



Research Article

Comparative study of effects of endotracheal tube cuff inflation by digital palpation method versus cuff inflation by pressure gauge in patients undergoing surgeries under general anaesthesia after endotracheal intubation

Authors

Dr Kundan Kumar¹, Dr Ekramul Haque^{2*}, Dr (Prof) Usha Suwalka³

¹JR3, Department of Anaesthesiology, Rajendra Institute of Medical Sciences, Ranchi

²Associate Professor, Department of Anaesthesiology, Rajendra Institute of Medical Sciences, Ranchi

³Prof. & HOD, Department of Anaesthesiology, Rajendra Institute of Medical Sciences, Ranchi

*Corresponding Author

Dr Ekramul Haque

Associate Professor, Department of Anaesthesiology, Rajendra Institute of Medical Sciences, Ranchi

Abstract

Background: Endotracheal intubation is a common procedure in routine anaesthesia practice. Inadvertently high cuff pressure of endotracheal tube may result in several complications. Method of cuff inflation is directly related to complications encountered. Two most common methods of cuff inflation is digital palpation method or by using pressure gauge. Use of pressure gauge for cuff inflation has been proved as better method in earlier studies.

Method: After approval from ethical committee at RIMS, Ranchi 60 patients were included in this randomized controlled observational study who were planned for general anaesthesia with endotracheal intubation. Patients were equally distributed in two groups. In one group cuff was inflated by digital palpation method and in another group cuff was inflated to 25cm H₂O by using pressure gauge. Both groups were compared with regard to occurrence of sore throat and hoarseness of voice just after extubation and after 24 hours.

Result: Occurrence of sore throat and hoarseness of voice was significantly low in pressure gauge group.

Keywords: Endotracheal intubation, cuff pressure, pressure gauge, sore throat, hoarseness of voice.

Introduction

Cuffed endotracheal tubes are routinely used for endotracheal intubation in most patients. The high volume low pressure cuff is inflated with air to provide a seal against the tracheal wall to protect the lungs from pulmonary aspiration and to ensure that the tidal volume delivered ventilates the lungs rather than escapes into the upper airways.

A pilot balloon with a one-way valve allows for the inflation of the cuff and an assessment of the

cuff pressure. The endotracheal tube cuff pressure must be in a range that ensures delivery of the prescribed tidal volume and reduces the risk of aspiration of secretions that accumulate above the cuff without compromising the perfusion of tracheal mucosa. Lomholt et al recommended selection of cuff pressure of 25cm H₂O as a safe minimum pressure to prevent aspiration and leak past the cuff^[1]. Bernhard et al supported this recommendation^[2].

Catastrophic consequences of endotracheal tube cuff over-inflation such as tracheo-esophageal fistula, rupture of the trachea, carotid artery erosion and tracheo-innominate artery fistula are rare as low pressure high volume cuffs are routinely used now a days.

However post operative sore throat is a common side effect of general anaesthesia with endotracheal intubation and may partly result from ischemia of the oropharyngeal & tracheal mucosa. There are too many risk factors related to the incidence of post operative sore throat. Some of them are over-inflated cuff, size of endotracheal tube used, duration of anaesthesia, positioning of patients, use of anaesthetic spray, female sex, use of succinylcholine and aggressive oropharyngeal suctioning^[3]. By this study, we have compared the side effects of cuff inflation by pressure gauge versus digital palpation method.

Methods

The study was randomized controlled observational study. After approval from ethics committee in Rajendra Institute of Medical Sciences, Ranchi and obtaining written informed consent, 60 patients in age group 18 to 65 years having American Society of Anaesthesiologists (ASA) physical status I or II posted for planned surgeries under general anaesthesia (duration ≤ 3 hrs) with endotracheal intubation, were studied in the department of anaesthesiology. Patients with Emergency surgery, laryngeal surgery, history of difficult intubation, those requiring more than one attempt of intubation, nasotracheal intubation, laryngotracheal abnormalities, current upper respiratory tract infection, pre-existing sore throat and/or hoarseness of voice and history of smoking were excluded from the study.

The patients were randomly assigned into two groups (each having size of $n=30$), depending upon whether the cuff was inflated with digital palpation method or by pressure gauge. In group D, after intubation pilot balloon was inflated using digital palpation method and in group P, after intubation pilot balloon was inflated using

pressure gauge up to the level of 25cm of H₂O. Randomization was done by simple randomization using "close envelop method". Anaesthesiologist concerned for data interpretation was blinded regarding the cuff inflation method used.

A thorough pre anaesthetic evaluation was done with special emphasis on previous anaesthesia history, personal habits and airway assessment. All relevant investigations were done.

Patients were advised to be nil orally for 8 hours and were premedicated with tablet Alprazolam (0.25mg) and tablet Ranitidine (150mg) on the previous night before surgery. On the day of surgery, 18G intravenous cannula was secured in non-dominant hand and ringer lactate infusion was started. All patients were premedicated with inj. Ranitidine 50 mg i.v., inj. Glycopyrrolate 0.20mg i.v. and inj. Metoclopramide 10mg i.v., 30 minutes before induction.

After setting standard monitoring (ECG, NIBP, pulse oximetry) pre-oxygenation was given for five minutes. Anaesthesia was induced with 2mg/kg propofol intravenously and butorphanol 40 μ g/kg intravenously. Muscle paralysis was obtained by 1-1.5mg/kg succinylcholine intravenously. Trachea was intubated with 7-7.5mm cuffed endotracheal tube in females and 8-8.5mm in males. In the group P cuff was inflated up to level of 25cm H₂O using pressure gauge. In the group D the cuff was inflated using digital palpation method. Tube cuffs were not lubricated with Lignocaine Jelly. Anaesthesia was maintained with 50% oxygen with air and 1-1.5% isoflurane. Neuromuscular blockage was done with inj. Vecuronium 0.1mg/kg i.v. and thereafter maintenance dose if needed. At the end of surgical procedure, patients were administered inj. neostigmine 2.5 mg i.v. along with 0.5 mg i.v. glycopyrrolate. Extubation done after gentle oral suctioning and complete deflation of cuff. In Post operative period, patients were observed for occurrence of sore throat and occurrence of hoarseness of voice

Sore throat is defined as pain & irritation at the larynx and pharynx. It was recorded either 'yes' or

‘no’ just after regaining consciousness and after 24 hours.

Hoarseness is defined as harsh or stained voice. It was recorded either ‘yes’ or ‘no’ just after regaining consciousness and after 24 hours.

Statistical Methods

Data was collected and tabulated. Numerical variables were presented as mean & standard deviation (SD) while categorical variables were presented as frequency and percentage. As regard numerical variables; between groups comparison unpaired student- t test was used whenever appropriate; while for categorical variables chi-square test and fischer exact was used. p value less than 0.05 was considered as statistically significant. SPSS version 20.0 was used for data analysis.

Observation and Result

60 patients were included in this study which were equally distributed in both groups.

In group P number of male was 14 and female was 16. In group D number of male and female each was 15.

Average weight (in kg) was 54.98±11.6 in Group D and 51.22±10.36 in Group P.

Average duration of anaesthesia (in minute) was 91±26.04 in Group D and 93.33±26.31 in Group P.

Number of patients in ASA Grade I in Group D was 16 and that of Group P was 11. Number of patients in ASA Grade II in Group D was 14 and that of Group P was 19.

Figure No.1: Duration of Anaesthesia in both groups

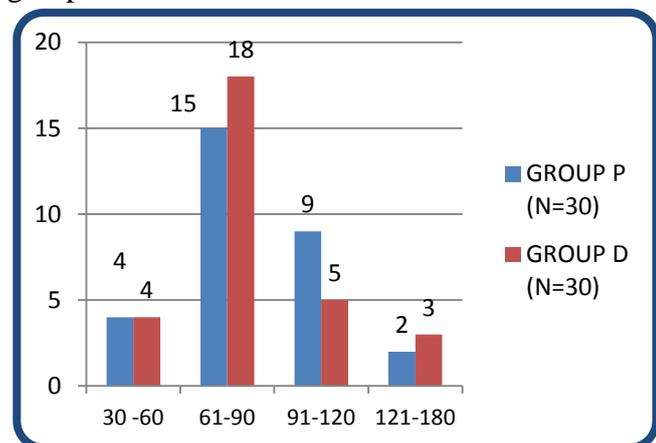


Table 1: Intraoperative blood pressure, oxygen saturation and pulse

Parameter	Group D (Mean±SD)	Group P (Mean±SD)	p value
Systolic blood pressure (mmHg)	133.57±9.66	114.7±11.56	<0.0001
Diastolic blood pressure (mmHg)	84.93±7.80	75.57±6.61	<0.0001
Mean arterial pressure (mmHg)	101.14±6.32	88.57±6.38	<0.0001
Oxygen saturation (%)	94.07±12.84	82.77±7.87	0.0001
Pulse (rate per minute)	99.5±0.57	99.45±0.51	0.8122

Table 2: Postoperative blood pressure, oxygen saturation and pulse

Parameter	Group D (Mean±SD)	Group P (Mean±SD)	p value
Systolic blood pressure (mmHg)	125±9.03	111±9.21	0.217
Diastolic blood pressure (mmHg)	77±5.53	72±5.91	0.071
Mean arterial pressure (mmHg)	93±6.84	85±5.59	0.027
Oxygen saturation (%)	99±2.35	99±0.30	0.355
Pulse(rate per minute)	88±11.81	80±6.90	0.836

Table 3: Occurrence of various side effects at various time in both groups

	OCCURRENCE OF SORE THROAT JUST AFTER REGAINING CONSCIOUSNESS	OCCURRENCE OF SORE THROAT AFTER 24 HOURS	OCCURRENCE OF HOARSENESS OF VOICE JUST AFTER REGAINING CONSCIOUSNESS	OCCURRENCE OF HOARSENESS OF VOICE AFTER 24 HOURS
Group D	25	10	25	4
Group P	7	1	5	1

25 patients in group D and 7 patients in group P complained of sore throat just after regaining consciousness. 10 patients in group D and 1 patient in group P complained of sore throat after 24 hours. 25 patients in group D and 5 patient in group P complained of hoarseness of voice just after regaining consciousness. 4 patients in group D and 1 patient in group P complained of hoarseness of voice after 24 hours.

Discussion

Evidence of securing the airway by artificial means is present since ancient time. But the use of endotracheal tube become prevalent after the introduction of neuromuscular blocking agents.

Now we usually use high volume low pressure cuffed endotracheal tube in current anesthesia practice. These endotracheal tubes are more patient friendly than earlier one but the complications may occur if we over inflate the cuff. Perfusion pressure of human capillary ranges from 30-44 cm of H₂O and impairment of mucosal blood flow at tracheal cartilage occurs at >30 cm H₂O^[4]. So the increased intra cuff pressure causes POST^[5], hoarseness of voice^[6] and many other complications. Various measures for minimising or preventing POST have been used with uncertain efficacy. During anaesthesia, intra cuff pressure can be influenced by anaesthetic depth, degree of muscle relaxation, patient temperature and position, ventilation mode and additional drug administration^[7].

After completion of anesthesia patients were observed for:

- a) Changes in hemodynamics like blood pressure, pulse, oxygen saturation intraoperatively and post operatively
- b) Occurrence of sore throat just after regaining consciousness and after 24 hours.
- c) Occurrence of hoarseness of voice just after regaining consciousness and after 24 hours.

Result of my study is in accordance with the earlier studies which concluded that increased intracuff pressure results in many complications like sore throat, hoarseness of voice and many others.

In 1984 Seegobin R D & Hasselt GL^[8] studied the effect of endotracheal cuff pressure on tracheal mucosal blood flow. They assessed tracheal mucosal blood flow in 40 patients undergoing surgery by endoscopic photographic technique. They found that over pressurised cuff impaired mucosal blood flow. They recommended that a cuff pressure should not exceed 30cm of water. Now a days the awareness regarding the complications of over pressurized cuff is also increased among anaesthesiologist which was confirmed by a study done by Trivedi L, Jha P, Bajiya N R et al^[9] in 2010. They concluded that there is increasing awareness in anaesthesiologist

regarding the risk of over inflation as 81.3% of them used PVC endotracheal tube and remaining 18.7% used red rubber tubes. They also found that in 40% of cases the intra cuff pressure was outside the recommended range. They recommended the use of aneroid manometer for cuff inflation. Baoji Hu, Rui Bao, Xiaolin Wang et al^[10] in 2013 performed a systemic review and meta analysis study regarding the size of endotracheal tube and sore throat after surgery. They included total of 509 female patients in three trials. They concluded that patients under general anaesthesia with smaller size of ETT were associated with a lower incidence of post operative sore throat in female patients.

Conclusion

From this study we concluded that:

- a) Use of pressure guage for inflation of endotracheal tube cuff results in less occurrence of sore throat just after regaining consciousness and after 24 hours.
- b) Use of pressure guage for inflation of endotracheal tube cuff results in less occurrence of hoarseness of voice just after regaining consciousness but not after 24 hours.
- c) Cuff inflation by digital palpation method result in increased mean arterial blood pressure intraoperatively and increased systolic blood pressure, diastolic blood pressure, mean arterial pressure and pulse rate post operatively.

References

1. Lomholt N. A device for measuring the lateral wall cuff pressure of endotracheal tubes. *Acta anaesthesiologica scandinavica*. 1992; 36: 775-778.
2. Bernhard WN, Yost L, Joynes D, Cothalis S, Turndurf H. Intracuff pressures in endotracheal and tracheostomy tubes. Related cuff physical characteristics. *Chest*. 1985; 87:720-725.

3. Agarwal A, Nath SS, Goswami D, Gupta D, Dhiraaj S, Singh PK. An evaluation of the efficacy of aspirin and benzydamine hydrochloride gargle for attenuating postoperative sore throat: A prospective, randomized, single-blind study. *Anesth Analg.* 2006;103:1001–3.
4. Seegobin R D, Hasselt G L. Endotracheal cuff pressure and tracheal mucosal blood flow: endoscopic study of effects of four large volume cuffs. *British Medical Journal.*1984; 288:965-968.
5. Gemechu BM, Gebremedhn EG, Melkie TB. Risk factors for postoperative throat pain after general anaesthesia with endotracheal intubation at the University of Gondar Teaching Hospital, Northwest Ethiopia, 2014. *Pan Afr Med J.* 2017;27:127. Published 2017 Jun 16. doi:10.11604/pamj.2017.27.127.10566.
6. Stevanovic A, Rossaint R, Fritz HG, et al. Airway reactions and emergence times in general laryngeal mask airway anaesthesia: a meta-analysis. *Eur J Anaesthesiol* 2015; 32:106–116.
7. Kim D, Jeon B, Son JS, et al. The changes of endotracheal tube cuff pressure by the position changes from supine to prone and the flexion and extension of head. *Korean J Anesthesiol* 2015; 68: 27–31.
8. Terashima H, Sakurai T, Takahashi S, Saitoh M, Hirayama K. Postintubation tracheal stenosis: Problems associated with choice of management. *KyobuGeka* .2002; 55:837-42.
9. Trivedi L, Jha P, Bajjiya NR, Tripathi D. We should care more about intracuff pressure: The actual situation in government sector teaching hospital. *Indian J Anaesth.* 2010;54(4):314–317. doi:10.4103/0019-5049.68374.
10. Hu B, Bao R, Wang X, Liu S, Tao T, et al. (2013) The Size of Endotracheal Tube and Sore Throat after Surgery: A Systematic Review and Meta-Analysis. *PLoS ONE* 8(10):e74467. doi:10.1371/journal.pone.0074467.