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CORRELATION OF ESTIMATION TECHNIQUES AND DIRECT CUFF PRESSURE MEASUREMENT TECHNIQUE IN ASSESSING ENDOTRACHEAL TUBE CUFF PRESSURES -A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT The endotracheal tube cuff pressure must be high enough to seal the trachea to prevent micro or frank aspiration but also be low enough to allow perfusion of the tracheal mucosa. Although various cuff inflation techniques are used, there is no standard technique in the literature addressing the method of cuff inflation or cuff pressure maintenance in anaesthetic practice.

The purpose of the study is to correlate direct cuff pressure measurement technique (Group A) and estimation techniques like Minimal leak test (Group B), Minimal occlusive volume test (Group C), Palpation of pilot balloon (Group D), Predetermined volume test (Group E) in assessing endotracheal tube cuff pressures. A convenience sample of 144 patients intubated with endotracheal tube size 6.5-8.5 was included. The cuff of endotracheal tube was inflated by anaesthesia provider by using their usual estimation techniques and the cuff pressures were measured with noninvasive aneroid manometer connected to pilot balloon. The results were analysed using appropriate statistical software and a p-value < 0.05 was considered significant.

Direct cuff pressure measurement (Group A) showed mean cuff pressures of 29.9±4cmH2O which is in normal range (25-40 cmH2O). Whereas, with other estimation techniques (Group B, C, D, E) the pressures recorded were 37.32±16.40, 37.86±16.13 ,46.21±16.94, 45.19±16.61 cmH2O respectively, which are either too low pressures or too high pressures when compared to normal range pressures.

CONCLUSION: The direct cuff pressure measurement technique resulted in normal range cuff pressures when compared to other four estimation techniques. Thus, direct cuff pressure measurement with anaeroid manometer is the safest and simple method to be used to inflate the endotracheal tube cuff and prevent very high or low intracuff pressures. Endotracheal tube cuff pressure monitoring should be practiced routinely in regular anaesthesia practice.

KEYWORDS : Endotracheal Cuff Pressure, Estimation Techniques, Manometer

INTRODUCTION:

General anesthesia with endotracheal tube intubation is a standard method of airway protection during various surgeries. An endotracheal tube after intubation, cuff of tube is inflated. Although various cuff inflation techniques are used, there is no standard technique in the literature addressing the method of cuff inflation or cuff pressure maintenance in anesthetic practice.

The goal in using cuffed endotracheal tubes is to achieve a seal between the cuff and trachea with a pressure great enough to prevent aspiration but not so high that tracheal blood flow will be impeded. An acceptable maximum cuff pressure ranges from 25-40cm H2O. Despite the use of high-volume, low-pressure cuffs, certain patients remain at risk for cuff-induced laryngotracheal morbidity, even with short-duration anesthesia. This has produced a growing interest in studying measuring of endotracheal tube cuff pressures after intubation.

Various estimation techniques included in study are:

1. MINIMAL OCCLUSIVE VOLUME TECHNIQUE: A volume of air is injected into the cuff that eliminates an audible end inspiratory leak with positive pressure ventilation.
2. MINIMAL LEAK TECHNIQUE: This technique is described as air being injected into the cuff allowing only a small leak to be auscultated at end inspiration. Compared to minimal occlusive technique this method is associated with increased risk of silent aspiration.
3. PREDETERMINED VOLUME TECHNIQUE: A randomly selected predetermined volume of air is used to inflate the endotracheal cuff. This technique does not take in to account the tracheal diameter, thoracic pressure or the type of anesthetic agent used.
4. PALPATION TECHNIQUE: (Finger estimation): The endotracheal cuff is inflated with air, and the pilot balloon is palpated as a gross indication of intra cuff pressure. For practical cases this is one of the most used technique in clinical setting
5. DIRECT INTRACUFF PRESSURE MEASUREMENT: An anaeroid manometer is used to assess the intracuff pressure through connecting to pilot balloon.

AIM:

To correlate estimation techniques and direct cuff pressure measurement technique in assessing endotracheal tube cuff pressures.

METHODOLOGY:

Patients included in the study were 144 adults of ASA I & II, III grade, scheduled for elective surgery under general anaesthesia. Patients undergoing head and neck surgery and thoracic cavity, emergency surgeries, patients with laryngeal disease or laryngeal surgery, anaesthesia maintain on nitrous oxide were excluded from the study.

Standard anaesthesia protocol was followed. Patients were induced with Fentanyl-Propofol- Atracurium sequence. Endotracheal intubation was performed with high volume, low pressure cuffed Portex endotracheal tube no. 6.5, 7, 7.5, 8, 8.5 mm ID accordingly to patients. At intubation the endotracheal tube cuff was inflated with some amount of air with 10ml leur lock syringe to create an intra-cuff pressure for proper seal by the anaesthesia provider. Endotracheal tube cuff is inflated accordingly by anaesthesia provider by using their estimation techniques such as direct cuff pressure measurement technique (Group A), minimal leak technique (Group B), minimal occlusive volume technique (Group C), palpation of pilot balloon (Group D), and predetermined volume technique (Group E).

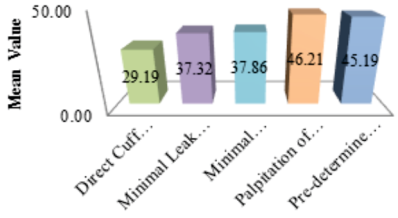
Endotracheal tube intra-cuff pressure was measured with an aneroid manometer immediately after intubation and then recorded and the volume used to inflate the endotracheal tube cuff is asked to anaesthesia provider and then recorded. Endotracheal tube intra-cuff pressure was measured are informed to anaesthesia provider and changes which they made later are not included in the study.

RESULTS:

Correlation between demographic data and measured cuff pressure are statistically comparable. The manometric pressure (cm H2O) attained at the endotracheal tube cuff was 29.9±4.33, 37.32±16.40, 37.86±16.13 ,46.21±16.94, 45.19±16.61 cmH2O for group A, Group B and Group C, Group D, Group E, respectively. This difference was statistically significant amongst all the five groups with a p value <0.05 using Fisher's exact test. Direct cuff pressure measurement (Group A) shows cuff pressures of 29.9±4 (mean ± SD) which is in normal range (25-40cmH2O). Whereas other estimation techniques like Minimal leak test(Group B), Minimal occlusive volume test (Group C), Palpation of pilot balloon (Group D), Predetermined volume test (Group E), the pressures recorded are 37.32±16.40, 37.86±16.13 ,46.21±16.94, 45.19±16.61 respectively, which are either too low pressures or too high pressures when compared to normal range pressures(25-45cmH2O).

Comparison of Cuff Pressure (cm of H2O) with Estimation Technique

Estimation technique	N	Mean	Median	SD	Quartile Range	F-value	P-value
A. Direct Cuff Measurement	37	29.19	30.00	4.33	0.00	9.04	<.0001
B. Minimal Leak Test	41	37.32	40.00	16.40	20.00	Difference is significant	
C. Minimal Occlusive Volume Test	28	37.86	40.00	16.13	15.00		
D. Palpation of Pilot Balloon	58	46.21	50.00	16.94	30.00		
F. Pre-determine Volume Test	53	45.19	40.00	16.61	25.00		



Measured Cuff Pressure (cm of H2O)

DISCUSSION:

Although various cuff inflation techniques are used, there is no standard technique in the literature addressing the method of cuff inflation. Overinflation and under inflation of endotracheal cuff, prevented by different inflation techniques has been met with varying success. some studies showed no correlation between years in practice or number of intubations performed yearly to the ability to properly inflate ET tube cuffs or detect overinflation. Cuff pressures attained by minimal leak test, and minimal occlusive volume techniques are below 20cmH20, where there is increased risk of micro aspiration. The endotracheal cuff pressure achieved by direct cuff pressure measurement technique was within normal range (25-40cmH2O) when compared to the other four estimation techniques. Based on studies regarding ideal cuff pressures Nordin et al, Seegobin et al, Brimacombe, we have taken ideal cuff pressure 25-40cmH_20, at this pressure it is proved safe for tracheal mucosa.

In our study, Volume used to inflate the endotracheal cuff using direct cuff pressure measurement technique required lesser volume of air when compared to other estimation techniques. A positive correlation is seen between measured cuff pressure and volume of air used and it was statistically significant (p= <0.05). There is no particular volume to attain normal cuff pressure (25-40cmH2O) and the cuff volume varied according to tube size and patient morphology. Increase in the volume of air, lead to increase in cuff pressure.

Sengupta P et al studied the endotracheal tube cuff pressure and the volume required to produce an appropriate cuff pressure in three hospitals, concluded that there is no correlation between cuff pressure and cuff volume. Therefore, measuring cuff pressures appears preferable to injecting a given volume of air. According to Ganner C , Trived , Lomholt et al **,** endotracheal tube cuff pressures should be routinely monitored with anaeroid manometer. According to our study also, the direct cuff pressure measurement technique should be used to inflate the endotracheal tube cuff and cuff pressure monitoring should be practiced routinely in regular anaesthesia practice. This study is limited by the accuracy of measurement technology. Although the type of manometer used in this study is one of the most convenient and common tool in literatures, the set and measured endotracheal tube cuff pressures are only accurate to within 1 cmH_2O. Smaller variation of cuff pressure can't be detected by this device but it may be of less clinical relevance.

CONCLUSION:

Our study results show that the direct cuff pressure measurement technique resulted in adequate manometric cuff pressure (25-40 cmH_20) and hence may be associated with lesser airway morbidity. Thus direct cuff pressure measurement technique should be used to inflate the endotracheal tube cuff and cuff pressure monitoring should be practiced routinely in regular anaesthesia practice.

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