Original Research Paper

Volume-9 | Issue-9 | September - 2019 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Anaesthesiology

EFFECT OF PRE- EMPTIVE ALVEOLAR RECRUITMENT STRATEGY BEFORE PNEUMORERITONEUM ON ARTERIAL OXYGENATION DURING LAPAROSCOPIC SURGERIES

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ABSTRACT The physiological changes during laprascopic surgeries causes decreases compliance of lung and arterial oxygenation. This atelectasis produced by pneumoperitoneum can be overcome by Alveolar recruitment strategy(ARS) and PEEP. To avoid additional increase in airway pressure during pneumoperitoneum, ARS and PEEP were applied before pneumoperitoneum. After intubation, 50 patients were randomly allocated to receive either tidal volume 10 ml/kg with no positive end-expiratory pressure (group C) or alveolar recruitment strategy of 10 breaths with peak inspiratory pressure (PIP) 40 cmH20 plus positive end-expiratory pressure (PEEP) 15 cmH20 before gas insufflation (group P). During pneumoperitoneum, group P was ventilated with the same setting as group C (FiO2=0.35, tidal volume 10 ml/kg). Pa02 measured during peumoperitoneum was higher in group P than in group C (210.4mmHg vs 144.84mmHg at 15 minutes, P0.001 170.6 mmHg vs 135.44mmHg at 30 minutes, P- 0.001).

KEYWORDS : Pneumoperitoneum, Alveolar Recruitment Strategy, Laprascopic Surgery

AIM

The objective was to find whether pre-emptive Alveolar recruitment strategy before pneumoperitoneum improves arterial oxygenation during laparoscopic surgeries

EFFECT OF PEEP IN LAPROSCOPIC SURGERIES

Positive-pressure ventilation during general anaesthesia is a prerequisite for numerous surgical conditions. Mechanical ventilation is non-physiological and can induce lung injury, although ventilator-induced lung injury may be of minor clinical importance during anaesthesia for most patients with healthy lungs. However, growing evidence suggests that lung injury can be initiated by mechanical ventilation with a low tidal volume as well as with a high tidal volume in animal models of healthy lungs . These recent data suggest that ventilation strategies to minimize lung improve oxygenation and can reduce lung injury during general anaesthesia. Increase in shunt and low ventilation to perfusion after the induction of general anaesthesia are due to alterations in the shape and dimension of the thoracic cage, which result in reductions in the functional residual capacity (FRC) and pulmonary compliance and an increase in airway resistance. The cephalad movement and reduced activity of the diaphragm in the supine position promote the formation of compression atelectasis in the dependent portion of the lung. In addition, the decreased lung volume increases the ratio of the closing capacity to FRC during general anaesthesia, which may increase cyclic alveolar closure and reopening during mechanical ventilation. In particular, the increase in abdominal pressure caused by pneumoperitoneum and the head-down body position during laparoscopic surgery causes an additional cranial shift in the end-expiratory position of the diaphragm and enhances airway closure and atelectasis formation in the dependent lung regions . The application of PEEP is believed to preserve lung structures and decrease cyclic closure and reopening of alveoli although there is insufficient evidence regarding whether intraoperative PEEP improves postoperative mortality and respiratory complications A previous study found that application of a constant PEEP of 5 cmH20 improves arterial oxygenation compared with zero end-expiratory pressure during endoscopic robot-assisted radical prostatectomy. Lee et al, also suggested use of different levels of PEEP and that the application of a PEEP of 7 cmH20 improved arterial oxygenation without excessive peak airway pressure or depression of hemodynamic parameters during endoscopic robot-assisted radical prostatectomy. These results should be interpreted carefully in terms of the application of PEEP in overall laparoscopic surgery because various factors, such as body position during laparoscopic surgery and obesity, may affect respiratory function and arterial oxygenation. Previous studies have shown that pneumoperitoneum could increase arterial oxygen tension despite an increase in atelectasis and a PEEP of 10 cmH20 alone did not improve end-expiratory lung volume or oxygenation during laparoscopic surgery requiring the reverse Trendelenburg position . PEEP alone did not reduce atelectasis or improve oxygenation in morbidly obese patient

MATERIALS AND METHODS

The institutional ethical committee approval for the study was obtained . the informed written consent was obtained from the patient participating in the study was obtained

1. DESIGN OF STUDY : RANDOMISED CONTROLLED
2. SINGLE BLIND TRIAL
3. COLLABORATING DEPARTMENT : GENERAL SURGERY
4. SELECTION OF STUDY SUBJECTS: CASES POSTED FOR LAPAROSCOPIC SURGERIES.
5. DATA COLLECTION : DATA REGARDING HISTORY, CLINICAL EXAMINATION,RADIOLOGICAL EXAMINATION
6. CONSENT : INDIVIDUAL WRITTEN AND INFORMED CONSENT.
7. ANALYSIS : STATISTICAL ANALYSIS
8. CONFLICT OF INTEREST : NIL
9. FINANCIAL SUPPORT : NIL
10. PARTICIPANTS : PATIENTS POSTED FOR LAPAROSCOPIC SURGERIES
11. INCLUSION CRITERIA:

a. Elective laparoscopic surgeries Both sexes Age :20-60
b. years ASA I & II

12. EXCLUSION CRITERIA:

a. Patients with pre-existing lung and cardiac illness
b. Patients who are obese

13. Patients with history of bleeding disorders or patients on
14. anticoagulant therapy Patient's refusal
15. Patients with known allergy to anaesthetic drugs
16. Psychiatric illness Patient with heart disease
17. METHODOLOGY
18. GENERAL ANAESTHESIA
19. Patient including both groups are premedicated with injection glycopyrolate 0.2mg and injection fentanyl 2mic/kg and induced with propofol 2mg/kg and paralysed with injection atracurium(0.5mg/kg).After adequate relaxation patient was intubated with adequate sized cuffed endotracheal tube and maintained with titrated dose of injection atracurium(0.1mg/kg).
20. After intubation, 50 patients were randomly allocated to receive either tidal volume 10 ml/kg with no positive end-expiratory pressure (group C) or alveolar recruitment strategy of 10 manual breaths with peak inspiratory pressure of 40 cmH20 plus positive end-expiratory pressure of 15 cmH20 before gas insufflation (group P). During pneumoperitoneum, group P was ventilated with the same setting as group C (FiO2=0.35, tidal volume 10 ml/kg)
15. PARAMETERS TO BE MONITORED:
    The following parameters are assessed:

a. pH, Pa02, PaC02
b. Pa02/Fi02(P/F ratio)
C. measured plateau inspiratory pressure (PPL), expiratory

VT, mean airway pressure (mPaw) and peak inspiratory pressure (PIP).

d. Dynamic compliance of the respiratory system (CDYN) was calculated, CDYN(ml/cmH20)=VT/(PIP-PEEP)
e. static compliance was obtained with the formula C ST AT (ml/cmH20)=VT/(PPL-PEEP)
f. MAP - mean arterial pressure

STATISTICAL TOOLS TO BE APPLIED:

Repeated measures of analysis of variance can be performed to evaluate the time-by-ARS treatment interaction effect (baseline, 15 and 30 minutes after pneumoperitoneum). If there was significant difference between groups, the Mann-Whitney rank sum test can be performed for the difference between groups at each time point. P <0.05 was considered statistically significant. Mean, standard deviation percentages, student's J-test and the Fisher's exact test are used for statistical comparisons. P < 0.05 was considered significant

Table 1: Comparison of PaO2

Pa02	GROUPC	GROUPP				
	MEAN	SD	MEAN	SD	P	Significance
BEFORE PP	145.16	8.877	240.6	28.333	<0.001	Significant
"15 MIN AFTER PP	144.84	9.072	210.4	30.786	<0.001	Significant
'30 MIN AFTER PP	135.44	8.865	170.6	17.037	<0.001	Significant

Table 2: Comaprison of PaCO2

PaC02	GROUPC		GROUP P			
	MEAN	SD	MEAN	SD	P	Significance
BEFORE PP	34.96	2.746	35.6	3.082	0.442	Not significant
15 MIN AFTER PP	36.08	2.798	37.32	2.529	0.107	Not significant
30 MIN AFTER PP-	38.04	2.263	37.28	2.638	0.28	Not significant

Table 3: Comparison of Static compliance

STATIC COMPLIANCE	GROUPC		GROUPP			
	MEAN	SD	MEAN	SD	P value	Significance
BEFORE PP	57.76	5.77	61.2	8.7	0.106	Not significant
15 MIN AFTER PP	29.4	2.08	32.44	4.04	0.002	Significant
30 MIN AFTER PP	28.48	3.14	31.16	5.59	0.042	Significant

Table 4: Comparison of PaO2/ Fio2

Pa02 / Fi02	GROUPC		GROUP P			
	MEAN	SD	MEAN	SD	P value	Significance
BEFORE PP	414.743	25.364	687.429	80.951	<0.001	Significant
15 MIN AFTER PP	413.829	25.921	601.143	87.959	<0.001	Significant
30 MIN AFTER PP	386.971	25.329	487.429	48.676	<0.001	Significant

DISCUSSION

In this study the effect of an ARS before gas insufflation during laparoscopic surgery improved oxygenation, without an increase of airway pressure, patients undergoing laparoscopy surgeries are predisposed to decrease in arterial oxygenation because of basal atelectasis, reduced functional residual capacity induced by general anaesthesia, mechanical ventilation and surgical positioning. Takahata et al observed the decrease in Pa02 during pneumoperitoneum, even in young patients. It has been reported that a longer duration of intraperitoneal gas insufflation decreases Pa02 . Healthy subjects in our study had a similar result and Pa02 decreased mildly after 30 minutes with pneumopertoneum. It has been known that alveolar recruitment with PEEP during general anaesthesia is effective in improving arterial oxygenation. Alveolar recruitment therapy produces re-expansion of atelectasis occurring due to general anaesthesia and PEEP prevents the redevelopment of atelectasis. Pang et al reported that an ARS applied during laparoscopic cholecystectomy improved arterial oxygenation compared with conventional ventilation. Whalen et al applied an alveolar recruitment manoeuvre using 12 cmH20 PEEP in morbidly obese patients and found that this ARS was very effective in improving intraoperative oxygenation. However, due to the ARS, the peak airway pressure rose to 42 cmH20 during laparoscopy, even in the supine position. Higher peak and mean airway pressures presumably caused the hypotension requiring treatment noted in that study, with patients receiving the ARS needing more vasopressor. High airway pressure and PEEP are also reported as risk factors for lung barotrauma, especially among patients with lung disease. In our study, the ARS was conducted only before C02 insufflation and no PEEP was applied during pneumoperitoneum, even though PEEP during surgery is an effective method of improving oxygenation. The main advantage of ARS before C02 insufflation over intraoperative ARS appears to be avoidance of further increase in airway pressure, which could increase the risk of ventilator induced lung injury and haemodynamic compromise. We postulated that anaesthesia-induced alveolar collapse could be fully reversed before C02 insufflation, such that the beneficial effect would be long-lasting despite the detrimental effects of pneumoperitoneum . We found that ARS before C02 insufflation kept arterial oxygenation higher during pneumoperitoneum without additional airway pressure increases or haemodynamic compromise. This study had some limitations. First, the between-group Pa02 after 45 minutes of pneumoperitoneum could not be compared, because only 4 patients remained at this time. The risk of hypoxaemia becomes greater when the duration of pneumoperitoneum is longer6,7. Even though the mean value of Pa02 at 45 minutes in group P was higher than that of group C (149 mmHg vs 127 mmHg), this was not significant and statistical power was low. Rothen et al used computed tomography to assess the extent of atelatasis, which recurred after recruitment manoeuvres. They observed that a recruitment manoeuvre with 40% oxygen in nitrogen virtually eliminated atelectasis for at least 40 minutes, so the preventive effect of ARS before pneumoperitoneum may persist in surgery of longer duration, such as laparoscopic colectomy. Second, the effect of ARS during pneumoperitoneum may be more important and more pronounced in the elderly, obese and those with impaired respiratory function.

CONCLUSION

In conclusion, pre-emptive ARS before gas insufflation may be useful in improving arterial oxygenation without additional increase in airway pressure in laparoscopic surgeries.

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