



Anesthesiology

ENDOTRACHEAL TUBE CUFF PRESSURE APPLICATION DURING GENERAL ANAESTHESIA - INSTRUMENTAL VERSUS CONVENTIONAL METHOD- A COMPARATIVE STUDY.

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ABSTRACT **Objective:** To evaluate the conventional practice of endotracheal tube (ETT) cuff inflation and pressure measurement as compared to the instrumental method.

Study Design: Prospective observational study. Place and Duration of Study: Aakash Fertility Centre, 10, Jawaharlal Nehru Road, Vadapalani, Chennai, during the period of August 2016 – July 2017

Methods: A total of 200 adult female patients posted for diagnostic laparoscopic surgery under General Anaesthesia for infertility treatment were selected for this study. Patients with anticipated difficult intubation, risk for aspiration, known anatomical laryngotracheal abnormalities, and emergency cases were excluded. Trachea was intubated with size 7.0 mm. The ETT cuff was inflated with air by one of the anaesthesia technician. Cuff pressures were measured using aneroid manometer. ETT cuff pressure of 20–30 cm of water was considered as standard.

Results:

In 87% of the patients, the cuff pressure measurements were above the standard. The mean cuff pressure was 46 cm of water.

Conclusion:

The conventional method for ETT cuff inflation and pressure measuring is unreliable. A routine instrumental cuff pressure, monitoring is suggested.

KEYWORDS : Cuff pressure, endotracheal tube, measurement

Introduction

A critical function of the endotracheal tube (ETT) cuff is to seal the airway, thus preventing leaks and aspiration of pharyngeal contents into the trachea during ventilation. In literature, catastrophic consequences of ETT cuff overinflation and insufficient inflation are reported. An ETT with a cuff is generally used for mechanically ventilated patients to prevent gas leakage and pulmonary aspiration. Excessive cuff pressure decreases tracheal capillary perfusion, and insufficient cuff pressure leads to pulmonary aspiration of oropharyngeal content.[\[1,2,3,4\]](#)

The ETT cuff pressure must be in a range that ensures delivery of the prescribed mechanical ventilation tidal volume, reduces the risk for aspiration of secretions that accumulate above the cuff without compromising the tracheal perfusion. A cuff pressure of 20–30 cm of water is recommended for the prevention of aspiration and ventilator-associated pneumonia.[\[5,6,7\]](#)

Post intubation sore throat is a common side effect of general anaesthesia. This may partly result from ischemia of the oropharyngeal and tracheal mucosa due to over-inflation of the cuff. In general, in anaesthesia practice ETT cuff pressure is assessed by palpation of cuff or cessation of audible leak around the cuff is the end point for inflation. We have conducted an observational study to evaluate the efficacy of cuff inflation and assessment of conventional method and instrumental measurement of cuff pressure. The ETT cuff pressure of 20–30 cm of H₂O was considered as standard.

Methods

This was a prospective observational study; Informed consent was obtained from the patients who met the eligibility criteria. Two hundred female adult patients above 22 years of age scheduled for elective surgical procedure requiring general anaesthesia and endotracheal intubation were included in the study. Patients with anticipated difficult intubation or having a history of difficult intubation, high risk for aspiration, known anatomical laryngotracheal abnormalities, and emergency intubations were excluded. General anaesthesia was induced using intravenous bolus of induction agent Inj. Propofol 2mg / Kg and paralysis was achieved using a non depolarizing muscle relaxant Inj. Vecuronium. All patients' trachea were intubated with an 7.0 mm internal diameter PVC Portex ETT. Anaesthesia was maintained with sevoflurane, a volatile anaesthetic agent, in a combination of nitrous oxide, oxygen and Inj Fentanyl. The duration of the study was 1 year. Endotracheal intubation was done by

anaesthesiologist and ETT cuff was inflated by the qualified anaesthesia technician. A 10 ml syringe was used as a routine for ETT cuff inflation. Adequacy of cuff inflation is generally assessed by palpation of the pilot balloon and sometimes readjusted by anaesthetist by inflating just enough to stop an audible leak around the cuff. The cuff pressure was measured by one of the investigator within 5 min of induction (before positioning) of anaesthesia using an aneroid manometer. The aneroid manometer (AMBU, Germany) was connected to the pilot balloon of the ETT and ETT cuff pressure was measured and recorded.

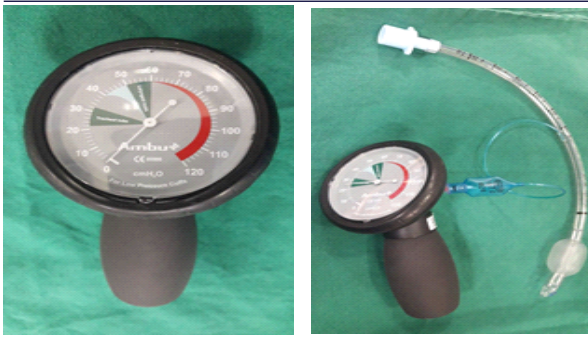
Results

ETT cuff pressure was measured in 200 adult patients who underwent elective surgical procedures under general anaesthesia requiring endotracheal intubation. There was no significant difference in age, weight, and duration of surgery (mean duration 33 minutes.) The overall incidence of ETT cuff pressures within the recommended range (20–30 cm of water) was 13% and in 87% it was above the recommended range. None of the measured cuff pressures was below the recommended range. The mean cuff pressure was 50.67 cm of water, which is above the standard. The lowest pressure measured was 24 cm of water and highest cuff pressure was 80 cm of water. In 41% the pressure range was 60-70 cm of water, in 25% the pressure range was 50-60 cm of water, in 10% the pressure range was 40-50 cm of water, in 8% the pressure range was 30-40 cm of water and in 3% the pressure range was 70-80 cm of water. In 13% patients only the pressure was measured between 20-30 cm of water.

Table 1

Cuff Pressure in cm of water	Number of Patients	Percentage
< 20 cm	0	0%
20 - 30 cm	26	13%
30 - 40	16	8%
40-50	20	10%
50-60	50	25%
60-70	82	41%
70-80	6	3%
80-90	0	0%
Mean Cuff Pressure - 50.67 cm of water		

Picture - AMBU pressure gauge



Discussion

The pressure exerted on the tracheal wall is one of the primary determinants of tracheal injury.[8] The intra-cuff pressure in intubated patients should be high enough to prevent macroscopic aspiration and an air leak to ensure adequate ventilation. The cuff pressure should be adequate enough not to impair the mucosal blood flow.[9] It has been shown that continuous lateral wall cuff pressure above 30 cm H₂O compromises blood flow, and cuff pressure above 50 cm H₂O completely obstruct the tracheal wall blood flow.[3] It has been shown that compromised blood flow for 15 min resulted in superficial damage to the tracheal mucosa.[10] It is reported that high ETT cuff pressure lasting more than 15 min resulted in obstructed mucosal blood flow, the columnar epithelium was destroyed, and basement membrane was exposed.[8,9,10] Damage to the trachea during intubation is inevitable as a result of the contact between the ETT and the trachea.[8] Digital balloon palpation corresponds poorly with the measured endotracheal cuff pressure, and anaesthetist experience corresponds poorly with measured cuff pressures.[8,10,11,12] The instrumental measurement and adjustment of cuff pressure resulted in a significantly lower incidence of post procedural sore throat, hoarseness, and blood-stained expectorant.[12] The pressure exerted on the tracheal wall depends on the compliance of the trachea and the pressure measured at the pilot balloon of an ETT cuff. ETT cuff pressure can be considered as a good estimate of the pressure exerted on the tracheal mucosa.[13] When conventionally adjusted cuff pressure was measured in different settings, the reported cuff pressures in most of the cases ranges between 40 and 62 cm H₂O.[13,14,15] The highest recorded ETT cuff pressure in our study was 58 cm H₂O, and most of the patients (87%) were having high cuff pressure. In our study, we observed that the use of bigger size syringe (10 ml) is one of the important factors for over inflating the ETT cuff, resulted in high cuff pressure. It was shown that there is linear relationship between the measured cuff pressure and the volume of air retrieved from the cuff. Sengupta et al.[1] showed that injected volumes between 2 and 4 ml usually produce cuff pressures between 20 and 30 cm H₂O, independent of tube size for the same type of tube. We also observed the same. He has suggested the use of a 5 ml syringe alternative to the traditional bigger size syringe.[16] This study has highlighted the issue of training and awareness among anaesthesia personnel regarding cuff inflation and cuff pressure measurement technique. Minor but common complications like postoperative sore throat can be prevented using a routine simple aneroid instrument for cuff inflation and pressure measurement rather than relying on conventional methods.

A limitation of this study is that cuff pressure was evaluated just once within 5 min after induction of anaesthesia. We never measured intermittently as the mean duration of the surgery was 33 minutes. The other limitation of our study was lack of control or placebo group. Further studies are required to find out the incidence of postoperative sore throat after repeated instrumental measurement of cuff pressure in prolonged surgeries and surgeries in different positions.

Conclusion

The conventional method for ETT cuff inflation and balloon pressure measuring is unreliable. Instrumental cuff pressure monitoring is simple and inexpensive[17,18] and suggested to be used as a routine.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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