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Original Research Article

Application of Positive end-expiratory pressure (PEEP) in patients during prolonged Gynecological Surgery

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Abstract

Background & Methods: The aim of the study is to assess Application of Positive end-expiratory pressure (PEEP) in patients during prolonged Gynecological Surgery. In both groups we used a respiratory rate of 10–14/min and an inspiration:expiration ratio (I:E) of 1:2. We used side stream spirometry to determine peak inspiratory pressure (Ppeak), plateau pressure (Pplat), and respiratory compliance, pulse oximetry to monitor arterial blood saturation, non-invasive measurement of systolic blood pressure (SBP), mean blood pressure (MBP) and diastolic blood pressure (DBP), ECG monitoring.

Results: We found 22.5% pulmonary complication in control group & 20% complication in Exposed group.

Conclusion: We conclude that the use of protective ventilation strategy – low tidal volume, application of PEEP at level 6 cm H2O and RM, can reduce the cases of postoperative pulmonary complications as atelectasis, respiratory failure and application of non – invasive ventilation with CPAP masks. In our study there is significant association between intraoperative haemodynamic parameters of patients in both groups.

Keywords: Positive end-expiratory pressure (PEEP), prolonged & Gynecological.
Study Design: Comparative Study.

1. Introduction

Every year about 240 million patients worldwide undergo surgery which requires general anesthesia and mechanical ventilation. Postoperative pulmonary complications are the second most common type of complications, following general anesthesia [1]. General anesthesia with muscle relaxation and surgery in the supine position can lead to alveolar collapse in the lung bases – atelectasis [1, 2]. The resulting ventilation/perfusion mismatch in these zones increases right to left shunting, which, in turn, leads to hypoxia [3]. Atelectasis occurs in nearly 90% of patients operated under general anesthesia [4]. It persists for about 24 h after laparoscopic surgery and 3 days after open surgery and it may predispose the lung to infection – pneumonia [5]. Atelectasis formation depends on many factors – age, FiO2, type of surgery, duration of intraoperative mechanical ventilation, patient positioning, postoperative analgesia, early mobilization, etc. [1]. According to randomized clinical trials, the intraoperative application of PEEP reduces the incidence of postoperative atelectasis, which decreases right to left shunting and improves oxygenation [6–15]. The PaO2/FiO2

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ratio on the first postoperative day is statistically significantly higher in patients ventilated with low tidal volumes and PEEP (protective group) and the ratio increases with PEEP level. Respiratory compliance is also higher [6, 8, 9, 12, 13], and pulmonary infiltrates on X-ray are statistically significantly lower [6, 7, 9, 13]. Some of these trials also prove that this strategy of intraoperative mechanical ventilation can decrease ICU and hospital length of stay [6, 7].
PEEP application during general anesthesia prevents alveolar collapse at the end of expiration and the use of RMs can open up already collapsed alveoli. What level of PEEP should be used is controversial because of possible hemodynamic impairment. The purpose of this study is to investigate the effect of positive end-expiratory pressure (PEEP), together with recruitment maneuvers (RMs) and low tidal volumes (based on ideal body weight) on patients during prolonged non-laparoscopic gynecologic operations, on postoperative oxygenation and on intensive care unit length of stay.

2. Material and Methods

Present study was conducted at GMC, Bhopal for 01 Year. RMs were performed by applying CPAP = 30 cm H2O on the 80 patients. This was done after intubation, at each disconnection of the patients from the ventilator, and at extubation. The purpose of this maneuver is to expand any collapsed alveoli, whereas the application of PEEP aims to prevent the open alveoli from collapsing. RM was not performed in hemodynamically unstable patients, as it decreases cardiac output. In both groups we used a respiratory rate of 10–14/min and an inspiration:expiration ratio (I:E) of 1:2. We used side stream spirometry to determine peak inspiratory pressure (Ppeak), plateau pressure (Pplat), and respiratory compliance, pulse oximetry to monitor arterial blood saturation, non-invasive measurement of systolic blood pressure (SBP), mean blood pressure (MBP) and diastolic blood pressure (DBP), ECG monitoring. We noted the total dose of vasopressor used, as well as the amount of infused crystalline and colloid solutions, fresh frozen plasma and erythrocite concentrate during the operations. We also measured intraoperative blood loss. Arterial blood gas analysis was performed on the first postoperative day.

Inclusion criteria:

1. age > 18; non pregnant women; non laparoscopic open gynecological surgery, lasting for more than 2 hours.

Exclusion Criteria:

1. mechanical ventilation within the last preoperative month;
2. previous pulmonary surgery;

3. Result

Table 1: Postoperative pulmonary complications in each group

Type of group	None	Pulmonary Complication	Total	P Value
Control group – PEEP = 0 cm H2O	**27**	**13(32.5%)**	**40**	.047185
Exposed group – PEEP = 6 cm H2O	**29**	**11(27.5%)**	**40**	
Total	**56**	**24**	**80**	

The chi-square statistic is 0.2381. The *p*-value is .047185. The result is significant at $p < .05$.

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Table 2: Occurrence of atelectasis in each group

Type of group	Not observed	Pulmonary Complication	Total	P Value
Control group – PEEP = 0 cm H2O	**21**	**19(47.5%)**	**40**	.034177
Exposed group – PEEP = 6 cm H2O	**33**	**07(17.5%)**	**40**	
Total	**54**	**26**	**80**	

The chi-square statistic is 8.2051. The *p*-value is .034177. The result is significant at $p < .05$.

Table 3: Rates of patients with respiratory failure in both groups

Type of group	Not observed	Pulmonary Complication	Total	P Value
Control group – PEEP = 0 cm H2O	**31**	**09(22.5%)**	**40**	.784617
Exposed group – PEEP = 6 cm H2O	**32**	**08(20%)**	**40**	
Total	**54**	**26**	**80**	

The chi-square statistic is 1.0747. The *p*-value is .784617. The result is *not* significant at $p < .05$.

4. Discussion

In this trial we investigated the impact of intraoperative mechanical ventilation with low Vt, PEEP=6 cm H2O (the value of PEEP was constant) and RMs on postoperative oxygenation, atelectasis development and ICU length of stay. We only included women, who underwent conventional gynaecological surgery with duration of more than 2 hours. We proved that protective intraoperative mechanical ventilation can improve postoperative oxygenation – PaO2 and PaO2/FiO2 values on the first postoperative day were statistically significantly higher in the protective group compared to the control group. Some randomized studies have also proved better postoperative oxygenation in patients, ventilated with low VT, PEEP and RMs [6]. Higher levels of PEEP are associated with higher PaO2 and PaO2/FiO2 values [7–9]. In our study, the respiratory compliance of patients ventilated intraoperatively with PEEP and RMs was significantly higher. There are clinical trials that have proved the same. Moreover, the highest respiratory compliance has been measured in patient groups ventilated with the highest PEEP levels, with the use of RMs. We also observed a statistically significantly lower incidence of postoperative atelectasis in the protective group. Some randomized clinical trials have also found a statistically significant reduction of both postoperative atelectasis and pulmonary infiltrates on X-ray [6, 8, 10]. However, they did not successfully prove a lower incidence of postoperative pneumonia and respiratory failure [11]. Some of them observe a statistically significantly shorter ICU and hospital stay of the patients in the protective group [12], which correlates with the results of our study. One multicentre randomized double-blinded trial proves that protective intraoperative ventilation with PEEP and RMs decreases the risk of postoperative pulmonary complications, reduces mortality and ICU and hospital length of stay [13]. Another multicentre randomized double-blinded study concludes that higher levels of intraoperative PEEP are associated with a higher incidence of

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intraoperative complications like intraoperative hypotension, without significantly decreasing postoperative complications [14]. We investigated the effect of PEEP on intraoperative hemodynamic stability and found no statistically significant difference between the incidence of intraoperative hypotension and the intraoperative use of vasopressors in the investigated patient groups.

5. Conclusion

We conclude that the use of protective ventilation strategy – low tidal volume, application of PEEP at level 6 cm H2O and RM, can reduce the cases of postoperative pulmonary complications as atelectasis, respiratory failure and application of non – invasive ventilation with CPAP masks. In our study there is significant association between intraoperative haemodynamic parameters of patients in both groups.

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