

# Comparison of Cuff Manometer Measurement and Palpation Techniques to the Event of Throat Pain Post Extubation in Ga-Ett Patients

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## Abstract:-

**Introduction:** Postoperative sore throat has a reported incidence of up to 62% after general anesthesia. Many modalities to prevent or post intubation sore throat are performed. The measurement and monitoring of cuff pressure during anesthesia is important in reducing sore throat after intubation. This study aims to determine the comparison of manometer measurements and palpation techniques on the incidence of post-extubation pain in GA-ETT patients at Haji Adam Malik Hospital Medan.

**Methods:** This study was a double-blind randomized clinical trial study. The study was carried out at the Haji Adam Malik General Hospital Medan (RSUP HAM) for 3 months, April–June 2021. The samples got in this study were 48 samples that matched the inclusion and exclusion criteria and were divided into 2 groups, namely Group A with high pressure. We carried the throat pain assessment out 4 times using the VAS score.

**Results:** From the results of the post-extubation patient's throat pain score on T1 the highest group was at value 1 (VAS 1–3) of 15 patients (65.2%) in group B at value 2 (VAS 4–6) 12 patients (54, 5%). In T2 group A, the highest score was 0 (VAS 0) by 20 patients (87.0%) in group B at value 2 (VAS 4–6) by 10 patients (45.5%). For T3 group A, the maximum value of 0 (VAS 0) was 22 patients (95.7%) in group B the value of 1 (VAS 1-3) was 11 patients (50%). T4 for group A was maximum at a value of 0 (VAS 0) 22 patients (95.7%) in group B maximum at a value of 1 (VAS 1-3) of 11 patients (50%).

**Conclusion:** There is a significant difference in the value of the degree of throat pain and hoarseness of post-extubation patients in group A the cuff measured by a cuff manometer is lower than group B whose cuff is measured by palpation at 1 hour (T1), 6 hours (T2), 12 hours (T3), 24 hours (T4).

**Keywords:-** Sore Throat, Degree (Visual Analog Scale), Hoarseness, Cuff Manometer, Palpation Technique.

## I. INTRODUCTION

Postoperative sore throat has a reported incidence of up to 62% after general anesthesia. In adults undergoing tracheal intubation, female sex, younger age, pre-existing lung disease, long duration of anesthesia, and presence of blood-stained tracheal tube on extubation were associated with greater risk. Monitoring and limitation of tracheal tube

cuff pressure as a method for reducing postoperative sore throat have been widely studied because excessive cuff pressure can damage the tracheal mucosa by direct trauma and decreased blood flow (K El-Boghdady, 2016).

Sore throat in patients undergoing general anesthesia with intubation is generally not fatal and will disappear within 48-72 hours after surgery but this can cause significant disturbance to the patient, increase the length and cost of patient stay in hospital and leave a bad impression against operation. This results in patient dissatisfaction and sometimes leads to complaints against the hospital (Miller, 2010). Many modalities to prevent or minimize post-intubation sore throat are performed with uncertain effectiveness. During anesthesia monitoring of cuff pressure during anesthesia, routine measurement of cuff pressure is important in reducing post-intubation sore throat (Young Jin Lee, 2016).

From Steward's research, it was found that the pressure was over or below the standard as much as 70%, while the ideal was 30%, so Steward recommends using a cuff manometer to avoid underinflation and overinflation which can lead to morbidity. Most anesthesiologists generally recommend a pressure of 20 to 30 cmH<sub>2</sub>O (Sengupta, 2004). The incidence of the postoperative sore throat under general anesthesia using an endotracheal tube whose cuff pressure measured by a manometer is smaller than the cuff pressure measured by palpation estimates (Sally Ruth, 2014). Insufficient cuff pressure can increase the risk of aspiration and conversely excessive pressure is prone to trauma to the trachea (Kambic, 1998).

The high incidence of throat pain complaints in patients undergoing general anesthesia is based on the literature and the fairly large impact, as well as a relationship caused by cuff pressure on the endotracheal tube (ETT). In fact, in daily practice, at the time of ETT insertion, we often measure the cuff pressure by palpation, where the magnitude of the cuff pressure cannot be ascertained. From the above background, the researcher wishes to know the comparison of cuff manometer measurements and palpation techniques on the incidence of post-extubation sore throat in GA-ETT patients.

## II. METHODS

The design of this study used a double-blind randomized clinical trial. To determine the effectiveness of the cuff ETT as measured using a cuff manometer and palpation techniques in reducing sore throat after extubation in patients under general anesthesia. This research was conducted at Haji Adam Malik General Hospital. The study population was all subjects who were electively scheduled to undergo surgery using General Anesthesia at Haji Adam Malik General Hospital Medan. The research sample is the population that meets the inclusion and exclusion criteria. This sample was divided into 2 groups, namely group A received the ETT cuff which was measured using a 25 cmH<sub>2</sub>O cuff manometer, and group B received the ETT cuff which was measured using a palpation technique developed with a 20cc syringe until it felt sufficient with an estimated pressure of 25 cmH<sub>2</sub>O. Patients who underwent elective surgery under general anesthesia using endotracheal intubation at the central surgical installation of Haji Adam Malik General Hospital Medan and obtained a sample of 48 people.

Inclusion criteria in this study were samples aged 18-60 years, underwent elective surgery under general anesthesia, physical status ASA 1 and 2, Body Mass Index (BMI) < 30 kg/m<sup>2</sup>, agreed to participate in the study with an operation duration of 3 -4 hours. Exclusion criteria in this study were patients with a sore throat before surgery, cough and runny nose before surgery, surgery in the mouth, neck, and face area, unable to communicate well, and patients with difficult airway assessment of Lemon Score. Drop Out criteria are if there is a cardiac and pulmonary emergency, there is difficulty in intubating (more than 1 intubation attempt) and during surgery, the ETT leaks, is out of position, or is pulled out.

Patient assessment was carried out based on acceptance criteria and exclusion criteria. Then randomization was carried out using block sampling by volunteers and the sample was divided into two groups. Patients were fasted for 6 hours before surgery and were instilled with an 18 G intravenous cannula. This study used two volunteers. The first volunteer to intubate and measure cuff. The second volunteer assessed the hemodynamics and VAS of the patient In the patient monitoring room, a monitor measuring blood pressure, pulse, ECG, and oxygen saturation were installed.

The patient was given the analgesic ketorolac 30 mg/intravenous. The throat pain assessment was carried out 4 times, the first in the RR 1 hour after the patient was awake with an Aldrete score of 9-10, the second 6 hours after awakening, the third 12 hours after awakening, and the last 24 hours after the patient regained consciousness, assessed by the same assessor. do not know what inhaled medication has been given to the patient. Careful observations and interviews with patients about the presence of sore throat were assessed using a pain scale with a value of 0 to 3. The degree of postoperative throat pain was interpreted as a score of 0 = No sore throat (VAS 0), a score

of 1 = mild sore throat if there is sore throat but no pain when swallowing (VAS 1-3), score 2 = moderate sore throat is sore throat and pain when swallowing (VAS 4-6), and score 3 = severe sore throat is sore throat accompanied by difficulty in swallowing (VAS 7 – 10)

The assessment of hoarseness is interpreted as a value of 0 is that there is no hoarseness, a value of 1 is a mild hoarse voice that is only felt by the patient, but is not heard by the examiner, a value of 2 is a moderate hoarse voice that can be heard by the examiner and a value of 3 is a severe hoarse voice, namely aphonia. . The collected data will be re-checked for completeness before being tabulated and processed then analyzed with the epi-info program and presented in the form of tables, sentences, and graphs. The collected data is tabulated into a master table using Microsoft Office Excel 2007 software. Numerical data is displayed in the average value  $\pm$  standard deviation, while categorical data is displayed in numbers (percentages). The research hypothesis was tested using the Chi-Square method. The limit of significance set is 5%. The confidence interval used: 95% with a p-value of <0.05 is considered statistically significant. At the end of the study, the analysis will be separated between throat pain.

## III. RESULTS

This research was conducted for 3 months, namely April - June 2021 at Haji Adam Malik Hospital Medan. This study aims to determine the comparison of cuff manometer measurements and palpation techniques on the incidence of post-extubation sore throat in GA-ETT patients. The samples obtained in this study amounted to 48 samples that matched the inclusion and exclusion criteria, with 3 samples entering the drop-out criteria. The characteristics of the sample are shown in Table 1.

**Table 1. Sample Characteristics**

Characteristics	Group A	Group B	P-value
<b>Gender, n (%)</b>			
Male	4	7	0,505
Female	19	15	
<b>Age, mean (SD)</b>	42,52 $\pm$ 11,75	41,73 $\pm$ 12,82	0,817
<b>BMI, mean (SD)</b>	23,37 $\pm$ 1,91	23,41 $\pm$ 2,62	0,915
<b>Intubation duration (Hour)</b>	3,71 $\pm$ 0,42	3,70 $\pm$ 0,42	0,737
<b>ASA</b>			
ASA 1	11	15	0,083
ASA 2	12	7	
<b>Total</b>	23	22	

### *Shapiro-Wilk*

Based on Table 1, using the Mann-Whitney normality test, it was obtained with  $p > 0.05$  on the characteristics of age and body mass index (BMI), duration of surgery, gender characteristics, ASA. In addition, in this study, the most samples were female as many as 34 samples (68%) with an average age of 42.12 years. Status. The average body mass index (BMI) in the internal sample is 23.39 kg/m<sup>2</sup> which

indicates normoweight. Most of the patients in this study were on ASA 1 by 26 samples (52%). Regarding the comparison of cuff manometer measurements and palpation

techniques on the incidence of post-extubation sore throat in GA-ETT patients at T1 it is shown in Table 2.

**Table 2. Comparison of cuff manometer measurements and palpation techniques on the incidence of post-extubation sore throat in GA-ETT patients at T1**

	0 score (%)	1 score (%)	2 score (%)	3 score (%)	Total	P-value
Group A	8 (34,8%)	15 (65,2%)	0 (0%)	0 (0%)	23 (100%)	0,004
Group B	2 (9,1%)	8 (36,4%)	12 (54,5%)	0 (0%)	22 (100%)	
Total	10 (22,2%)	23 (51,1%)	12 (26,7%)	0 (0%)	45 (100%)	

Anova test,  $\alpha < 0,05$

Based on table 2, it was found that the value of the post-extubation patient's throat pain in group A where the cuff was measured by the cuff manometer was mostly 1 (VAS 1-3) of 15 patients (65.2%) while in group B the cuff was measured by palpation technique. the highest score was 2 (VAS 4 – 6) by 12 patients (54.5%). In addition, in groups A and B, there were no patients with a grade of sore throat with a value of 3 (VAS 7 – 10). Based on this, it can be

concluded that patients whose cuffs were measured with a cuff manometer had a lower degree of pain than those whose cuffs were measured by palpation technique. Statistically, there was a significant difference in the degree of sore throat value on the cuff manometer measurement with post-extubation palpation technique in GA-ETT patients at T1 with p-value = 0.004 (<0.05).

**Table 3. Comparison of cuff manometer measurements and palpation techniques for hoarseness after extubation in GA-ETT patients at T1**

	0 score (%)	1 score (%)	2 score (%)	3 score (%)	Total	P-value
Group A	16 (69,6%)	7 (30,4%)	0 (0,0%)	0 (0,0%)	23 (100%)	0,001
Group B	4 (18,2%)	12 (54,5%)	5 (22,7%)	1 (4,5%)	22 (100%)	
Total	20 (44,4%)	19 (42,2%)	5 (11,1%)	1 (2,2%)	45 (100%)	

Anova test,  $\alpha < 0,05$

Based on table 3, it was found that the assessment of the hoarseness of post-extubation patients in group A where the cuff was measured by the cuff manometer was mostly 0 (no hoarseness was found) for 16 patients (69.6%) while in group B the cuff was measured by palpation technique. at a value of 1 (mild hoarseness was only felt by the patient, but was not heard by the examiner) for 12 patients (54.5%). In addition, in group B, 1 patient (4.5%). Based on this, it can be concluded that patients whose cuff is measured by a cuff

manometer have a lower assessment of hoarseness than those whose cuff is measured by palpation technique. Statistically, there was a significant difference in the degree of assessment of hoarseness in the cuff manometer measurement with post-extubation palpation techniques in GA-ETT patients at T1 with p-value = 0.001 (<0.05). Comparison of cuff manometer measurements and palpation techniques on the incidence of post-extubation sore throat in GA-ETT patients at T2 is shown in Table 4.

**Table 4. Comparison of cuff manometer measurements and palpation techniques on the incidence of post-extubation sore throat in GA-ETT patients at T2**

	0 score (%)	1 score (%)	2 score (%)	3 score (%)	Total	P-value
Group A	20 (87,0%)	3 (13,0%)	0 (0%)	0 (0%)	23 (100%)	0,001
Group B	5 (22,7%)	7 (31,8%)	10 (45,5%)	0 (0%)	22 (100%)	
Total	25 (55,6%)	10 (22,2%)	10 (22,2%)	0 (0%)	45 (100%)	

Anova test,  $\alpha < 0,05$

Based on table 4, it was found that the value of the post-extubation patient's throat pain in group A where the cuff was measured by the cuff manometer was highest at 0 (VAS 0) for 20 patients (87.0%) while in group B the cuff was measured by palpation technique mostly in the value of 2 in 10 patients (45.5%). In addition, in groups A and B, there were no patients with a grade of sore throat with a value of 3 (VAS 7 – 10). Based on this, it can be concluded

that patients whose cuffs were measured with a cuff manometer had a lower degree of pain than those whose cuffs were measured by palpation technique. Statistically, there was a significant difference in the degree of sore throat value on the cuff manometer measurement with post-extubation palpation technique in GA-ETT patients at T2 with p-value = 0.001 (<0.05).

**Table 5. Comparison of cuff manometer measurements and palpation techniques for hoarseness after extubation in GA-ETT patients at T2**

	0 score (%)	1 score (%)	2 score (%)	3 score (%)	Total	P-value
<b>Group A</b>	22 (95,7%)	1 (4,3%)	0 (0,0%)	0 (0,0%)	23 (100%)	0,001
<b>Group B</b>	8 (36,4%)	11 (50,0%)	3 (22,7%)	0 (0,0%)	22 (100%)	
<b>Total</b>	30 (66,7%)	12 (26,7%)	3 (6,7%)	0 (0,0%)	45 (100%)	

Anova test, alpha&lt;0,05

Based on table 5, it was found that the assessment of the hoarseness of post-extubation patients in group A where the cuff was measured by the cuff manometer was mostly 0 (no hoarseness was obtained) by 22 patients (95.7%) while in group B the cuff was measured by palpation technique. at a value of 1 (mild hoarseness was only felt by the patient, but was not heard by the examiner) of 11 patients (50.0%). In addition, in groups A and B there were no patients with a grade of sore throat with a score of 3 (severe hoarseness, namely aphonia). Based on this, it can be concluded that

patients whose cuff is measured by a cuff manometer have a lower assessment of hoarseness than those whose cuff is measured by palpation technique. Statistically, there was a significant difference in the degree of assessment of hoarseness in the cuff manometer measurement with post-extubation palpation techniques in GA-ETT patients at T2 with p-value = 0.001 (<0.05). Comparison of cuff manometer measurements and palpation techniques on the incidence of post-extubation sore throat in GA-ETT patients at T3 is shown in Table 6.

**Table 6. Comparison of cuff manometer measurements and palpation techniques on the incidence of post-extubation sore throat in GA-ETT patients at T3**

	0 score (%)	1 score (%)	2 score (%)	3 score (%)	Total	P-value
<b>Group A</b>	22 (95,7%)	1 (4,3%)	0 (0%)	0 (0%)	23 (100%)	0,001
<b>Group B</b>	6 (27,3%)	11 (50%)	5 (22,7%)	0 (0%)	22 (100%)	
<b>Total</b>	28 (62,2%)	12 (26,7%)	5 (11,1%)	0 (0%)	45 (100%)	

Anova test, alpha&lt;0,05

Based on table 6, it was found that the value of the post-extubation patient's throat pain in group A where the cuff was measured by the cuff manometer was highest at 0 (VAS 0) for 22 patients (95.7%) while in group B the cuff was measured by palpation technique mostly in the value of 1 in 11 patients (50%). In addition, in groups A and B, there were no patients with a grade of sore throat with a value of 3 (VAS 7 – 10). Based on this, it can be concluded that

patients whose cuffs were measured with a cuff manometer had a lower degree of pain than those whose cuffs were measured by palpation technique. Statistically, there was a significant difference in the degree of sore throat value on the cuff manometer measurement with post-extubation palpation techniques in GA-ETT patients at T3 with p-value = 0.001 (<0.05).

**Table 7. Comparison of cuff manometer measurements and palpation techniques for hoarseness after extubation in GA-ETT patients at T3**

	0 score (%)	1 score (%)	2 score (%)	3 score (%)	Total	P-value
<b>Group A</b>	23 (100%)	0 (0,0%)	0 (0,0%)	0 (0,0%)	23 (100%)	0,001
<b>Group B</b>	11 (50,0%)	9 (40,9%)	2 (9,1%)	0 (0,0%)	22 (100%)	
<b>Total</b>	34 (75,6%)	9 (20,0%)	2 (4,4%)	0 (0,0%)	45 (100%)	

Anova test, alpha&lt;005

Based on table 7, it was found that the assessment of the hoarseness of post-extubation patients in group A where the cuff was measured by the cuff manometer was mostly at a value of 0 (no hoarseness was obtained) for 23 patients (100%) while in group B the cuff was measured by palpation technique at a value of 0 (No hoarseness) in 11 patients (50.0%). In addition, in groups A and B there were no patients with a grade of sore throat with a score of 3 (severe hoarseness, namely aphonia). Based on this, it can be concluded that patients whose cuff is measured by a cuff

manometer have a lower assessment of hoarseness than those whose cuff is measured by palpation technique. Statistically, there was a significant difference in the degree of assessment of hoarseness on the cuff manometer measurement with post-extubation palpation techniques in GA-ETT patients at T3 with p-value = 0.001 (<0.05). Comparison of cuff manometer measurements and palpation techniques on the incidence of post-extubation sore throat in GA-ETT patients at T4 is shown in Table 8.

**Table 8 Comparison of cuff manometer measurements and palpation techniques on the incidence of post-extubation sore throat in GA-ETT patients at T4**

	0 score (%)	1 score (%)	2 score (%)	3 score (%)	Total	P-value
<b>Group A</b>	22 (95,7%)	1 (4,3%)	0 (0%)	0 (0%)	23 (100%)	0,001
<b>Group B</b>	9 (40,9%)	11 (50%)	2 (9,1%)	0 (0%)	22 (100%)	
<b>Total</b>	31 (68,9%)	12 (26,7%)	2 (4,4%)	0 (0%)	45 (100%)	

Anova test, alpha&lt;005

Based on table 8, it was found that the value of the post-extubation patient's throat pain in group A where the cuff was measured by the cuff manometer was highest at 0 (VAS 0) for 22 patients (95.7%) while in group B the cuff was measured by palpation technique mostly in the value of 1 in 11 patients (50%). In addition, in groups A and B, there were no patients with a grade of sore throat with a value of 3 (VAS 7 – 10). Based on this, it can be concluded that

patients whose cuffs were measured with a cuff manometer had a lower degree of pain than those whose cuffs were measured by palpation technique. Statistically, there was a significant difference in the degree of sore throat on the cuff manometer measurement with post-extubation palpation technique in GA-ETT patients at T4 with p-value = 0.001 (<0.05).

**Table 9 Comparison of cuff manometer measurements and palpation techniques for hoarseness after extubation in GA-ETT patients at T4**

	0 score (%)	1 score (%)	2 score (%)	3 score (%)	Total	P-value
<b>Group A</b>	23 (100%)	0 (0,0%)	0 (0,0%)	0 (0,0%)	23 (100%)	0,002
<b>Group B</b>	14 (63,6%)	7 (31,8%)	1 (4,5%)	0 (0,0%)	22 (100%)	
<b>Total</b>	37 (82,2%)	7 (15,6%)	1 (2,2%)	0 (0,0%)	45 (100%)	

Anova test, alpha&lt;005

Based on table 9, it was found that the assessment of the hoarseness of post-extubation patients in group A where the cuff was measured by the cuff manometer was highest at a value of 0 (no hoarseness was obtained) for 23 patients (100%) while in group B the cuff was measured by palpation technique at a value of 0 (No hoarseness) of 14 patients (63.6%). In addition, in groups A and B there were no patients with a grade of sore throat with a score of 3 (severe hoarseness, namely aphonia). Based on this, it can be concluded that patients whose cuff is measured by a cuff manometer have a lower assessment of hoarseness than those whose cuff is measured by palpation technique. Statistically, there was a significant difference in the degree of assessment of hoarseness on the cuff manometer measurement with post-extubation palpation techniques in GA-ETT patients at T3 with p-value = 0.002 (<0.05).

Table 1, using the Mann-Whitney normality test, it was obtained with  $p > 0.05$  on the characteristics of age and body mass index (BMI), duration of surgery, gender characteristics, ASA. In addition, in this study, the most samples were female as many as 34 samples (68%) with an average age of 42.12 years. Status. The average body mass index (BMI) in the internal sample is 23.39 kg/m<sup>2</sup> which indicates normoweight. Most of the patients in this study were on ASA 1 by 26 samples (52%).

Measurement of cuff pressure with a cuff manometer is averaged at a pressure of 25cmH<sub>2</sub>O, 3.20±0.39cc, for a minimum cuff pressure of 25cmH<sub>2</sub>O, 3 cc, and a maximum cuff pressure of 25 cmH<sub>2</sub>O, 4 cc. While the measurement of cuff pressure by palpation technique averages at a pressure of 32.36±6.911cmH<sub>2</sub>O, 4.3864±0.81550 cc, for a minimum cuff pressure of 20cmH<sub>2</sub>O, 3cc and a maximum cuff pressure of 43 cmH<sub>2</sub>O, 6.5 cc.

#### IV. DISCUSSIONS

This study was conducted to determine the comparison of cuff manometer measurements and palpation techniques on the incidence of post-extubation sore throat in GA-ETT patients at Haji Adam Malik Hospital Medan. Sore throat and hoarseness after extubation can be reduced by measuring cuff pressure using a cuff manometer. Based on

Based on Tables 2 and 3, it was found that the value of the degree of throat pain and hoarseness of post-extubation patients in group A whose cuff was measured by a cuff manometer was lower than that of group B whose cuff was measured by palpation technique. Statistically, there was a significant difference in the degree of sore throat and hoarseness in the cuff manometer measurement with post-extubation palpation technique in GA-ETT patients at T1 with a p-value = 0.004 (<0.05) the degree of sore throat and hoarseness values at T1 with a value of  $p = 0.001$  (<0.05).

The results of this study are in line with research by Sally Ruth (2014) that the incidence of post-extubation sore throat in general anesthesia using an endotracheal tube whose cuff pressure measured by a manometer is smaller than the cuff pressure measured by palpation estimates. Monitoring and restriction of tracheal tube cuff pressure as a method for reducing postoperative sore throat has been widely studied because excessive cuff pressure can damage the tracheal mucosa by direct trauma and decreased blood flow. A prospective randomized controlled trial compared cuff inflation by manometer (pressure 15-25 mmHg) with manual palpation in 509 patients. Patients in the manometer group experienced a significant reduction in the incidence of

sore throat at 24 hours compared to a careful control by K El-Boghdadly (2016).

Based on Tables 4 and 5, it was found that the value of the degree of sore throat and hoarseness after extubation in group A where the cuff was measured by a cuff manometer was lower than that of group B where the cuff was measured by palpation technique. Statistically, there was a significant difference in the degree of sore throat and hoarseness on the cuff manometer measurement with post-extubation palpation techniques in GA-ETT patients at T2 with  $p = 0.001 (<0.05)$  the degree of sore throat and hoarseness values at T1 with  $p$ -value = 0.001 ( $<0.05$ ). A prospective, randomized, controlled, multi-center trial in China studied more than 500 patients receiving standard anesthetic techniques and evaluated postoperative complications. In the control group, the ET tube cuff was inflated by the anesthesiologist according to personal experience without pressure measurement.

In Liu et al's (2010) study, patients in the study group had their cuff pressure adjusted to the range of 20-34cmH<sub>2</sub>O using a monometer. 273 control group patients showed a higher incidence of postoperative sore throat ( $p=0.03$ ), hoarseness ( $p=0.001$ ), and bloody sputum ( $p=0.002$ ) when compared to 236 study group patients. The incidence of these symptoms was found to increase in both the control and study groups with increasing duration of endotracheal intubation. In addition, fiberoptic examination of 20 patients randomly selected from each group at the end of surgery showed an increase in tracheal mucosal injury in the control group ( $p = 0.043$ ).

Based on tables 6 and 7, it was found that the value of the degree of throat pain and hoarseness of post-extubation patients in group A whose cuff was measured by a cuff manometer was lower than that of group B whose cuff was measured by palpation technique. Statistically, there was a significant difference in the degree of sore throat and hoarseness in the cuff manometer measurement with post-extubation palpation techniques in GA-ETT patients at T3 with  $p$ -value = 0.001 ( $<0.05$ ) the degree of throat pain and hoarseness at T1 with  $p$ -value = 0.001 ( $<0.05$ ). This is in line with research by Sulisyono (2010) which explains that there is a link between the cuff and the symptoms of sore throat. Measurement of cuff pressure during anesthesia has been recommended to limit the incidence of postoperative complications. However, it does not appear to be widely practiced (Latto, 1997).

Based on tables 8 and 9, it was found that the value of the degree of sore throat and hoarseness of post-extubation patients in group A where the cuff was measured by a cuff manometer was lower than that of group B whose cuff was measured by palpation technique. Statistically, there was a significant difference in the degree of sore throat and hoarseness in the cuff manometer measurement with post-extubation palpation techniques in GA-ETT patients at T3 with  $p$ -value = 0.001 ( $<0.05$ ), with the degree of throat pain and hoarseness at T1 with  $p$ -value = 0.002 ( $<0.05$ ). The research of Al Metwalli et al (2011) supported by several

other studies has suggested that cuff measurement by palpation technique is an unreliable technique that can produce high cuff pressure which can cause laryngotracheal complaints. Therefore, it is necessary to use a manometer to adequately assess the cuff pressure or to inflate the cuff with air to the desired pressure.

Based on table 10, it is found that the average cuff pressure measurement with a cuff manometer is at a pressure of 25cmH<sub>2</sub>O, 3.20±0.39cc, for a minimum cuff pressure of 25cmH<sub>2</sub>O, 3cc and a maximum cuff pressure of 25 cmH<sub>2</sub>O, 4cc. ETT cuff pressure should be applied immediately after intubation. The ideal pressure is between 25 cmH<sub>2</sub>O-30 cmH<sub>2</sub>O. Pressure below 20 cmH<sub>2</sub>O will cause a risk of aspiration and oxygen leakage, Ventilator-Associated Pneumonia (VAP). (Sundanese, 2008). Fernandez et al (1990) found that the volume of air required to inflate the endotracheal tube cuff varies as a function of tube size and type. But interestingly, the volume required to inflate the cuff to a certain pressure is much smaller when the cuff is inflated inside the artificial trachea. Fernandez et al (1990) also found that the volume of air required to inflate the cuff to 20 cmH<sub>2</sub>O was not significantly different as a function of the size of the endotracheal tube. These data suggest that the size of the ETT is not an important determinant of the precise volume of cuff inflation.

This study also found for a cuff pressure of 25 cmH<sub>2</sub>O, the volume of air injected was 3.20±0.39cc on average, where the minimum air volume was 3cc and the maximum was 4cc. This is in line with the study of Sengupta et al (2004). We observed a linear relationship between the measured cuff pressure and the volume of air drawn from the cuff. The regression equations show that an injected volume between 2 and 4 ml typically results in a cuff pressure between 20 and 30 cmH<sub>2</sub>O regardless of tube size for the same type of tube. Measuring cuff pressure seems better than injecting a certain volume of air.

Based on table 10, it was found that the average cuff pressure measurement using palpation technique was at a pressure of 32.36±6.911cmH<sub>2</sub>O, 4.3864±0.81550cc, for a minimum cuff pressure of 20cmH<sub>2</sub>O, 3cc and a maximum cuff pressure of 43 cmH<sub>2</sub>O, 6.5cc. Based on the data above, measuring cuff pressure with palpation technique until no leakage is heard can be used if there is no cuff manometer to prevent the risk of aspiration. Data from table 4.9 where to get a cuff pressure of 25 cmH<sub>2</sub>O we can enter the air volume of 3.20±0.39cc, and from table 4.10 the cuff development by palpation technique is then confirmed again with no minimal leakage from this study getting a cuff pressure of 20 cmH<sub>2</sub>O. Where the cuff pressure is below 20 cmH<sub>2</sub>O the risk of aspiration (Craven DE, 1995).

However, in this study the measurement of cuff pressure by palpation technique can reach 43 cmH<sub>2</sub>O, this can cause trauma to the tracheal mucosa which causes sore throat. In a survey involving three different UK hospitals where measurement of cuff pressure is not a routine practice, cuff pressure was found to be 46±26cmH<sub>2</sub>O in 111

patients measured at the start of anesthesia after a stabilization period of 15-30 minutes (Rose et al 2009).

A comprehensive telephone audit in the UK also revealed that monitoring of intraoperative cuff pressure is not mandatory in any department, and cuff manometers are only available in one-third of hospitals (Rose et al 2010). A recent study from Denmark also showed that 54/119 patients had a cuff pressure >30cmH<sub>2</sub>O (Rokamp et al 2010). Two small North American studies, one assessing 40 anesthetic providers and the other investigating ET tube pressure in 93 patients, also showed that less than one-third of anesthesia providers inflated ET tubes to 20-30cmH<sub>2</sub>O (Sengupta et al 2004).

## V. CONCLUSION

There was a significant difference in the value of the degree of throat pain and hoarseness of post-extubation patients in group A whose cuff was measured by a cuff manometer, which was lower than that of group B whose cuff was measured by palpation technique. Measurement of cuff pressure using the average palpation technique at a pressure of 25cmH<sub>2</sub>O, 3.20±0.39 cc, for a minimum cuff pressure of 25cmH<sub>2</sub>O, 3 cc, and a maximum cuff pressure of 25 cmH<sub>2</sub>O, 3 cc. Measurement of cuff pressure by palpation technique averaged at a pressure of 32.36±6.911cmH<sub>2</sub>O, 4.3864±0.81550 cc, for a minimum cuff pressure of 20cmH<sub>2</sub>O, 3cc and a maximum cuff pressure of 43 cmH<sub>2</sub>O, 6.5 cc.

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