Original Article

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Anaesthesia Section

Comparison of Change in Endotracheal Tube Cuff Pressure during Laparoscopic Abdominal Surgeries in Different Positions: A Prospective Observational Study

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ABSTRACT

Introduction: Laparoscopic abdominal surgeries involve the creation of pneumoperitoneum along with specific patient positioning, both of which can significantly affect respiratory mechanics and airway pressures. These changes may alter Endotracheal Tube (ETT) cuff pressure, potentially increasing the risk of postoperative airway-related complications such as sore throat and tracheal mucosal injury.

Aim: To assess variations in ETT cuff and airway pressures in patients undergoing surgery in Trendelenburg and Reverse Trendelenburg positions.

Materials and Methods: The present hospital-based prospective observational study was conducted in the Department of Anaesthesiology, Dr. SN Medical College and Associated Group of Hospitals, Jodhpur, Rajasthan, India, on 50 adult patients {American Society of Anaesthesiologists (ASA) I-II, aged 20-60 years} scheduled for elective laparoscopic procedures under general anaesthesia from February 2024 to December 2024. Participants were allocated into two groups based on surgical positioning: Trendelenburg (n=25) and Reverse Trendelenburg (n=25). After tracheal intubation, ETT cuff pressure was initially set between 25-30 cm H_2O and measured at baseline, after pneumoperitoneum, after positioning, and at regular intraoperative intervals. Airway pressures were also recorded. Postoperative sore throat and hoarseness were assessed at two and 24 hours. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 22, unpaired t-test and chi-square test were used, with $p<0.05$ considered significant.

Results: The demographic characteristics of patients were comparable between the two groups ($p>0.05$). Pneumoperitoneum caused a significant rise in cuff pressure in both groups, with a greater increase in the Trendelenburg group (baseline 25 to peak 46.50±4.43 cm H_2O) compared to Reverse Trendelenburg (from baseline 25 to peak 38.60±4.88 cm H_2O; $p<0.05$). Airway pressures increased significantly from baseline after pneumoperitoneum in both groups, but intergroup differences were not statistically significant. Postoperative sore throat (36% vs. 8%) and hoarseness (16% vs. 8%) were significantly higher in Trendelenburg ($p<0.05$).

Conclusion: Trendelenburg positioning during laparoscopic surgery results in a greater increase in ETT cuff pressure than Reverse Trendelenburg, correlating with a higher incidence of postoperative airway symptoms. Continuous intraoperative cuff pressure monitoring is recommended.

Keywords: Airway management, Intubation, Pneumoperitoneum, Postoperative complications, Sore throat

INTRODUCTION

Endotracheal intubation is routinely performed during general anaesthesia to ensure airway protection and facilitate controlled mechanical ventilation. In adults, cuffed ETTs are considered the standard of care for preventing aspiration and maintaining an effective airway seal [1,2]. The cuff creates a seal between the tube and tracheal wall, enabling positive pressure ventilation while protecting against aspiration of gastric contents [3,4]. However, the pressure exerted by the inflated cuff is transmitted directly to the tracheal mucosa. For this reason, maintaining cuff pressure within the recommended range of 20-30 cm H_2O is essential to balance airway sealing with preservation of mucosal perfusion [5,6].

Inappropriate cuff pressure is associated with clinically significant complications. Excessive pressure may impair tracheal mucosal blood flow, leading to ischaemia, inflammation, ulceration, and postoperative airway symptoms such as sore throat and hoarseness [7]. Conversely, inadequate cuff pressure may result in aspiration and ineffective ventilation. Despite these recognised risks, intraoperative cuff pressure is not routinely monitored in many clinical settings, and commonly used estimation techniques such as pilot balloon palpation are unreliable. Direct measurement using a cuff pressure manometer remains the most accurate method for ensuring safe cuff pressure [8,9].

Laparoscopic surgery has become increasingly common owing to its minimally invasive nature, reduced postoperative pain, and faster recovery [10]. However, these procedures are associated with distinct physiological changes that may influence airway mechanics. Carbon dioxide pneumoperitoneum increases intra-abdominal pressure, resulting in cephalad displacement of the diaphragm, reduced pulmonary compliance, and increased intrathoracic and airway pressures [11]. These changes can be transmitted to the ETT cuff, leading to alterations in intracuff pressure during the intraoperative period [12].

Patient positioning during laparoscopic surgery further modifies respiratory mechanics. The Trendelenburg position, frequently used for pelvic and lower abdominal procedures, increases venous return and causes additional cephalad displacement of abdominal viscera, thereby reducing lung compliance and increasing airway pressure [13]. In contrast, the Reverse Trendelenburg position produces different respiratory and haemodynamic effects. Changes in head and neck position associated with surgical positioning may also lead to ETT displacement within the trachea. Because the trachea is not uniformly cylindrical, such displacement can alter the contact between the cuff and tracheal wall, resulting in changes in intracuff pressure. These factors indicate that cuff pressure during laparoscopic surgery is dynamic and influenced by both pneumoperitoneum and patient positioning [14].

Previous studies [10-12] have demonstrated that pneumoperitoneum and anaesthetic factors can increase ETT cuff pressure and may contribute to postoperative airway morbidity. However, the specific influence of surgical positioning remains inadequately defined, and available findings are inconsistent [12,15]. Many studies [11,16] have evaluated cuff pressure changes without directly comparing commonly used surgical positions or assessing their clinical implications. Furthermore, data on intraoperative cuff pressure trends in routine laparoscopic practice remain limited [16-21].

Given the increasing use of laparoscopic techniques and the potential for preventable airway complications, evaluation of intraoperative cuff pressure dynamics is clinically relevant. A comparative assessment of cuff pressure changes in different surgical positions may provide valuable information for improving perioperative airway management. Therefore, the present study was undertaken to compare intraoperative changes in ETT cuff pressure in Trendelenburg and Reverse Trendelenburg positions during laparoscopic abdominal surgery and to evaluate their association with postoperative airway complications.

MATERIALS AND METHODS

The present hospital-based prospective observational study was conducted in the Department of Anaesthesiology, Dr. SN Medical College and Associated Group of Hospitals, Jodhpur, Rajasthan, India after obtaining approval from the Institutional Ethics Committee (SNMC/IEC/2024/Plan/818) and written informed consent from all participants. The study was carried out between February 2024 to December 2024.

Sample size calculation: Sample size was calculated based on a previous study with alpha error of 0.05 and study power of 90%, using the formula:

$$n = \frac{2\sigma^2 (Z_{\alpha/2} + Z_\beta)^2}{d^2}$$

where,

σ^2 = pooled variance of the two-population taken as 20.5 as calculated from findings of Wu C-Y [12])

μ_1-μ_2 = The mean difference between ETT cuff pressures between the two population. (taken as 8 as calculated from findings of Wu C-Y [12]).

No of sample per group (n) = $\frac{2 \times (1.96 + 1.28)^2 \times 20.5}{(8)^2}$ = 430.40 / 64

(n) = 7

where 'n' is the sample size per group, σ is the standard deviation from a previous study, 'd' is the minimum expected difference between groups, $Z\alpha/2$ corresponds to the desired confidence level (1.96 for 95%), and $Z\beta$ corresponds to study power (1.28 for 90% power). Based on this calculation, the minimum required sample size was seven patients per group; however, 25 patients were included in each group to improve statistical validity, yielding a total sample size of 50 patients.

Inclusion and Exclusion criteria: Patients aged 20-60 years, ASA physical status I or II, body mass index 18-24.9 kg/m², and scheduled for elective laparoscopic abdominal surgery of duration less than two hours under general anaesthesia were included. Patients with recent upper respiratory tract infection, chronic smoking, airway disease {Chronic Obstructive Pulmonary Disease (COPD), bronchiectasis, asthma, tuberculosis}, previous airway or head and neck surgery, traumatic or multiple intubation attempts, and pregnant patients were excluded from the study. Patients not meeting inclusion criteria were excluded prior to enrolment.

Grouping:

- Trendelenburg group (n=25) {15-30 degree} [13-15]: Included patients undergoing laparoscopic hysterectomy, hernia repair, or ovarian cystectomy.
- Reverse Trendelenburg group (n=25) {10-30 degree} [3,12,15]: Included patients scheduled for laparoscopic cholecystectomy.

Study Procedure

Anaesthetic management: All patients received general anaesthesia under standard ASA monitoring care. After establishing standard anaesthesia monitoring, baseline measurements such as Heart Rate (HR), Electrocardiogram (ECG), Non Invasive Blood Pressure (NIBP) and peripheral oxygen saturation were recorded.

All patients were pre medicated with Inj. Glycopyrrolate 4 mcg/kg, Inj. Lignocaine 2% 1.5 mg/kg, Inj. Midazolam 1 mg and preoxygenated with 100% O_2 for three minutes. Induction was achieved with propofol (2 mg/kg), fentanyl (2 µg/kg), and Rocuronium (1.2 mg/kg) for muscle relaxation. Tracheal intubation was done using direct laryngoscopy with 7.5 or 8.0 size tubes for men and 7 or 7.5 size tubes for women and ETT position in trachea was confirmed by chest rise, auscultation and four wave capnography. In all patients, an ETT of high-volume low-pressure type (PORTEX healthcare P2310159) was used. ETT Cuff was inflated with air using a sterile 10 cc syringe to achieve intracuff pressure of 25 cm of H_2O.The volume used to fill the cuff and cuff pressure was recorded in each patient using hand held, PORTEX aneroid cuff pressure manometer (REF100/568/000) and baseline ETT cuff pressure was recorded using appropriately sized high-volume, low-pressure cuffed ETTs. The cuff was inflated to 25 cm H_2O using a manual manometer. Anaesthesia was maintained with oxygen and sevoflurane {according to Minimum Alveolar Concentration (MAC)}. Mechanical ventilation was controlled using Drager Fabius anaesthesia work station ventilator. All patients were mechanically ventilated using volume-controlled mode with the tidal volume 6-8 mL/kg and respiratory rate between 12-14/min as required to maintain end-tidal carbon dioxide at 30-35 mmHg during the procedure. Nasogastric tube was inserted in every patient to reduce intrabdominal pressure. Baseline ETT cuff pressure was recorded using Portex aneroid cuff pressure manometer and airway pressures were monitored on anaesthesia workstation. If intracuff pressure of >30 cm H_20 was noted, ETT position was reconfirmed. Intraabdominal pressure was checked and if it was more than 15 mm Hg, it was reduced if possible. Intraoperatively muscle relaxation was maintained by injection Rocuronium 0.1 mg per kg every 30 minutes.

Patient was reversed with inj. sugammadex (2 mg/kg) and the oropharynx was gently suctioned. Patient was extubated after regaining adequate muscle power to maintain spontaneous respiration and adequate tidal volume, and demonstration of purposeful movement. After extubation, patient was observed for emergence coughing. Patients were followed-up at two hours and twenty-four hours after extubation by ward visitations for the presence of sore throat and hoarseness.

Data collection: ETT cuff pressure, peak airway pressure, and plateau airway pressure were recorded at baseline immediately after intubation, after creation of pneumoperitoneum, after surgical positioning, every five minutes for the first hour of surgery, and thereafter every 15 minutes until deflation of pneumoperitoneum.

Postoperative sore throat and hoarseness were assessed at two hours and 24 hours after extubation by an investigator blinded to the study groups.

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS software version 22.0 (SPSS Inc., Chicago, IL, USA). Quantitative variables were expressed as mean±standard deviation and compared using the unpaired Student's t-test. Categorical variables were expressed as numbers and percentages and analysed using the chi-square test. A p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 50 patients (25 in the Reverse Trendelenburg group and 25 in the Trendelenburg group) completed the study.

Baseline demographic characteristics, including age, weight, gender distribution, and ASA grade, were comparable between the groups (p>0.05) [Table/Fig-1] and the haemodynamic parameters between groups shows no statistically significant differences [Table/Fig-2].

Parameters	Reverse Trendelenburg	Trendelenburg	p-value
Age (years) Mean±SD	38.88±1.89	36.84±4.20	0.234
Gender (Female/Male)	16/9	18/7	0.762
Weight (kg) Mean±SD	59.60±6.81	57.88±4.71	0.329
ASA I /ASA II	12/13	16/9	-
Duration of surgery (min) Mean±SD	53.80±20.27	53.00±16.89	0.880
Duration of anesthesia (min) Mean±SD	64.60±21.60	63.40±18.13	0.832
Duration of Pneumoperitoneum (min) Mean±SD	47.40±20.26	48.00±16.89	0.909

[Table/Fig-1]: Demographic characteristics of patients.
Values expressed as Mean±SD or number. Independent Student's t-test and chi-square/Fisher's-exact test were used for comparison between groups. p<0.05 considered statistically significant. ASA: American Society of Anaesthesiologists

Parameters	Reverse Trendelenburg (Mean±SD)	Trendelenburg (Mean±SD)	p-value
HR (bpm)	77.24±7.90	77.64±7.73	0.857
SBP (mmHg)	124.68±7.41	123.96±8.00	0.326
DBP (mmHg)	73.80±5.82	70.96±6.17	0.100
SpO_2 (%)	99.28±0.98	98.48±0.87	0.256

[Table/Fig-2]: Comparison of haemodynamic parameters between groups.
Values are expressed as mean±Standard Deviation (SD); HR: Heart rate; SBP: Systolic blood pressure; DBP: Diastolic blood pressure, SpO_2: peripheral oxygen saturation; p<0.05 was considered statistically significant; statistical analysis was performed using appropriate comparative tests (e.g., independent t-test).

Cuff Pressure Trends

Cuff pressure increased progressively following pneumoperitoneum in both groups. A statistically significant rise was observed over time, with greater increases noted in the Trendelenburg group compared to the Reverse Trendelenburg group [Table/Fig-3].

Time (minutes)	Reverse Trendelenburg (Mean±SD)	Trendelenburg (Mean±SD)	p-value
Baseline cuff pressure	25.28±1.51	25.24±1.27	0.919
0 min	25.28±1.51	25.24±1.27	0.919
5 min	28.08±2.31	27.60±1.87	0.423
10 min	29.04±2.28	29.64±2.23	0.352
15 min	30.80±3.38	33.16±2.67	0.009
20 min	31.44±3.31	33.10±3.05	0.033
25 min	32.60±3.27	35.20±3.65	0.007
30 min	33.12±3.70	36.92±3.67	<0.001
35 min	33.68±4.24	38.00±4.73	0.0013
40 min	34.62±4.55	40.00±5.69	0.001
45 min	35.60±4.78	39.60±5.82	0.032
50 min	35.08±4.52	42.42±5.38	0.001
55 min	37.25±4.40	43.25±5.65	0.033
60 min	37.43±4.72	46.00±5.51	0.013
75 min	38.60±4.88	46.50±4.43	0.038
90 min	36.00±3.65	42.00±8.49	0.514
105 min	36.00±0.00	36.00±0.00	–
120 min	–	–	–

[Table/Fig-3]: Comparison of cuff pressure between groups.
Values are expressed as mean±Standard Deviation (SD). Cuff pressure is measured in centimetres of water (cm H_2O). p-value calculated using independent Student's t-test. p<0.05 considered statistically significant.

Intergroup comparison showed significantly higher cuff pressures in the Trendelenburg group at multiple time points, particularly after pneumoperitoneum and positional changes [Table/Fig-3].

Event-based comparison further demonstrated significantly higher cuff pressures in the Trendelenburg group at key intraoperative stages [Table/Fig-4].

Parameters (Cuff pressure at various events, cm H_2O)	Reverse Trendelenburg Mean±SD	Trendelenburg Mean±SD	p-value
Baseline cuff pressure	25.28±1.51	25.24±1.27	0.919
Post pneumoperitoneum	30.80±3.38	33.16±2.67	0.009*
After giving surgical position	32.60±3.27	35.20±3.65	0.007*
Final time (before deflation of pneumoperitoneum)	37.43±4.72	46.00±5.51	0.013*

[Table/Fig-4]: Comparison of Endotracheal Tube (ETT) Cuff Pressure between groups.
Values are expressed as mean±SD; cuff pressure measured in cm H_2O; p<0.05 was considered statistically significant, with * indicating statistically significant difference between groups; statistical analysis was performed using appropriate comparative tests (e.g., independent t-test)

The cuff pressure increased further after giving surgical position; increase was more in Trendelenburg position. The cuff pressure measured after surgical position was 35.20±3.65 cm of H_2O in Trendelenburg and 32.60±3.27 cm of H_2O in Reverse Trendelenburg position. The cuff pressures in Trendelenburg position were higher than in Reverse Trendelenburg position at each observation time point. This difference in the cuff pressures was statistically significant at all times during observation period.

Airway Pressure Trends

Peak and plateau airway pressures increased intraoperatively in both groups; however, no statistically significant differences were observed between the groups at any time point [Table/Fig-5].

Postoperative Complications

Postoperative sore throat at two hours was significantly higher in the Trendelenburg group compared to the reverse Trendelenburg group [Table/Fig-6]. The incidence of hoarseness at both two hours and 24 hours was comparable between the groups and was not statistically significant.

DISCUSSION

The present study demonstrates that both pneumoperitoneum and patient positioning significantly influence ETT cuff pressure, with the Trendelenburg position producing greater and more sustained increases compared to reverse Trendelenburg. This increase in ETT cuff pressure was also directly associated with postoperative respiratory complications such as throat pain, sore throat, hoarseness, and blood-streaked expectoration. The primary purpose of the ETT cuff and maintaining adequate pressure within the cuff is to avoid aspiration into the trachea, to prevent ventilatory leak during mechanical ventilation, and to fix ETT in position.

Demographic Parameters

The demographic profile in the present study was comparable between groups. Mean age was 38.88±1.89 years in the Reverse Trendelenburg group and 36.84±4.20 years in the Trendelenburg group (p=0.234). Gender distribution and ASA grading were also statistically comparable (p>0.05). These findings are consistent

Time (min)	Peak airway pressure (Mean±SD) Reverse Trendelenburg	Peak airway pressure (Mean±SD) Trendelenburg	p-value	Plateau airway pressure (Mean±SD) Reverse Trendelenburg	Plateau airway pressure (Mean±SD) Trendelenburg	p-value
0	14.08±1.93	14.28±2.44	0.749	12.96±1.34	13.04±2.05	0.871
5	18.92±2.08	18.56±1.96	0.531	16.52±1.78	16.80±2.06	0.609
10	20.44±1.73	20.04±1.84	0.432	21.88±1.93	18.36±1.96	0.373
15	21.60±1.96	20.96±1.97	0.254	19.16±2.44	19.32±1.97	0.800
20	22.76±1.92	22.08±1.68	0.189	20.56±2.52	20.40±1.63	0.791
25	23.48±1.83	23.52±1.81	0.938	21.76±2.68	21.72±1.81	0.951
30	23.52±1.78	23.96±2.11	0.429	21.52±2.74	22.16±2.06	0.355
35	22.24±3.84	23.36±2.93	0.252	20.32±3.73	21.44±2.96	0.245
40	21.43±3.85	21.74±4.50	0.806	19.55±4.42	19.74±4.51	0.890
45	21.60±4.15	21.20±4.26	0.782	19.64±4.50	19.53±3.75	0.937
50	21.42±4.46	21.25±5.33	0.934	19.91±4.09	18.92±4.83	0.599
55	23.75±3.96	22.38±4.93	0.548	21.88±3.87	20.13±4.55	0.421
60	22.86±4.45	21.17±3.19	0.443	20.00±3.56	19.40±3.65	0.782
75	23.20±4.76	16.50±3.87	0.152	19.60±3.65	15.50±3.11	0.111
90	19.00±4.08	17.50±6.36	0.812	16.50±1.91	16.00±5.66	0.922
105	19.00±0.00	22.00±0.00	–	16.00±0.00	19.00±0.00	–
120	–	–	–	–	–	–

[Table/Fig-5]: Comparison of peak and plateau airway pressures between groups.
Values are expressed as Mean±SD. Airway pressures are measured in cm H_2O. Independent Student's t-test was used for intergroup comparison. p<0.05 was considered statistically significant

Time (hours)	Variable	Response	Reverse Trendelenburg (n=25) (%)	Trendelenburg (n=25) (%)	p-value
2 hours	Sore throat	No	23 (92)	16 (64)	0.027
		Yes	2 (8)	9 (36)	
24 hours	Sore throat	No	23 (92)	21 (84)	0.415
		Yes	2 (8)	4 (16)	
2 hours	Hoarseness	No	23 (92)	21 (84)	0.172
		Yes	2 (8)	4 (16)	
24 hours	Hoarseness	No	24 (96)	23 (92)	1.000
		Yes	1 (4)	2 (8)	

[Table/Fig-6]: Distribution of postoperative sore throat and hoarseness between groups (N=50).
Values are expressed as number of patients {n (%)}. Chi-square test was used for comparison between groups. p<0.05 was considered statistically significant

with observations by Kwon Y et al., who reported no significant demographic differences between study groups [16].

Endotracheal Tube (ETT) Cuff Pressure Changes due to Pneumoperitoneum

Following creation of pneumoperitoneum, cuff pressure increased significantly in both groups, exceeding the recommended upper limit of 30 cm H_2O. cuff pressures were higher in the Trendelenburg group (46.50±4.43 cm H_2O) compared to the Reverse Trendelenburg group (38.60±4.88 cm H_2O). Mean airway pressures also increased significantly from baseline in both groups. This increase was statistically significant in both the groups when compared with the baseline cuff pressure (with a p-value <0.05). Yildirim ZB et al., observed cuff pressure changes during laparoscopic and open abdominal cholecystectomy surgery [11]. The endotracheal cuff pressure was registered every five minutes after tracheal intubation and patients were investigated for sore throat, dysphagia, and hoarseness. The results showed that endotracheal cuff pressures in laparoscopy group were significantly higher than in the group open surgery group at all time points studied (p<0.05). The study concluded that the CO_2 pneumoperitoneum and Trendelenburg position used during laparoscopy increase endotracheal cuff pressure and lead to discomfort in the postoperative patient. The present study observes a similar finding of increased cuff and mean airway pressure following pneumoperitoneum.

Endotracheal Tube (ETT) Cuff Pressure Changes due to Change in Position

The cuff pressure increased further after giving surgical position; increase was more in Trendelenburg position. The cuff pressure measured after surgical position was 35.20±3.65 cm of H_2O in Trendelenburg and 32.60±3.27 cm of H_2O in Reverse Trendelenburg position. The cuff pressures in Trendelenburg position were higher than in Reverse Trendelenburg position at each observation time point. This difference in the cuff pressures was statistically significant at all times during observation period. Wu CY et al., studied 70 patients undergoing elective laparoscopic colorectal tumour resection (head-down position, n=38) and laparoscopic cholecystectomy (head-up position, n=32) and compared them to 15 patients undergoing elective open abdominal surgery [12]. After insufflation, the cuff pressure increased from 26±3 to 32±6 and 27±3 to 33±5 cm H_2O in patients of laparoscopic cholecystectomy and laparoscopic colorectal tumour resection respectively (both p<0.001). The head-down tilt further increased cuff pressure from 33±5 to 35±5 cm H_2O (p<0.001). They concluded that increase of ETT cuff pressure occurred during laparoscopic surgery especially in the head-down position. The present study results corroborate that both pneumoperitoneum and Trendelenburg positioning independently and cumulatively increase cuff pressure.

Airway Pressure Changes due to Change in Position

Peak airway pressures increased intraoperatively in both groups, though intergroup differences were not statistically significant. Geng G et al., suggested that increased airway pressures during pneumoperitoneum may transmit pressure to the cuff, contributing to cuff overinflation [17]. Continuous monitoring in the present study demonstrated a gradual rise in both airway and cuff pressures during pneumoperitoneum. In another similar study, Gali B et al., reported that peak airway pressure at 30 minutes after incision for robotically assisted hysterectomy with pneumoperitoneum and the steep Trendelenburg position increased [18].

Laryngotracheal Morbidity

Postoperative sore throat was significantly higher in the Trendelenburg group (36%) compared to Reverse Trendelenburg (8%) in the PACU (p=0.027). At 24 hours, although incidence remained higher in the Trendelenburg group, the difference was not statistically significant.

Hoarseness incidence was comparable between groups. Seegobin RD demonstrated that cuff pressures above 30 cm H_2O impair tracheal mucosal perfusion and pressures above 50 cm H_2O may completely obstruct blood flow, explaining the higher morbidity observed with elevated cuff pressures [19].

As highlighted by Liu J et al., palpation-based cuff inflation often results in excessive pressures [20]. Kako H et al., further emphasised the need for continuous monitoring during prolonged procedures [21].

Thus, from the current study the authors observed that the incidence of postoperative laryngotracheal morbidity was significantly higher in trendelenburg position. Position which correlated with higher cuff pressures observed in the group. Monitoring of ETT cuff pressure is important in intubated patients, specifically in patients undergoing laparoscopic surgeries in Trendelenburg Position. Endotracheal tube cuff pressure manometer a cheap, simple to use, handheld device which will help detect increased cuff pressure so that preventive measures can be carried out to reduce post-operative laryngotracheal morbidity associated with endotracheal intubation.

Limitation(s)

Randomisation and blinding could not be done in this study as the surgical procedures employed varied positioning which is very obvious for the investigator to be blinded. The lack of comparison with a control who undergoes open surgery under general anaesthesia to study the exact impact of pneumoperitoneum and raised intra thoracic pressures. The data obtained was subject to the accuracy of the measuring device.

CONCLUSION(S)

The present study shows that ETT cuff pressure increases during laparoscopic surgeries, particularly in the Trendelenburg position. The rise is greater compared to the Reverse Trendelenburg position and is associated with a higher incidence of early postoperative sore throat. No significant differences were observed in airway pressures or late postoperative complications. These findings emphasize the importance of intraoperative cuff pressure monitoring to reduce airway-related complications and improve patient safety.

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REFERENCES

[1] Khan RM. Airway management. New Delhi: Jaypee Brothers Medical Publishers; 2015.
[2] Black JJ, Skinner DV. Confirmation of correct endotracheal tube placement. J Accid Emerg Med. 2000;17(1):74-75. Doi: 10.1136/emj.17.1.74.
[3] Leonard IE, Cunningham AJ. Anaesthetic considerations for laparoscopic cholecystectomy. Best Pract Res Clin Anaesthesiol. 2002;16(1):1-20. Doi: 10.1053/bean.2002.0219.
[4] Rizzotti L. Respiratory system mechanics during laparoscopic cholecystectomy. Respir Med. 2002;96(4):268-74. Doi: 10.1053/rmed.2001.1258.
[5] American Thoracic Society, Infectious Diseases Society of America. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. Am J Respir Crit Care Med. 2005;171(4):388-416. Doi: 10.1164/rccm.200405-644ST.
[6] Lizy C, Swinnen W, Labeau S, Poelaert J, Vogelaers D, Vandewoude K. Cuff pressure of endotracheal tubes after changes in body position in critically ill patients treated with mechanical ventilation. Am J Crit Care. 2014;23(1):e1-e8. Doi: 10.4037/ajcc2014487.
[7] Streich B, Decillion F, Perney C, Duvaldestin P. Increased carbon dioxide absorption during retroperitoneal laparoscopy. Br J Anaesth. 2003;91(6):793-96. Doi: 10.1093/bja/aeg265.
[8] Sole ML, Su X, Talbert S, Penoyer DA, Kalita S, Jimenez E, et al. Evaluation of an intervention to maintain endotracheal tube cuff pressure within therapeutic range. Anesth Analg. 2011;113(3):593-99. Doi: 10.1213/ANE.0b013e318222f2b1.
[9] Fernandez R, Blanch L, Mancebo J, Bonsoms N, Artigas A. Endotracheal tube cuff pressure assessment: Pitfalls of finger estimation and need for objective measurement. Crit Care Med. 1990;18(12):1423-26. Doi: 10.1097/00003246-199012000-00009.
[10] Fahy BG, Barnas GM, Flowers JL. The effects of increased abdominal pressure on lung and chest wall mechanics during laparoscopic surgery. Anesth Analg. 1995;81:744-50.
[11] Yildirim ZB, Uzunkoy A, Cigdem A, Ganidagli S, Ozgonul A. Changes in cuff pressure of endotracheal tube during laparoscopic and open abdominal surgery. Surg Endosc. 2012;26(2):398-401. Doi: 10.1007/s00464-011-1891-0.
[12] Wu CY. Changes in endotracheal tube cuff pressure during laparoscopic surgery in head-up or head-down position. BMC Anesthesiol. 2014;14:75. Doi: 10.1186/1471-2253-14-75.
[13] Miller RD, Cohen NH, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Young WL, et al. Miller's anesthesia. 8th ed. Philadelphia: Elsevier; 2015.
[14] Sprung J, Whalley DG, Falcone T, Warner DO, Hubmayr RD, Hammel J. The impact of morbid obesity, pneumoperitoneum, and posture on respiratory system mechanics and oxygenation during laparoscopy. Anesth Analg. 2002;94:1345-50. Doi: 10.1097/00000539-200205000-00049.
[15] Mouret P. Laparoscopic surgery: The importance of patient positioning and ergonomics. Surg Endosc. 1993;7(5):404-07.
[16] Kwon Y, Jang JS, Hwang SM, Lee JJ, Hong SJ, Hong SJ, et al. The change of endotracheal tube cuff pressure during laparoscopic surgery. Open Med (Wars). 2019;14:431-36. Doi: 10.1515/med-2019-0047.
[17] Geng G, Hu J, Huang S. The effect of endotracheal tube cuff pressure changes during gynaecological laparoscopic surgery on postoperative sore throat: A control study. J Clin Monit Comput. 2015;29(1):141-47. Doi: 10.1007/s10877-014-9564-2.
[18] Gali B, Bakkum-Gamez JN, Plevak DJ, Schroeder D, Wilson TO, Jankowski CJ. Perioperative outcomes of robotic-assisted hysterectomy compared with open hysterectomy. Anesth Analg. 2018;126:127-33. Doi: 10.1213/ANE.0000000000002550.
[19] Seegobin RD, Van Hasselt GL. Endotracheal cuff pressure and tracheal mucosal blood flow: Endoscopic study of effects of four large volume cuffs. Br Med J. 1984;288:965-68. Doi: 10.1136/bmj.288.6422.965
[20] Liu J, Zhang X, Gong W, Li S, Wang F, Fu S, et al. Correlations between controlled endotracheal tube cuff pressure and postprocedural complications: A multicentre study. Anesth Analg. 2010;111(5):1133-37. Doi: 10.1213/ANE.0b013e3181f2ecc7
[21] Kako H, Goykhman A, Ramesh AS, Krishna SG, Tobias JD. Changes in intracuff pressure of a cuffed endotracheal tube during prolonged surgical procedures. Int J Pediatr Otorhinolaryngol. 2015;79:76-79. Doi: 10.1016/j.ijporl.2014.10.033.

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