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MANOMETRIC ASSESSMENT OF ETT CUFF PRESSURE IN OBSTETRIC POPULATION AT A TERTIARY CARE HOSPITAL: AN OBSERVATIONAL STUDY.

Hajra Zafar Siddiqui[1], Muhammad Arsalan Jamil[2*], Hubba Ahmed[3], Syed Muhammad Moizuddin[4], Shaista Uzair[5], Muhammad Nauman Aqeel[6]

[1]FCPS, MBBS, Senior Registrar Anesthesiology Sindh Institute of Urology and Transplantation
[2]Obstetric Anesthesia Fellowship, FCPS, MBBS Assistant Professor Anesthesiology Dow University of Health Sciences
[3]FCPS, MBBS Senior Registrar Anesthesiology Dow University of Health Sciences
[4]MCPS, MBBS Senior Medical Officer Dow University of Health Sciences
[5]FCPS, MBBS Senior Registrar Anesthesiology Dow University of Health Sciences
[6]FCPS, MBBS Senior Registrar Anesthesiology Dr. Ziauddin University Hospital

***Corresponding Author:** Muhammad Arsalan Jamil
*Obstetric Anesthesia Fellowship, FCPS, MBBS Assistant Professor Anesthesiology Dow University of Health Sciences 22arsalan@gmail.com

ABSTRACT

BACKGROUND: The use of a cuffed endotracheal tube intubation forms the cornerstone of securing the airway and provision of general anesthesia for patients undergoing emergency obstetric surgery. It is important to have adequate endotracheal tube (ETT) cuff pressure to prevent complications such as tracheal mucosal injury and aspiration. The aim of this study is to measure and record the endotracheal tube cuff pressure by pilot balloon palpation method and compare it to corresponding manometric pressures.

METHOD: This single-centered, observational study was performed in the obstetrics operation theaters on 100 patients who underwent emergency or elective cesarean sections under general anesthesia. ETT cuff pressures were measured first by using a pilot balloon palpation technique and then by manometer. Data were analyzed using SPSS software.

RESULT: Estimated pilot balloon cuff pressures were optimal in all the cases. However, only 17% had normal pressure, 28% were under-pressure and 55% were over-pressured when compared with the manometer.

CONCLUSION: Monitoring of ETT cuff pressure with a manometer is crucial to enhance patient safety and reduce the risk of complications. This practice should be mandated in all medical centers to ensure optimal patient outcomes.

KEY WORDS: Endotracheal tube, cuff pressure, manometer, obstetric anesthesia

INTRODUCTION

The use of a cuffed endotracheal tube for intubation forms the cornerstone of securing the airway and provision of inhalational anesthesia for patients undergoing emergency obstetric surgery. It is imperative that the endotracheal cuff pressure be measured immediately after intubation and

throughout the procedure by a manometer according to American Society of Anesthesiologist (ASA) guidelines [1-3]. The primary function of the cuff is to create a secure seal between the cuff and the tracheal mucosa, thereby preventing air leaks and minimizing the risk of aspiration. [4,7]. Prior research has recommended cuff pressures between 20-30 cmH_2O to prevent aspiration and the compromise of tracheal mucosal blood supply. [8]. Cuff pressure of less than 20 cmH_2O is an independent risk factor for ventilator-associated pneumonia. At cuff pressures of greater than 30 cmH_2O blood flow to the tracheal mucosa diminishes, with complete cessation occurring at pressures of 50 cmH_{2O} leading to complications such as tracheal stenosis, rupture, trachea-esophageal fistula, hoarseness of voice, and complete nerve damage. Ischemia of as little as 15 minutes due to elevated cuff pressures can cause these changes, especially in those with unstable hemodynamics and low cardiac output states [2,3].

Manometric cuff pressure measurement is the only objective way to quantify the endotracheal cuff pressure according to American Society of Anesthesiologist (ASA) and to determine if the estimated pressures by pilot balloon palpation correlate.

In our setup manometer for cuff pressure measurement is seldom used being a low resource and high turnover setting. Therefore this study aimed to cross check pilot balloon palpation technique for endotracheal cuff pressure measurement and to compare it with direct manometric measurements to know its accuracy. By identifying the prevalence of under- and over- inflation the routine use of manometer can be emphasized and practiced to avoid the complications specially in obstetric population where airway is at greater risk of complications, so the patient safety can be assured.

METHODOLOGY

This is a single-centered, prospective, observational study performed in the emergency obstetric operation theaters of the Dow University of Health Sciences Karachi after taking approval from the institutional ethical review committee. The sample size was calculated by using Open Epi Version 3.0. In this study, all pregnant females aged between 18 to 40 years, who underwent cesarean section under general anesthesia were included. Those patients in which ETT could not be inserted were excluded from the study. Informed consent was obtained from the patients who meet the inclusion criteria of the study.

Non probability, consecutive sampling was used for this study. The anesthesia care providers with at least two years of training were enrolled in the study. A self-administered proforma was used to record data regarding the participant's demographics, years of experience in anesthesia, size of the tube, estimated cuff pressure, and cuff pressure obtained by direct manometric measurement. As a means to reduce bias, an anesthesia professional not directly inflating the pilot balloon was asked to palpate and estimate cuff pressure before measuring it with the manometer. Cuff pressures were categorized as under-inflated when lesser than 20 cm H_2O, appropriate at 20-30 cmH_2O, and over-inflated when greater than 30 cmH_2O. Cuff pressure was adjusted in case of under or over inflation.

Data analysis was performed in statistical software SPSS-27. Mean and standard deviation were computed for quantitative variables like age, BMI and manometric pressures and analyzed by ANOVA. Frequency and percentage were computed for categorical observation and analyzed by chi-square test. $P \leq 0.05$ was considered as significant.

RESULTS:

A total of 100 patients undergoing obstetric surgery under general anesthesia were recruited in this study. The average age of the patients was 28.46±5.39 years. Other demographics of the patients are reported in table 1. Pilot balloon cuff pressures were estimated as optimal by all the providers based on pilot balloon palpation. However according to the manometric pressures, only 17 patients (17%) had optimal ETT pressure (20-30 cmH_2O), 28 patients (28%) were underinflated (<20cmH_2O), and 55 patients (55%) had overinflated (>30cmH_2O) as illustrated in figure 1. The difference in cuff pressure categories was statistically significant ($p < 0.001$). Mean age and BMI were not

statistically significant among different manometric pressures similarly it was not statistically significant with experience of anesthesia as shown in table 2.

Table 1: Demographic Characteristics (n=100)

Variables	Statistics
Age (Years)	28.46±5.39
BMI (kg/m^2)	19.64±4.58
Manometric pressures(cmH_2O)	27.19±6.47
Years of experience in anesthesia 3rd Year 4th Year	 51% 49%

Figure 1: Comparison between estimated and measured ETT cuff pressures.

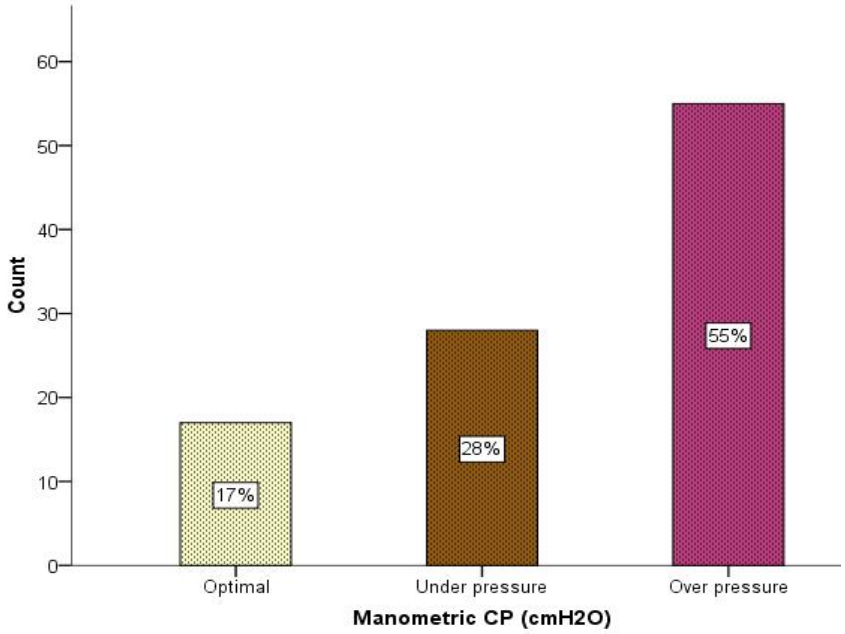

Table 2: Comparison of characteristics according to Manometric pressures

Variables	Manometric pressures			P-Value
	Optimal n=17	Under Pressure n=28	Over Pressure n=55	
Age (Years)	27.82±3.89	28.29±5.95	28.75±5.55	0.813
BMI (kg/m^2)	18.91±4.10	21.10±4.91	19.10±4.46	0.137
Manometric pressures (cm H_2O)	24.71±2.64	18.25±0.84	32.51±1.49	0.0005
Years of experience in anesthesia 3rd Year 4th Year	 7(41.2%) 10(58.8%)	 16(57.1%) 12(42.9%)	 28(50.9%) 27(49.1%)	0.583

DISCUSSION

The results from this observational study highlight a significant disparity related to improper inflation of endotracheal cuff with in the patients undergoing cesarean section under general anesthesia. When measured with a pilot cuff palpation technique, our study showed that a vast majority of the patients experienced the pressure which was out of the optimum range (20-30

cmH_2O). Only 17% of the patients had optimal ETT pressure whereas 28% had under-inflated cuff and 55% of the patients had over-inflation of the ETT cuff.

Our results are compatible with the prior studies showing unreliability of the pilot balloon palpitation technique. A cross-sectional study by Dullenkopf et al. found that only 27% of patients had endotracheal tube cuff pressures within normal range[9]. Abubaker et al supported that 45% endotracheal tube cuffs were over inflated when measured by manometer[1]. Similarly, Rahmani et al. (2017) and Stevens et al. (2018) found frequent over-inflation of endotracheal tube cuff when manometers were not used[3-4]. These results conjointly advocate our findings that subjective estimation methods are inaccurate and potentially harmful.

Over-inflation or under-inflation of endotracheal tube cuff may lead to various airway complications[10-12]. Excessively high cuff pressures pose significant patient risks. Even short period of excessive cuff pressure can lead to tracheal mucosal damage, including ischemia, ulcers, necrosis, tracheoesophageal fistula, and potentially fatal tracheal rupture[13-14], along with increased incidence of post operative sore throat[15]. Under-inflation of endotracheal tube cuff may lead to the incidence of ventilator associated pneumonia due to aspiration of pharyngeal secretions[16]. Both extremes compromise airway safety particularly critical in obstetric patients, where emergency airway management and hemodynamic instability are common.

Inspite of strong evidence supporting manometry, certain limitations and practical conderations exist. Bench studies by Plotnikow et al. and Gonzalez et al. demonstrated that pressure drop of 6-11 cmH_2O occurs by connecting a manometer to pilot balloon[17-18]. Further 73.33% of healthcare professionals have never used a manometer in a study conducted by Abubaker et al in our population[1].

The use of manometer in the clinical practice can reduce the risk of complications associated with improper inflation of the endotracheal tubes. Our study emphasizes on the routine use of manometer to improve the patient outcomes. While no significant immediate complications were reported in our study. The long-term complications of improper cuff inflation make it necessity to use a proactive approach while maintaining ETT pressure. This study is conducted at a low resource tertiary care setup, this population cannot be considered to be the representative of all other patients. Therefore; further researches should be conducted on a larger scale to investigate the effectiveness of new techniques in maintaining optimal endotracheal cuff pressure.

CONCLUSION

The prevalence of improper ETT cuff pressure in obstetric patients undergoing cesarean sections is highlighted in this study. These patients experienced both over-inflation and under-inflation of the ETT cuff when measured via the pilot cuff palpation method. These findings emphasize the necessity of measuring ETT cuff pressure using a manometer to maintain the pressure within the recommended range of 20-30 cmH_2O to minimize complications and improve patient outcomes.

CONFLICT OF INTEREST

There was no reported conflict of interest related to this article.

AUTHERS CONTRIBUTION

Dr. Muhammad Arsalan Jamil generated the idea and designed the study. Dr. Hubba Ahmed and Dr. Hajra Zafar Siddiqui helped with the conceptialization, collected and curated data. They also derived the methodology. Dr.Moizuddin, Dr. Shaista Uzair, and Dr. Muhammad Nauman Aqeel helped with data collection, writing and reviewing the original draft.

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