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Anaesthesia

Changes in Endotracheal Tube Cuff Pressure during Laparoscopic assisted vaginal hysterectomy and Total abdominal hysterectomy.

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ABSTRACT Aim of this study was to evaluate endotracheal cuff pressure changes and incidence of postoperative sore throat during laparoscopic surgery in Trendelenburg position.

Thirty patients from 2 groups -Group L (Laparoscopic assisted vaginal hysterectomy) and Group O (Open abdominal hysterectomy) were given general anaesthesia. Endotracheal cuff pressure and Airway pressure was measured with Manometer after intubation, after Pneumoperitoneum and after giving position in group L then every 10 min till 1hr. The increase in Endotracheal cuff pressures [Group L 8.07 ± 2.96 & Group O 3.13 ± 2.4 cm of H2O] , Airway pressures [Group L 10.10 ±3.0 & Group O 8.10 ±3.16cm of H2O] were higher in Group L compared to Group O, ($p < 0.001$).

Conclusion: Pneumoperitoneum in Trendelenburg position increases ETT cuff pressure probably due to increase in airway pressure. Therefore it seems advisable to include routine monitoring of ETT cuff pressure.

KEYWORDS : Endotracheal cuff pressure, Laparoscopy, Hysterectomy.

Introduction:

Laryngotracheal complications are common after endotracheal intubation.[1]

Tracheal arterial capillary perfusion decreases when cuff exerts pressure greater than 30cm of H2O, causing tracheal ischemia.[3]

Aim of this study is to evaluate endotracheal cuff pressure changes and Airway pressure changes during laparoscopic surgery after pneumoperitoneum andchange in position (Trendelenburg)in laparoscopic assisted vaginal hysterectomy and total abdominal hysterectomy.

Now a days laparoscopic surgery is becoming popular as it is a minimal invasive surgery with multiple advantages.[4]

Laparoscopic surgery is performed under general Anesthesia with mechanical ventilation. Pneumoperitoneum is created.[5](IAP -10 to 12 mmHg)[14]

There are several significant respiratory system changes during laparoscopic surgery. Pneumoperitoneum andhead low position elevates intrathoracic pressurechanges pulmonary compliance and causes increase in airway pressure.[2,6]Sustained over inflation ofETT cuff increases risk of postoperative complications.[3,11,12,13]

Material and methods:

Study design: Hospital based double blind prospective randomized study.Clearance from institutional ethical committee

Total no of 60 cases undergoing laparoscopic assisted vaginal hysterectomy and open total abdominal hysterectomy surgery were selected.

Patient was divided into 2 groups:

Group L(Total Laparoscopic Vaginal Hysterectomy in Trendelenburg- Head Down position)

Group O (Open total abdominal hysterectomy in supine position)

Inclusion & exclusion criteria were as follows:

Inclusion criteria:

1. Age group 45 to 60
2. ASA grade I and II
3. BMI between 20 and 30 kg/m^2

Exclusion criteria:

1. Obesity BMI>30
2. Upper respiratory tract infection before surgery
3. COPD
4. Lung diseases
5. History of abnormal airway anatomy
6. Patients with tracheostomy

The patients were premedicated with i.v midazolam 0.15 mg /kg 30 min before the induction of anesthesia. Inj. Ondansetron 4mg and glycopyrrolate 0.2mg were given intravenously. Depending on the surgery and ongoing losses, Ringer Lactate solution was infused. After preoxygenation for 3 min, anesthesia was induced with propofol 2–2.5 mg/kg , fentanyl 1–2mcg /kg i.v. Neuromuscular block was achieved with Inj.Vecuronium 0.1 mg/kg iv. Endotracheal intubation was performed by an experienced anesthesiologist using an appropriately sized endotracheal tube with high volume and a low-pressure cuff when maximum neuromuscular blocking effect was achieved. The endotracheal tube cuff was inflated with air by sealing method using Aneroid manometer and cuff pressure was measured. The endotracheal cuff pressure was measured immediately after intubation, after creating Pneumoperitoneum, after change of position and then after every 10 min. Anesthesia was maintained with sevoflurane (1–2% MAC) and 66% air in oxygen. Additional boluses of fentanyl (1–2 mcg/kg) were administered to maintain surgical analgesia and Ventilation was controlled with a tidal volume of 10 ml/ kg and respiratory rate was adjusted to maintain an end-tidal carbon dioxide (ETCO2) value of between 35 and 45 mmHg.

All patients were monitored by electrocardiography (ECG), noninvasive blood pressure (BP), peripheral oxygen saturation (SpO2), end-tidal carbon dioxide (ETCO2) and during laparoscopic procedures, the abdominal pressure was maintained in between12-14 mm of Hg. At the end of surgery, the neuromuscular block was

reversed with neostigmine (0.05mg /kg) and glycopyrrolate 0.08 mg/kg. Mechanical ventilation was maintained until spontaneous respiration began. After complete reversal of neuromuscular block, cuff was deflated and endotracheal tube removed. The duration of surgery and anesthesia time was recorded. In Post-Anesthesia Care Unit (PACU) patients were observed for 24h after tracheal extubation, patients were asked about their laryngotracheal condition by an independent observer who was uninformed of the patient allocation groups. We investigated laryngotracheal complaints such as sore throat, dysphasia, and hoarseness. These symptoms were assessed using a visual analog scale (VAS; 0 = no discomfort and 10 = worst discomfort possible)

Statistical Analysis:

Considering standardized effect size of 0.75 and 80% power (β), the sample size for each group comes out as 30 each.

The data was entered in MS Excel and was analyzed using SPSS Version 20 and Epi info version 7.2. Levene's Test for Equality of Variances was used and equal variances were assumed within the groups. Independent sample test (Unpaired t test) was used to test equality of means. Post hoc analysis was done using Tuckey's test by considering 5% margin of error (α). P value of < 0.05 was considered as significant.

Results:

Endotracheal cuff pressures in Group L increased by 8.07 ± 2.96cm of H2O as against group O where cuff pressure increased by 3.13 ± 2.4 cm of H2O (p<0.001).Cuff pressure exceeded above 30cm of H2O in 40% patients in group L as against 10% against group O. The changes happened within 10 min of CO2 insufflation and Trendelenburg position which remained same thereafter till 1 hr.

Increase in Airway pressures was also high in Group L(10.10+_3.0 cm of H20) as compared with group O (8.10+_3.16 cmH2O) (p < 0.001). Incidence of postoperative sore throat was also high in group L.

Table 1 - Endotracheal cuff pressure:

Parameter	LAVH (n=30)		TAH (n=30)		t value	df	P value	p value	Statistical Association
	Mean	SD	Mean	SD					
Baseline CP	22.97	1.63	23.17	1.78	0.454	58	0.652	> 0.05	Not Significant
CP @ 10min	30.83	2.55	26.03	1.75	8.505	58	0	< 0.05	Significant
CP @ 20min	31.17	2.53	26.30	2.05	8.173	58	0	< 0.05	Significant
CP @ 30min	31.13	2.54	26.30	2.05	8.100	58	0	< 0.05	Significant
CP @ 40min	31.13	2.56	26.30	2.05	8.074	58	0	< 0.05	Significant
CP @ 50min	31.13	2.61	26.30	2.05	7.972	58	0	< 0.05	Significant
CP @ 60min	31.17	2.53	26.30	2.05	8.173	58	0	< 0.05	Significant
Difference in CP	8.07	1.48	3.13	1.2	14.178	58	0	< 0.05	Significant
CP(T2-T1)	5.47	1.36	2.87	1.14	8.042	58	0	< 0.05	Significant
CP(T3-T2)	2.73	0.98	0.27	0.58	11.844	58	0	< 0.05	Significant

***CP – cuff pressure**

Table 2 - Airway pressures:

Parameter	LAVH (n=30)		TAH (n=30)		t value	df	P value	p value	Statistical Association
	Mean	SD	Mean	SD					
Baseline AP	14.97	1.35	14.57	1.14	1.241	58	0.219	> 0.05	Not Significant
AP @ 10min	24.83	1.56	22.50	1.11	6.695	58	0	< 0.05	Significant
AP @ 20min	25.03	1.52	22.53	1.25	6.954	58	0	< 0.05	Significant
AP @ 30min	24.90	1.52	22.53	1.25	6.591	58	0	< 0.05	Significant
AP @ 40min	24.87	1.41	22.53	1.25	6.784	58	0	< 0.05	Significant
AP @ 50min	24.90	1.52	22.53	1.25	6.591	58	0	< 0.05	Significant
AP @60min	24.90	1.42	22.53	1.25	6.840	58	0	< 0.05	Significant
Difference in AP	10.10	1.5	8.10	1.58	5.033	58	0	< 0.05	Significant
AP(T2-T1)	6.20	1.63	7.93	1.46	4.342	58	0	< 0.05	Significant
AP(T3-T2)	3.87	1.224	.03	.718	14.791	58	0	< 0.05	Significant

***AP- airway pressure**

Figure 1 - Line Diagram showing Comparison of Cuff Pressure in 2 groups:

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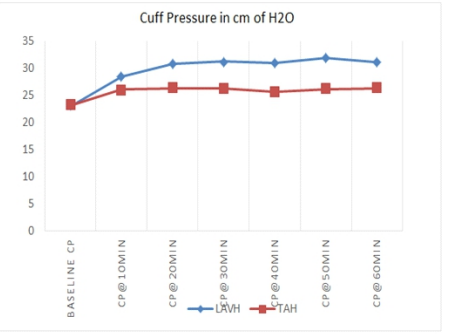

There was no significant difference observed in baseline cuff pressure in the two groups. The Cuff pressure was significantly higher in LAVH patients throughout the surgery. The difference between pressures after creating Pneumoperitoneum and baseline cuff pressure was statistically significant.

The baseline airway pressure readings were similar in both the groups. The airway pressure had risen significantly more in LAVH group as compared to the TAH group. The difference between maximum airway pressure and baseline airway pressure was statistically significant.

Figure 2 - Line Diagram showing Comparison of Airway Pressure in 2 groups

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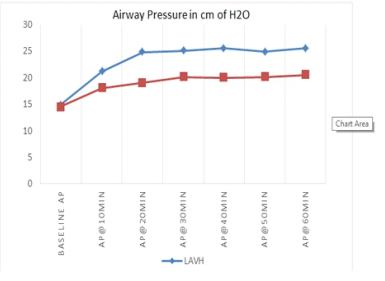
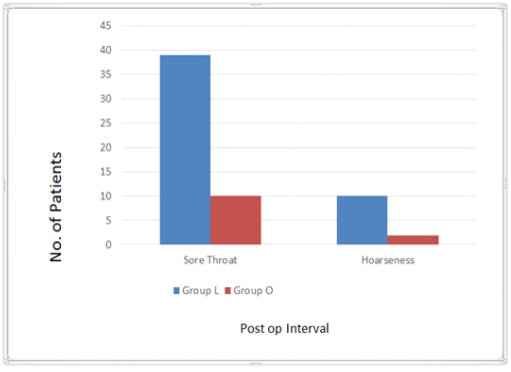


Table 3 - Post op Complications in LAVH Group:

Sr. No.	Complication	Duration	Presence of Post op Complication
1	Sore throat	After 6 Hrs	22 (40%)
		After 12 Hrs	14
		After 24 Hrs	3

2	Hoarseness	After 6 Hrs	16
		After 12 Hrs	7
		After 24 Hrs	4
3	Dysphagia	After 6 Hrs	12
		After 12 Hrs	9
		After 24 Hrs	5

Figure 3 – Postoperative Complications



The incidence of complications was maximum in initial 6 hours in post op period, which later reduced by 24 hours.

Discussion:

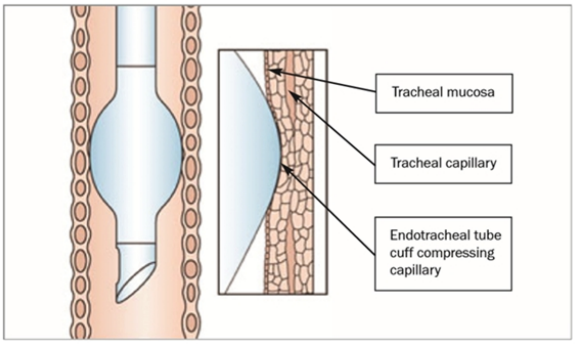
This study shows that the cuff pressure of the endotracheal tube progressively increased during pneumoperitoneum in the laparoscopy group (group L) in first 10 min. The increase in cuff pressure observed in present study can be explained by the increased intra-abdominal pressure (IAP) due to the carbon dioxide insufflation. It is known that the insufflation of CO2 into the abdomen during pneumoperitoneum affects the intrathoracic pressure by approaching the diaphragm upward [6]. Peak inspiratory pressure increases. It also can cause an increase in endotracheal tube cuff pressure during laparoscopic surgery. Some authors report that endotracheal tube movement as a result ofchanges in the position of the head and neck affect endotracheal tube cuff pressure.[7]

Brimacombe et al. concluded that the rotated position caused a greater increase in tracheal mucosal pressure [8]. In our study, when the patient was positioned at 30°Trendelenburg pressure significantly increased in the laparoscopy group in initial 20 min[2]. We did not use N2O to affect the results because this gas diffuses rapidly into the endotracheal tube cuff. Previous studies show this result.[9]

Armando Carlos et alobserved that there is significant variations in cuff pressure with change of position of head and concluded that changes in body position can cause significant cuff variations in patients under mechanical ventilation.[15]

We found that the incidence of postoperative sore throat was significantly high in group L. However, dysphasia and hoarseness were similar for the two groups. Sore throat is a common postoperative airway complication. After endotracheal intubation, the incidence of sore throat varied from 20 to 30%.[11, 12] Several causative factors have been reported for sore throat aftersurgery likeage, intubation condition, and the diameter of tracheal tube, cuff design, intra cuff pressure, and movement of the tracheal tube during surgery. We thought that high tracheal cuff pressure, which was related to pneumoperitoneum and head and neck position, was an important factor in the development of postoperative sore throat in the laparoscopy group. The sore throat after short-term intubation in the anesthetized patients studied was of moderate intensity and its incidence should be minimized by monitoring cuff pressure [1, 2]. Hence, we monitored the cuff pressure of all patients.

Figure 4 – Tracheal mucosal perfusion pressure changes



Conclusion:

Pneumoperitoneum in Trendelenburg position increases Endotracheal cuff pressure exceeding critical value of 30 cm of H2O in many cases. Therefore it seems advisable to include routine monitoring and readjustments in Endotracheal cuff pressure.

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