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Use of AG Cuffill Syringe for Monitoring of Changes in ETT Cuff Pressure in Prone Position Under GA: (Cross Sectional Study)

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Abstract: ***Background and Aims:*** ***We conducted a study of monitoring endotracheal cuff pressure during general anaesthesia in elective spine surgery in prone position with AG Cuffill Syringe.*** ***Methods:*** ***A cross section study carried out at Medical College, Vadodara, 126 ASA I&II patient, 18-60yrs age group, undergoing elective spine surgery, more than 4hrs in prone position in general anaesthesia.*** ***Results:*** ***Paired t-test was used for measurement of cuff pressure changes. P< 0.05 is considered statistically significant. A significant decline in the cuff pressures were noted from the initial supine position after intubation (P < 0.001) in the supine group. Also, a significant decline in the cuff pressures were found in the prone before supine position to all the other three corresponding time points i.e., after final positioning (P < .001), at the end of the procedure (P < 0.01) and before extubation (P <0 .001). There was no any significant difference in hemodynamic parameters after position changes from supine to prone.*** ***Conclusion:*** ***Endotracheal cuff pressure changes occurs during change of position from supine to prone. So, monitoring of cuff pressure is must in different position to avoid complication.***

Keywords: Endotracheal tube cuff pressure, Prone position, Cuff pressure monitoring, Postoperative complication

1. Introduction

A gold standard method for administration of general anaesthesia via endotracheal tube was first reliably used in early 1900s, to provide a secure airway, reduce dead space, for pulmonary toileting, optimal ventilation and prevention of gastric aspiration. (12) To provide adequate cuff sealing Guedel Arther and other anesthetist used different materials for purpose of endotracheal cuff. (13) Ideal cuff pressure maintains between 25-30 cm of H_2O for avoiding unwanted complication and during duration of surgery was prolong, at that time endotracheal cuff pressure affected due to various factor.

We Use device like AG (Anapnoguard) Cuffill syringe (6), that is novelSimple, cheap, digitalpocket size syringe, not required any specific equipment, provides both cuff pressure control and control of the inflated air volume during measuring and reading of cuff pressure without losing pressure during mechanical ventilation and different position of patients. Also used in pediatric patients and supraglottic airway devices.

In Neurosurgical procedures, which is usually long duration and in prone position. The cuff of the endotracheal tube is inflated (20-30 cm of H_2O) with novel device AGCUFFILL syringe with air to achieve an adequate seal and monitoring.

2. Aim & Objectives

To monitor endotracheal cuff pressure changes in supine and prone position via AG Cuffill syringe and also monitoring of airway leak pressure, ventilatory parameters and hemodynamic and postoperative complication.

3. Methodology

After approval from the Institutional ethical committee for Human research –PG (IECBHR/081-2022), SSG hospital Vadodara and from Clinical trial registry of India (CTRI/2022/11/047600) we carried out this cross-sectional study on 125 patients who are admitted for neurosurgery requiring prone position. Sample size was calculated after conducting 10 pilot studies. ETT cuff pressure was recorded at 5, 10, 15, 30 min, 1hr, 2hr, and before extubation. Mean and standard deviation were calculated from the data keeping alpha error 0.05 and beta error at 0.2, sample size came out to be 125.

We included patients with age group of 18 to 65 of either sex with ASA status 1 and 2 undergoing elective surgery of duration 3 or more hours under General anaesthesia requiring intubation. We excluded patients who refused to give consent and in those with known tracheal/ laryngeal pathology, pregnant patients, difficult intubation, use of N2O or tracheostomized patients.

Patients evaluated preoperative and explained about the anesthetic procedures as well as information before taking Informed and written consent from all patients recruited for the study. Patients kept nil by mouth from 10:00 pm previous night. Tab.Ranitidine 150 mg and Tab.Diazepam 10mg orally was given on the night before surgery.

We kept AGCUFFILL syringe ready. Premedication was given after Intravenous line secure, after preoxygenation with 100% oxygen, induction was done by Inj.Propofol and Inj.Vecuronium chloride, Intubated by Endotracheal tube with high-volume low-pressure cuff, after conformation air entry over chest by auscultation, air was used inflated in endotracheal tube cuff through the AG Cuffill syringe. The volume of air, endotracheal cuff pressure and airway leak pressure was noted as baseline in supine position. Position of patient changed from supine to prone. After fixation of head done by pin. Following parameters will be noted;

1) Cuff pressure was kept between 20-30cm of H_2O via Cuffill syringe device after intubation.
2) Monitoring and adjusting the cuff pressure according to difference in cuff pressure via Cuffill syringe and airway leak pressure at 5min,30min,1hour,2hour after prone position, the final position at the end of the procedure and before extubation.

By controlled ventilation through closed circuit with oxygen and medical air, sevoflurane and vecuronium maintained during surgery. In Modern anaesthesia machine, the ventilatory parameters like, Respiratory rate-10-12/min Tidal volume -8-10ml/kg Peak airway pressure-25-35 cm of H_2O at the end expiration of patient during supineposition and three different point, setting was done. At the end of procedure, neuromuscular blockade will be reversed by Inj Neostigmine-50mcg/kg IV Inj Glycopyrrolate-10mcg/kg IV extubation was done followed by oropharyngeal suction. patients observed for 24 hrs. for Complains of sore throat and hoarseness of voice were also assessed postoperatively.

4. Technique

a) ETT cuff pressure measured Via AGCUFFILL syringe, turn ON by pressing the power button on right of display of plunger of syringe, was blinked twice and show“00”, andpushthe plunger to the distal end of the syringe, Connect the AG CUFFILL to the cuff inflation line and read the pressure valve. Required cuff pressureachieved byadjusting plunger. Disconnect the AG CUFFILL from the inflation line.
b) Cuff pressure was adjusted by pressing the power buttonON of AG CUFFILL syringethen display was blinkedtwice showing the number “00”. Position the plunger about half way out and Connected to the cuff inflation line.Required pressure was achievedby adjusting the plunger. If the required pressure is not achieved, disconnect the AG CUFFILL, pull the plunger 1-2 cc backward and repeat this step.
c) NOTE- The device automatically turns OFF 60 seconds after activation. For airway leak test was donefor measure airway leak from airway device. It was determined by closing the closed circuit of popoff valve 40cm of H_2O and fresh gas flow of only O_2 at 3lit/min and airway Pressure at equilibrium or when there was audible or palpable air leak from throat was noted.

Statistical analysis

The Software SPSS version 26was used for analysis. All parametric data were analyzed by paired t-test. The significance of paired t-test was done at, a) $P > 0.05$ not significant b) $P< 0.05$ significant and c) $P< 0.01$ was highly significant.

5. Result and Observation

Demographic data include maximum patients belonged to age group 51-60 and 41-50 i.e., 30% and 29.6%respectively. (Table. 1)

Table 1: Demographic and hemodynamic parameter:

Age(M/F)	46±9.33
Blood pressure	125.6±10.22(SBP) 81.48±5.32(DBP)
Pulse Rate	81.15±5.70

Maximum type of surgery occurred were MISS (21.6%) followed by disc laminectomy (16%) and aneurysm clipping (15%) in prone position. (Table 2)

Table 2: Type of surgery

Type of surgery	Number & percentage
Aneurysm clipping	19 (15.2%)
C-P angle tumor excision	17 (13.6%)
Craniectomy	14 (11.2%)
disc laminectomy	20 (16.2%)
MISS	27 (21.6%)
Pedicle Screw Fixation	18 (14.4%)
Pott spine repair	10 (8%)
Total	125 (100%)

We studied, the ETT cuff pressure at three different points. Firstly, in supine position then in prone position and before extubation and significantly difference was noted in cuff

pressure. Mean value changes from 25 to 13.65 with standard deviation of 2.02 and p value <0.001 keeping p value <0.05 statistically significant.

Therewas increase in airway leak pressure noted same time of cuff pressure measured due to decrease in cuff pressure after prone position and volume of air required for cuff inflation which was more significant value at prone before supine (p value <0.01 keeping p<0.05 statistically significant), and also value change at position supine before prone and before extubation. (Table.3)

Table 3: Mean ±SD of endotracheal cuff pressure, air volume for cuff inflation, airway leak pressure and peak airway pressure

Position	Supine	Prone	Before supine	Before extubation	P value
Cuff pressure	25±0.01	19.97±1.31	20.36±0.78	21.2±0.98	<0.001
Air volume to inflate	0.86±0.24	0.22±0.10	0.18±0.4	0.14±0.05	<0.01
Airway leak pressure	23.98±1.23	23.98±1.23	22.19±0.59	22.19±0.59	<0.01
Peak airway pressure	19.05±0.99	21.04±1.2	21.04±1.2	21.04±1.2	<0.001

For postoperative complication, out of 125, only 40 patients (32%) developed sore throat.

6. Discussion

Endotracheal cuff pressure was affected, during change of position from supine to prone like,

a) The trachea is located in the anterior portion of the neck, and therefore cervical spine, muscles, and major vessels can compress the trachea by the gravity in prone position. Moreover, the trachea contains numerous rings of hyaline cartilage which are C-shaped and incomplete dorsally, so the posterior aspect of the trachea can be more easily compressed.
b) Increased ETT cuff pressure due to increased intrathoracic pressure during prone position on Wilson frame led to anterior wall of the chest and abdomen compression so, increased intrathoracic pressure led increased airway pressure during inspiration. However, during expiration, if a patient did not receive a positive end-expiratory pressure, the airway pressure decreased to near zero. In this study, the cuff pressure was measured at the end-expiratory phase to prevent the effect of increased airway pressure in prone position, the effect of airway pressure would minimally increase the cuff pressure.

Surgeries that performed in prone position like spine surgeries, neuro surgeries, colorectal surgeries, vascular surgeries and tendon repair and in neurosurgeries include different types of spine surgeries like disc laminectomy and reconstruction, MISS (minimal invasive spinal surgery), pott spine repair, aneurysm clipping, C-P angle tumor excision, other brain tumor excision.

In our study, there was a significant reduction in the endotracheal cuff pressures from the initial supine position to the further end points inthe patients undergoing neurosurgical procedures. Initial reading was preset at25 cm of H_2O on supine position reduced significantly which correlated with the study done at Vellore may be due to the Skeletal muscle tone and the consciousness both are responsible in maintaining the upper airway structures and laryngeal dimensions. In the supine position, during the induction of anesthesia, loss of consciousness is associated with loss of the tonicity of the muscles around the neck which results in the posterior displacement of upper airway structures. Gravity, also plays a role in the posterior displacement of the upper airway structures by the loss of activity of the muscles during induction of anesthesia. This might have resulted in the reduction of the cuff pressures initially and the continuous level of unconsciousness provided by the adequate level of depth of anesthesia and paralysis over time would have resulted in the reduction of cuff pressures over a period of time et al Uk Athiraman.

A significant decline in the cuff pressures were found in the prone group from their initial intubated supine position to all the other three corresponding time points namely after final positioning (P < .001), at the end of the procedure (P < .001) and before extubation (P < .001) et al Uk Athiraman. Here, contradict to our study**,** Christelle Lizzy et al., showed that there was a significant rise in endotracheal tube cuff pressure with change of position from supine neutral to supine extension and supine flexion and cuff pressure should be measured after each change in a patient's body position and supports use of continuous monitoring of cuff pressure with automatic adaptation to a preset pressure, when all other factors that may cause alterations in cuff pressure are considered. A cuff pressure of 20–30 cm of H_2O is recommended for ET for prevention of post intubation sore throat is a common side effect. This may be result from ischemia of the oropharyngeal and tracheal mucosa due to over-inflation of the cuff et al Saudi Qureshi, support that pressure exerted on the tracheal wall is one of the primary determinants of tracheal injury. Pressure in intubated patients should be high enough to prevent macroscopic aspiration and an air leak to ensure adequate ventilation. 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. The instrumental measurement and adjustment of cuff pressure resulted in a significantly lower incidence of post procedural sore throat and hoarseness. 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.

7. Conclusion

Significant decrease in cuff pressure supine to prone position, at the end of surgery, and before extubation as well as the volume of air required to inflate the cuff also increases significantly at all above position during to achieve target cuff pressure of 25 cm of H_2O. Endotracheal tube Cuff pressure has to be checked after change the position of the patient and adjusted to the prescribed limits to prevent airway pressure related complications.

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Conflicts of Interest
None

Limitation
Our limitation was not able to measure Etco2, gas volume leak during endotracheal cuff pressure leak.

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