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 ± 3.16 cm 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. Tracheal arterial capillary perfusion decreases when cuff exerts pressure greater than 30 cm of H2O, causing tracheal ischemia. Now a day’s laparoscopic surgery is becoming popular as it is a minimal invasive surgery with multiple advantages.

Laparoscopic surgery is performed under general Anesthesia with mechanical ventilation. Pneumoperitoneum is created. There are several significant respiratory system changes during laparoscopic surgery. Pneumoperitoneum and head low position elevates intrathoracic pressure changes pulmonary compliance and causes increase in airway pressure. Sustained over inflation of ETT cuff increases risk of postoperative complications.

Material and methods:
Study design: Hospital based double blind prospective randomized study.Clearence 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/m²

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 1–2 mcg/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 between 12-14 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 groups. 

**Results:**
Endotracheal cuff pressures in Group L increased by 8.07 ± 2.96cm of H2O as compared with group O (8.10 ± 3.16 cmH2O) (p < 0.001). Cuff pressure exceeded above 30cm of H2O in 40% of H2O as against group O where cuff pressure increased by 3.13 ± 2.4 cmH2O (p<0.001). 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.

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.

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

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

**Table 1 - Endotracheal cuff pressure:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LAVH (n=30)</th>
<th>TAH (n=30)</th>
<th>t value</th>
<th>df</th>
<th>p value</th>
<th>p value</th>
<th>Statistical Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline CP</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>0.454</td>
<td>0.652</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>CP @ 10min</td>
<td>30.83</td>
<td>2.55</td>
<td>26.03</td>
<td>1.75</td>
<td>8.565</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>CP @ 20min</td>
<td>31.17</td>
<td>2.53</td>
<td>26.30</td>
<td>2.05</td>
<td>8.173</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>CP @ 30min</td>
<td>31.13</td>
<td>2.54</td>
<td>26.30</td>
<td>2.05</td>
<td>8.100</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>CP @ 40min</td>
<td>31.15</td>
<td>2.56</td>
<td>26.30</td>
<td>2.05</td>
<td>8.074</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>CP @ 50min</td>
<td>31.13</td>
<td>2.61</td>
<td>26.30</td>
<td>2.05</td>
<td>7.972</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>CP @ 60min</td>
<td>31.17</td>
<td>2.53</td>
<td>26.30</td>
<td>2.05</td>
<td>8.173</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>Difference in CP</td>
<td>8.07</td>
<td>1.48</td>
<td>3.13</td>
<td>1.2</td>
<td>14.17</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>CP(T2-T1)</td>
<td>5.47</td>
<td>1.36</td>
<td>2.87</td>
<td>1.14</td>
<td>8.042</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>CP(T3-T2)</td>
<td>2.73</td>
<td>0.98</td>
<td>0.27</td>
<td>0.58</td>
<td>11.84</td>
<td>58</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 2 - Airway pressures:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LAVH (n=30)</th>
<th>TAH (n=30)</th>
<th>t value</th>
<th>df</th>
<th>p value</th>
<th>p value</th>
<th>Statistical Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline AP</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>1.241</td>
<td>0.219</td>
<td>&gt; 0.05</td>
</tr>
</tbody>
</table>

**Table 3 - Post op Complications in LAVH Group:**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Complication</th>
<th>Duration</th>
<th>Presence of Post op Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sore throat</td>
<td>After 6 Hrs</td>
<td>22 (40%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After 12 Hrs</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After 24 Hrs</td>
<td>3</td>
</tr>
</tbody>
</table>
Figure 4 – Tracheal mucosal perfusion pressure changes

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. 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 of changes in the position of the head and neck affect endotracheal tube cuff pressure. ²

Brimacombe et al. concluded that the rotated position caused a greater increase in tracheal mucosal pressure. ³ In our study, when the patient was positioned at 30° Trendelenburg pressure significantly increased in the laparoscopy group in initial 20 min. ³ We did not use N₂O to affect the results because this gas diffuses rapidly into the endotracheal tube cuff. Previous studies show this result. ³

Armando Carlos et al observed 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. ⁴

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%. ⁵, ⁶ Several causative factors have been reported for sore throat after surgery, 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.

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.

References

Figure 3 – Postoperative Complications

Table 1 - Postoperative Complications

<table>
<thead>
<tr>
<th>Condition</th>
<th>Group L</th>
<th>Group D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoarseness</td>
<td>After 6 Hrs 16</td>
<td>After 12 Hrs 7</td>
</tr>
<tr>
<td></td>
<td>After 24 Hrs 4</td>
<td>After 6 Hrs 12</td>
</tr>
<tr>
<td></td>
<td>After 12 Hrs 9</td>
<td>After 24 Hrs 5</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>After 6 Hrs 16</td>
<td>After 12 Hrs 7</td>
</tr>
<tr>
<td></td>
<td>After 24 Hrs 4</td>
<td>After 6 Hrs 12</td>
</tr>
<tr>
<td></td>
<td>After 12 Hrs 9</td>
<td>After 24 Hrs 5</td>
</tr>
</tbody>
</table>

Figure 4 – Tracheal mucosal perfusion pressure changes

INDIAN JOURNAL OF APPLIED RESEARCH 257