 15-minute interval during ENT surgery we found 20% patient suffered

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from shore throat, 10% patient suffered from hoarseness of voice. **Liu Jet et al[24].**, reported that even in procedures with short duration, high endotracheal tube cuff pressure has been reported to result in postoperative complications. **Christensen AM et al.[34],** and **Hisham AN et al[35].**, also concluded in their study, the post operative sore throat is a common airway complication of patients undergoing thyroidectomy under general anaesthesia, with an incidence of 62%to 84%. **S Kiran et al.[36]**, observed in their study that the incidence of hoarseness of voice after endotracheal intubation varies widely from 14% to 50% but it was mostly temporary. In a retrospective study of 3093 patients who had endotracheal intubation during anaesthesia, the incidence of hoarseness was 49% in the immediate post-operative period. **H Yamanaka et al[37]** observed that post-operative hoarseness of voice developed in 49% of the patients on the day of surgery and in 29%,11% and 0.8% on day 1,3 and 7 postoperative days, respectively. **K.Maruyamaet al[38]** observed that post-operative hoarseness of voice developed in 55% of the patients immediately after surgery. In present study only 10 (10%) cases in our study. post operative hoarseness of voice absent in 90 (90%) cases in our study. In this study change in pressure measure after changing the head and neck position for the surgery and at 15min, 30min, 45min, 60min, 75min, 90min, 120min, 135min and 150min intra- operatively. It has been observed that the maximum change in the ET tube cuff pressure was found immediately after intubation (>30cm of H2O) (71% patients in our study). **Giusti et al[39].**, in which it was observed that the manual palpation accurately estimated the cuff pressure in only 10% of the patients. **De Godoy et al.[40],** showed cuff pressure rise in 50.7% of their measurements in mechanically ventilated patients after 35° semi recumbent position to lateral position and back, while using target intra cuff pressure interval of 24.5-29.9cm of H2O. In our study, we have observed that change in cuff pressure in between 20 and 30cm of H2O after change in head and neck position in 41% cases and >30cm of H2O was observed in 59% cases. **Sultan et al.[41],** have shown that several factors influenced the change in the cuff pressure, like change in tracheal muscle tone, hypothermia, change in head and neck position. **Stanley et al[42].**, conducted the study in which they found nitrous oxide increased cuff gas volume resulting in increased in endotracheal tube cuff pressure. It has been observed that over all the average change in intra cuff pressure was raised for 5.94 cm of H_2O with SD-1.93 cm of H2O after every 15 minutes interval. Hence every time, the cuff pressure was observed to be >25cm of H2O, we changed it manually to 25cm of H2O with the help of digital automatic manometer cuff (AG Cuffill). This finding is consistent with **Jain MK et al[43].**, and **Trivedi et al.[36],** suggested that the ideal range for ET tube cuff pressure is typically between 20 and 30 cm of H_2O. It was observed from the study conducted by **Doyle DJ et al[44].,** describe a continuous digital display of endotracheal tube cuff pressure is mandatory during surgery.

5. CONCLUSION

In Our Study has been observed that change in average ETT cuff pressure was in between 6 cm of H2O after every 15 minutes interval, and every time when the ETT cuff pressure was found to be more than 25 cm of H2O, we reduced to within normal limits (25 cm of H2O) with the help of digital manometer. On the basis of the present study we arrived to the following conclusion that repeated reducing of ETT cuff pressure to within normal range (25 cm of H2O) lead to lesser complication of sore throat and hoarseness of voice as compared to the previous studies done for the same. Hence we can conclude that, ETT cuff pressure measuring manometer - (AG Cuffill) is an important tool to regulate ETT cuff pressure during intraoperative period, and it also helps to reduce post-operative complications like sore throat and hoarseness of voice

6. REFERENCES

1. M. El-Orbany and M. R. Salem, "Endotracheal tube cuff leaks: causes, consequences, and management," *Anesthesia and Analgesia*, vol. 117, no. 2, pp. 428–434, 2013.
2. D. Kim, B. Jeon, J.-S. Son, J.-R. Lee, S. Ko, and H. Lim, "The changes of endotracheal tube cuff pressure by the position changes from supine to prone and the flexion and extension of head," *Korean Journal of Anesthesiology*, vol. 68, no. 1, pp. 27–31, 2015.
3. P. Dobrin and T. Canfield, "Cuffed endotracheal tubes:mucosal pressures and tracheal wall blood flow," *The American Journal of Surgery*, vol. 133, no. 5, pp. 562–568, 1977.
4. H. Kako, S. G. Krishna, A. S. Ramesh et al., "The relationship between head and neck position and endotracheal tube intracuff pressure in the pediatric population," *PaediatricAnaesthesia*, vol. 24, no. 3, pp. 316–321, 2014.
5. J. Shiotsuka, A. T. Lefor, M. Sanui, O. Nagata, A. Horiguchi, and Y. Sasabuchi, "A quantitative evaluation of fluid leakage around a polyvinyl chloride tapered endotracheal tube cuff using an invitromodel," *HSR Proceedings in Intensive Care & Cardiovascular Anesthesia*, vol. 4, no. 3, pp. 169–175, 2012.
6. N. Komasawa, S. Fujiwara, S. Miyazaki, M. Soen, and T. Minami, "Comparison of fluid leakage from four different cuffed pediatric endotracheal tubes using a pediatric airway simulation model," *Pediatrics*

ISSN:0975-3583,0976-2833 VOL14,ISSUE05,2023

International, vol. 56, no. 4, pp. 634–636, 2014.
7. Honeybourne D. Endotracheal cuff pressure and tracheal mucosal blood flow: endoscopic study of effects of four large volume cuffs. Br Med J (Clin Res Ed) 1984;288:1237.
8. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. Am J RespirCrit Care Med 2005;171:388–416.
9. Lorente L, Blot S, Rello J. Evidence on measures for the prevention of ventilator-associated pneumonia. EurRespir J 2007;30:1193–207.
10. Liu J, Zhang X, Gong W, et al. Correlations between controlled endotracheal tube cuff pressure and postprocedural complications: a multicenter study. AnesthAnalg 2010;111:1133–7.
11. Dobrin P, Canfield T. Cuffed endotracheal tubes: mucosal pressures and tracheal wall blood flow. Am J Surg 1977;133:562–8.
12. Conrardy PA, Goodman LR, Lainge F, et al. Alteration of endotracheal tube position. Flexion and extension of the neck. Crit Care Med 1976;4:8–12.
13. Goodman LR, Conrardy PA, Laing F, et al. Radiographic evaluation of endotracheal tube position. AJR Am J Roentgenol 1976;127:433–4.
14. Bernhard WN, Yost L, Joynes D, et al. Intracuff pressures in endotracheal and tracheostomy tubes. Related cuff physical characteristics. Chest 1985;87:720–5.
15. Guyton D, Banner MJ, Kirby RR. High-volume, low-pressure cuffs. Are they always low pressure? Chest 1991;100:1076–81.
16. Combes X, Schauvliege F, Peyrouset O, et al. Intracuff pressure and tracheal morbidity: influence of filling with saline during nitrous oxide anesthesia. Anesthesiology 2001;95:1120–4.
17. Lichtenthal PL, Borg UB. Endotracheal cuff pressure: role of tracheal size and cuff volume. Crit Care 2011;15:147–147.
18. Tsuboi S, Miyashita T, Yamaguchi Y, et al. The TaperGuard endotracheal tube intracuff pressure increase is less than that of the Hi-Lo tube during nitrous oxide exposure: a model trachea study. AnesthAnalg 2013;116:609–12.
19. Wu CY, Yeh YC, Wang MC, et al. Changes in endotracheal tube cuff pressure during laparoscopic surgery in head-up or head-down position. BMC Anesthesiol 2014;14:75.
20. Rosato L, Avenia N, Bernante P, et al. Complications of thyroid surgery: analysis of a multicentric study on 14,934 patients operated on in Italy over 5years. World J Surg 2004;28:271–6.
21. Kim HC, Lee YH, Kim E, et al. Comparison of the endotracheal tube cuff pressure between a tapered- versus a cylindrical-shaped cuff after changing from the supine to the lateral flank position. Can J Anaesth 2015;62:1063–70.
22. Choi E, Park Y, Jeon Y. Comparison of the cuff pressure of a TaperGuard endotracheal tube and a cylindrical endotracheal tube after lateral rotation of head during middle ear surgery: a single-blind, randomized clinical consort study. Medicine (Baltimore) 2017;96:e6257.
23. Combes X, Schauvliege F, Peyrouset O, Motamed C, Kirov K, Dhonneur G, *et al*. Intracuff pressure and tracheal morbidity: Influence of filling with saline during nitrous oxide anesthesia. Anesthesiology 2001;95:1120-4.
24. Liu J, Zhang X, Gong W, Li S, Wang F, Fu S, *et al*. Correlations between controlled endotracheal tube cuff pressure and post procedural complications: A multicenter study. AnesthAnalg 2010;111:1133-7.
25. Rello J, Sonora R, Jubert P, Artigas A, Rue M, Valles J. Pneumonia in intubated patients: role of respiratory airway care. Am J RespirCrit Care Med 1996; 154: 111-5.
26. American Thoracic Society; Infectious Diseases Society of America. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. Am J RespirCrit Care Med 2005; 171: 388-416.
27. Dobrin P, Canfield T. Cuffed endotracheal tubes: mucosal pressures and tracheal wall blood flow. Am J Surg 1977; 133: 562-8.
28. Lim H, Kim JH, Kim D, Lee J, Son JS, Kim DC, et al. Tracheal rupture after endotracheal intubation - A report of three cases. Korean J Anesthesiol 2012; 62: 277-80.
29. Kim JT, Kim HJ, Ahn W, Kim HS, Bahk JH, Lee SC, et al. Head rotation, flexion, and extension alter endotracheal tube position in adults and children. Can J Anaesth 2009; 56: 751-6.
30. Kako H, Krishna SG, Ramesh AS, Merz MN, Elmaraghy C, Grischkan J, et al. The relationship between head and neck position and endotracheal tube intracuff pressure in the pediatric population. PaediatrAnaesth 2014; 24: 316-21.
31. Kim, D., Jeon, B., Son, J. S., Lee, J. R., Ko, S., & Lim, H. (2015). The changes of endotracheal tube cuff pressure by the position changes from supine to prone and the flexion and extension of head. Korean journal of anesthesiology, 68(1), 27-31.
32. Tan, P. H., Lin, V. C., Chen, H. S., & Hung, K. C. (2011). The effect of transoesophageal

ISSN:0975-3583,0976-2833 VOL14,ISSUE05,2023

echocardiography probe insertion on tracheal cuff pressure. Anaesthesia, 66(9), 791-795.
33. Kara H, Hundur D, Doruk C, Buyuk D, Cansever G, Salviz EA, Camci E. The changes of endotracheal tube intracuff pressures after ear and head and neck surgery-related positions: a prospective observational study. Braz J Otorhinolaryngol. 2022 Jan-Feb;88(1):46
34. Christensen AM, Willemoes-Larsen H, Lundby L, Jakobsen KB. Postoperative throat complaints after tracheal intubation. Br J Anaesth 1994;73:786–7.
35. Hisham AN, Roshilla H, Amri N, et al. Post-thyroidectomy sore throat following endotracheal intubation. ANZ J Surg 2001;71:669–71.
36. Trivedi L, Jha P, Bajiya NR, Tripathi D. We should care more about intracuff pressure: The actual situation in government sector teaching hospital. Indian J Anaesth. 2010;54:314-317.
37. H. Yamanaka, Y. Hayashi. Prolonged hoarseness and arytenoid cartilage dislocation after tracheal intubation A correction has been published: *BJA: British Journal of Anaesthesia*, Volume 103, Issue 3, September 2009,
38. K. Maruyama, H. Sakai', H. Miyazawa Sore throat and hoarseness after total intravenous anaesthesia DOI: 10.1093/ja098 Advance Access publication February 6, 2004
39. Giusti, G.D.; Rogari, C.; Gili, A.; Nisi, F. Cuff pressure monitoring by manual palpation in intubated patients: How accurate is it?A manikin simulation study.Aust. Crit. Care 2017, 30, 234–238.
40. De Godoy ACF, Vieira RJ, De Capitani EM. Endotracheal tube cuff pressure alteration after changes in position in patients under mechanical ventilation. J Bras Pneumol. 2008;34:294-7.
41. Sultan P, Carvalho B, Rose BO, Cregg R. Endotracheal tube cuff pressure monitoring: a review of the evidence. J PerioperPract. 2011; 21:379-86.
42. Stanley TH, Kawamura R, Graves C, Effects of nitrous oxide on volume and pressure of endotracheal tube cuffs. Anesthesiology 1974; 41: 256-262.
43. Jain MK, Tripathi CB. Endotracheal tube cuff pressure monitoring during neurosurgery - Manual vs. automatic method. J Anaesthesiol Clin Pharmacol. 2011;27:358-361.
44. Doyle DJ. Digital display of endotracheal tube cuff pressures made simple. Anesthesiology. 1999;91:329.