(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 6, Issue 1 , Page No: 429-438
January-February 2023

IJMSCR

Study On Effects Of Hyper Ventilation In Laparoscopic Surgeries On Haemodynamics, Partial Pressure Of Carbondioxide And Acid Base Status

[1]Dr. Gomathi Karmegam, [2]Dr. S. Mahalakshmi
[1,2]Associate Professor In Anesthesiology,
Department Of Emergency Medicine, Madras Medical College, Rajiv Gandhi
[1] Government General Hospital, Chennai, Tamil Nadu, India
[2]Government Medical College, Omandurar Estate, Chennai, Tamil Nadu, India

***Corresponding Author:**
Dr. S. Mahalakshmi
Associate Professor In Anesthesiology, Department Of Emergency Medicine,
Government Medical College, Omandurar Estate, Chennai, Tamil Nadu, India

Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Introduction: Surgical procedures have been improved to reduce trauma to the patient morbidity, mortality and hospital stay with consequent reductions in health care costs. Nowadays laparoscopy is used in colonic, gastric, splenic, hepatic and urologic surgeries. Although laparoscopic surgeries are minimally invasive, uptake of C02 from the pressurized pneumo peritoneum can cause clinically relevant hypercarbia and respiratory acidosis with physiological consequences. Hypercarbia and acidosis occurs due to absorption via huge peritoneal cavity, decreased lung compliance and insufficient ventilation. C02 is 20 times more soluble/diffusible than oxygen which is insufflated in pressurized form (10-15 mmHg). If duration of surgery is prolonged, systemic absorption of C02 will be more and it requires aggressive hyperventilation. The pneumoperitoneum and the patient positions required for laparoscopy induce pathophysiologic changes that complicate anaesthetic management.

Aim Of The Study: The aim of the study is to compare the effects of hyperventilation with three different respiratory rates and tidal volume of 10 ml /kg on haemodynamics like mean arterial pressure, pulse rate and partial pressure of carbon dioxide and acid base status in laparoscopic cholecystectomy.

Materials And Methods: It was a prospective, study conducted in the Department of Anaesthesiology, Madras Medical College in the year 2019-2020 Ninety patients of ASA physical status 1 undergoing elective laparoscopic cholecystectomy lasting a minimum of 45 minutes. Patients belonging to the age group of 20 – 60 years of both sexes It is a prospective randomized study. Ninety patients of both sexes undergoing laparoscopic cholecystectomy were randomly allocated into three groups . Group 1 – ventilated with rate of 12 /min and tidal volume of 10 ml/kg. Group 2- ventilated with rate of 14 /min and tidal volume of 10 ml/kg. Group 3 – ventilated with rate of 16/min and tidal volume of 10ml/kg.

Results : There was no significant difference in mean arterial pressure before creation of pneumo peritoneum in all the three groups .(p value 0.067). pH did not show any significant difference between the study and control groups before creation of pneumo peritoneum.(p value 0.073). PaCO2 values measured before pneumoperitoneum showed a higher value in group 1 whereas it was in lower normal range in groups 2 and 3. The values are 34.92 mm of Hg and 33.13 mm of Hg respectively. It was statistically significant and the p value is 0.000. Measurements showed a significantly higher value of 33.5 mm of Hg in group 1 . (p value 0.000). Group 2 had a significantly higher value than the group 3and the p value is 0.001.Bicarbonate levels measured before pneumoperitoneum did not show any significant difference among the three groups and the p value was 0.372.Pre pneumoperitoneum values showed no significant difference among the groups and the p value is

0.143.During pneumoperitoneum there was no significant change in the pulse rate in all the 3groups.After deflation the values showed significant increase in the study groups than the control group and the p value was 0.000. But this was not clinically significant.Prepneumoperitoneum values did not differ significantly between the groups and the p value was 0.976. During pneumoperitoneum the groups 2 and 3 showed a significantly higher values than the group 1 and the p value was 0.000.

Conclusion: Carbon dioxide output increases during laparoscopic surgeries and increasing the minute ventilation by increasing the respiratory rate from 12 per minute to 14 per minute in laparoscopic surgeries produces a significant decrease in Partial pressure of carbon dioxide, End tidal carbon dioxide and pH towards the high normal range levels. When the rate was increased to 16 per minute the same changes were observed but this was not statistically significant from patients ventilated with a rate of 14 per minute. There was no significant difference in the bicarbonate values. There was no significant difference in between the groups in the mean arterial blood pressure. But the heart rate was significantly higher in the control group than the study groups during pneumoperitoneum.

Keywords: hyper ventilation, Laparoscopic Surgeries ,Haemodynamics , partial pressure, Carbondioxide,Acid base status.

Introduction

Surgical procedures have been improved to reduce trauma to the patient morbidity, mortality and hospital stay with consequent reductions in health care costs.Laparoscopy for clinical purposes was first performed by Jacobaeus in 1910, and, following advances in optical and lighting systems and the work of Steptoe (1965, 1969) [1] The provision of better equipment and facilities along with increased knowledge and understanding of anatomy and pathology, has allowed the development of endoscopy for diagnostic and operative procedures.[2] In early 1970s, various pathologic gynecologic conditions were diagnosed and treated using laparoscopy. This endoscopic approach was extended to cholecystectomy in late 1980s. Nowadays laparoscopy is used in colonic, gastric, splenic, hepatic and urologic surgeries.[3] Although laparoscopic surgeries are minimally invasive, uptake of C02 from the pressurized pneumo peritoneum can cause clinically relevant hypercarbia and respiratory acidosis with physiological consequences. Hypercarbia and acidosis occurs due to absorption via huge peritoneal cavity, decreased lung compliance and insufficient ventilation C02 is 20 times more soluble/diffusible than oxygen which is insufflated in pressurized form (10-15 mmHg).[4] If duration of surgery is prolonged, systemic absorption of C02 will be more and it requires aggressive hyperventilation.The pneumoperitoneum and the patient positions required for laparoscopy induce pathophysiologic changes that complicate anaesthetic management.[5]In this study I am studying the effects of hyperventilation on haemodynamics, partial pressure of carbon dioxide and acid base status in laparoscopic cholecystectomy.[6]

Materials And Methods: It was a prospective, study conducted in the Department of Anaesthesiology, Madras Medical College in the year 2019-2020 Ninety patients of ASA physical status 1 undergoing elective laparoscopic cholecystectomy lasting a minimum of 45 minutes. Patients belonging to the age group of 20 – 60 years of both sexes It is a prospective randomized study. Ninety patients of both sexes undergoing laparoscopic cholecystectomy were randomly allocated into three groups . Group 1 – ventilated with rate of 12 /min and tidal volume of 10 ml/kg. Group 2- ventilated with rate of 14 /min and tidal volume of 10 ml/kg. Group 3 – ventilated with rate of 16/min and tidal volume of 10ml/kg. Inclusion Criteria: ASA physical status I.Patients undergoing laparoscopic cholecystectomy lasting more than 45 minutes.Exclusion Criteria:Patients suffering from any respiratory diseases (bronchial asthma, chronic bronchitis, emphysema and respiratory failure) Congestive cardiac failure Renal failure.Ninety patients of both sexes undergoing laparoscopic cholecystectomy were randomly allocated into three groups .Group 1 – ventilated with rate of 12 /min and tidal volume of 10 ml/kg,Group

2- ventilated with rate of 14 /min and tidal volume of 10 ml/kg,Group 3 – ventilated with rate of 16/min and tidal volume of 10ml/kg.Patients were advised overnight fasting.All patients were given T. Ranitidine 150 mg , T.Diazepam5mg on the previous night of surgery and on the morning of surgery .All the patients were pre medicated with Inj. Glycopyrrolate 10mics/ kg IM 45 minutes before surgery.After shifting to the theatre right cephalic vein was cannulated with 18 G IV cannula and Ringer Lactate was started.After attaching the monitors for electro cardiogram ,oxygen saturation and non invasive blood pressure basal parameters were recorded.Patients were given Inj. Fentanyl 2 micg /kg for analgesia and induced with Inj. Propofol 2 mg /kg and paralysed with Inj.Succinyl choline 1.5mg/kg.After adequate relaxation intubated with appropriate size endotracheal tubes and connected to DRAGER-FABIUS ventilator with the tidal volume of 10 ml/kg and ventilator rates as assigned to the patient. Maintained with N2O and O2 at 3 and1.5 litres per minute. And Isoflurane of o.4 to o.6%.Patient's left radial artery was cannulated with 20 G IV cannula and connected to a three way adaptor and flushed with heparin saline to maintain the patency. An arterial sample was collected and sent for analysis.Arterial Blood Gas analysis was sent 30 min after pneumoperitoneum and after exsufflation of CO_2.Throughout surgery intra abdominal pressure was maintained at 12 cm H_2O.Mean arterial pressure, Peak Inspiratory pressure, Heart rate, $EtCO_2$ were measured baseline and every 15 minutes thereafter. Increase in Mean arterial pressure of more than 20% controlled with Isoflurane. After the surgery is over and adequate respiratory attempts the patient was reversed with Inj. Neostigmine 50 micg /kg and Inj. Glycopyrrolate 10 micg/Kg dose . After the return of adequate muscle power and return of reflexes the patient was extubated after adequate oral suction.

Stastical Analysis : The sample of 90 patients was taken for the study .Data was expressed as mean +_SD or absolute values .Qualitative analysis was compared with **ANOVA TEST.**The level of statistical significance was set at p <0.05% .The patient in each group was statistically comparable in distribution of age, weight and sex distribution.

Results

Table 1:Comparison Of Age Group

	N	MEAN (yrs)	SD
GROUP			
1	30	38.6	14.58
2	30	35.6	12.7
3	30	39.3	12.67
TOTAL	90	37.8	13.29
		P VALUE 0.527	
		NOT SIGNIFICANT	

Volume 6, Issue 1; January-February 2023; Page No 429-438

Table :2 Comparison Of Anesthesia Duration

Group	N	Mean (min)	SD
1	30	88.86	18.04
2	30	80.6	12.05
3	30	86.56	14.13
Total	90	85.34	15.19

Table: 3 Comparison Of Surgery Duration

Group	N	Mean (min)	SD
1	30	65.96	11.19
2	30	62.83	7.17
3	30	65.9	9.14
Total	90	64.9	9.32

Table: 4 Comparison Of Mean Arterial Pressure Pre Pneumo Peritoneum

Group	N	Mean(mm Hg)	SD
1	30	84.6	9.74
2	30	86.7	8.85
3	30	83.63	8.92
Total	90	84.3	8.82

Table: 5 Comparison Of Mean Arterial Pressure During Pneumo Peritoneum

Group	N	Mean(mm Hg)	SD
1	30	114.13	16.57
2	30	110.2	8.03
3	30	112.63	9.42
Total	90	102.6	10.68

Table:6 Comparison Of Mean Arterial Pressure During Post Pneumoperitoneum

Group	N	Mean (mm Hg)	SD
1	30	90.05	11.34
2	30	88.96	6.81
3	30	89.23	7.8
Total	90	89.3	8.76

Volume 6, Issue 1; January-February 2023; Page No 429-438

Table :7 Comparison Of Ph Pre Pnemoperitoneum

Group	N	Mean	SD
1	30	7.4415	0.043
2	30	7.4516	0.0305
3	30	7.4505	0.051
Total	90	7.4393	0.045

Table :8 Comparison Of Ph During Pneumoperitoneum

Group	N	Mean	SD
1	30	7.3505	0.0183
2	30	7.4416	0.0351
3	30	7.4405	0.0466
Total	90	7.4109	0.0553

Table :9 Comparison Of Ph Post Pneumoperitoneum

Group	N	Mean	SD
1	30	7.3511	0.0221
2	30	7.4413	0.0325
3	30	7.4283	0.0408
Total	90	7.4069	0.0515

Table :10 Comparison Of Pco_2 Pre Pneumoperitoneum

Group	N	Mean(mm Hg)	SD
1	30	39.0303	2.6863
2	30	34.9267	3.2585
3	30	33.1363	2.4725
Total	90	35.6978	3.7361

Table :11 Comparison Of Pco_2 During Pneumoperitoneum

Group	N	Mean(mmHg)	SD
1	30	42.5547	2.9579
2	30	37.3367	3.5174
3	30	34.6687	3.8512

Volume 6, Issue 1; January-February 2023; Page No 429-438

Total	90	38.1867	4.7499

Table :12 Comparison Of Pco_2 Post Pneumoperitoneum

Group	N	Mean (mmHg)	SD
1	30	41.209	2.451
2	30	36.366	3.348
3	30	34.81	1.822
Total	90	37.4619	3.768

Table :13 Comparison Of $Etco_2$ Pre Pneumoperitoneum

Group	N	Mean (mm Hg)	SD
1	30	33.5	2.529
2	30	29	2.243
3	30	26.73	2.664
Total	90	29.74	3.746

Table :14 Comparison Of $Etco_2$ During Pneumoperitoneum

Group	N	Mean (mmHg)	SD
1	30	37.1	2.656
2	30	31.03	2.846
3	30	29.43	2.92
Total	90	32.52	4.329

Table :15 Comparison Of $Etco_2$ During Post Pneumoperitoneum

Group	N	Mean(mm Hg)	SD
1	30	35.43	2.83
2	30	29.36	2.83
3	30	29.16	2.98
Total	90	31.32	4.08

Table :16 Comparison Of Bicarbonate Pre Pneumoperitoneum

Group	N	Mean (mmol/l)	SD
1	30	22.6	0.695
2	30	24.44	1.848

Volume 6, Issue 1; January-February 2023; Page No 429-438

3	30	23.81	1.877
Total	90	23.61	1.734

Table :17 Comparison Of Bicarbonate During Pneumoperitoneum

Group	N	Mean (mmol/l)	SD
1	30	22.65	0.806
2	30	24.71	1.665
3	30	23.62	1.989
Total	90	23.66	1.767

Table :18 Comparison Of Bicarbonate Post Pneumoperitoneum

Group	N	Mean (mmol/l)	SD
1	30	23.31	1.15
2	30	24.64	1.7
3	30	23.92	1.718
Total	90	23.95	1.62

Table :19 Comparison Of Pulse Rate Pre Pneumoperitoneum

Group	N	Mean	SD
1	30	80.93	6.52
2	30	81.53	8.2
3	30	83.56	10.5
Total	90	82.47	8.9

Table :20 Comparison Of Pulse Rate During Pneumoperitoneum

Group	N	Mean	SD
1	30	92.03	8.49
2	30	88.73	8.23
3	30	89.63	8.61
Total	90	90.13	8.46

Volume 6, Issue 1; January-February 2023; Page No 429-438

Table :20 Comparison Of Pulse Rate Post Pneumoperitoneum

Group	N	Mean	SD
1	30	93.6	8.04
2	30	88.36	6.19
3	30	83.4	6.51
Total	90	88.45	8.05

Table :21comparison Of Peak Inspiratory Pressure Pre Pneumo Peritoneum

Group	N	Mean(cm of H2O)	SD
1	30	20.7	1.89
2	30	20.6	1.92
3	30	20.63	1.56
Total	90	20.64	1.78

Table :22 comparison Of Peak Inspiratory During Pneumo Peritoneum

Group	N	Mean (cm of H2O)	SD
1	30	23.63	1.9
2	30	25.06	1.99
3	30	26.46	1.71
Total	90	25.05	2.18

Table :23 Post Pneumoperitoneum

Group	N	Mean (cm of H2O)	SD
1	30	21.06	1.59
2	30	20.7	1.84
3	30	21.06	1.46
Total	90	20.94	1.63

Discussion

During laparoscopic surgeries carbondioxide pneumoperitoneum is created and the effects of hypercarbia on the circulatory system are complex. This usually includes an increase in cardiac output, heart rate ,force of myocardial contraction ,blood pressure ,central venous pressure,vasoconstriction in the pulmonary vessels and decreased peripheral resistance. Healthy ASA I patients are less likely than ASA III patients to undergo extreme changes[7].General anaesthesia with intubation and mechanical ventilation results in a decrease in functional residual capacity which is caused by loss of muscle tone, diaphragmatic displacement and loss of thoracic volume.Lung compliance drops ,airway pressures increase and V/Q abnormalities occur.

These changes are exaggerated by Trendelenburg position especially in elderly patients, obese and those with preexisting cardiopulmonary disease.[8]Various studies as mentioned in the review of literature have studied the effects of laparoscopy on haemodynamics and respiratory function..There was no significant difference in mean arterial pressure before creation of pneumo peritoneum in all the three groups .(p value 0.067).[9] During pneumoperitoneum there was an increase in mean arterial pressure in all the 3 groups but there was no significant difference in between the groups . (p value 0.157) and the mean arterial pressure decreased after deflation of pneumoperitoneum but there was no significant difference in between the groups (p value 0.142).pH did not show any significant difference between the study and control groups before creation of pneumo peritoneum.(p value 0.073). [10]During pneumoperitoneum the pH varied significantly from control to study groups but no significant difference was observed between the study groups. After deflation also the control group differed significantly from study groups(p value 0.000). But no significant difference was observed between the study groups (p value 0.127).PaCO2 values measured before pneumoperitoneum showed a higher value in group 1 whereas it was in lower normal range in groups 2 and 3.[11] The values are 34.92 mm of Hg and 33.13 mm of Hg respectively. It was statistically significant and the p value is 0.000.In between groups 2 and 3 there was further significant difference and the value was higher in group 2 than the group 3.P value was 0.016.During pneumoperitoneum also the PaCO2 was significantly higher in group 1 than the other 2 groups.p value is 0.000. [12]Even groups 2 and 3 varied significantly among themselves ie; group 2 showed a higher value than group 3 . p value is 0.004.After deflation also the PaCO2 remained at higher level in group 1 than groups 2 and 3. p value is 0.000.Measurements showed a significantly higher value of 33.5 mm of Hg in group 1 . (p value 0.000). Group 2 had a significantly higher value than the group 3and the p value is 0.001.During pneumoperitoneum also the values were significantly higher in group 1 than the groups 2 and 3 . p value is 0.000 . Group 2 showed a significantly higher value of 31.03 mm of Hg than group 3 and the p value is 0.030.After deflation also group 1 had a higher value of 35.43mm of Hg than the groups 2 and 3 which had values of 29.36 mm of Hg and 29.166 mm of Hg respectively (p value is 0.000). Groups 2 and 3 did not show significant difference and the p value was 0.789. [13]Bicarbonate levels measured before pneumoperitoneum did not show any significant difference among the three groups and the p value was 0.372.During pneumoperitoneum also bicarbonate values did not show any statistically significant difference and the p value was 0.590. Values measured after disflation also showed no significant difference among the groups and the p value was 0.970.Pre pneumoperitoneum values showed no significant difference among the groups and the p value is 0.143.During pneumoperitoneum there was no significant change in the pulse rate in all the groups. After deflation the values showed significant increase in the study groups than the control group and the p value was 0.000. But this was not clinically significant. [14]Prepneumoperitoneum values did not differ significantly between the groups and the p value was 0.976. During pneumoperitoneum the groups 2 and 3 showed a significantly higher values than the group 1 and the p value was 0.000.But after deflation the values were not significantly different and the p value was 0.608. Our study shows that increasing the minute ventilation by 15 % in group2 and 30 % in group3 keeps the partial pressure of carbon dioxide and End tidal Carbon dioxide and pH within normal limits but it did not have significant changes in mean arterial pressure and heart rate .[15]

Conclusion:

Carbon dioxide output increases during laparoscopic surgeries and increasing the minute ventilation by increasing the respiratory rate from 12 per minute to 14 per minute in laparoscopic surgeries produces a significant decrease in Partial pressure of carbon dioxide, End tidal carbon dioxide and pH towards the high normal range levels. When the rate was increased to 16 per minute the same changes were observed but this was not statistically significant from patients ventilated with a rate of 14 per minute. There was no significant difference in the bicarbonate values. There was no significant difference in between the groups in the mean arterial blood pressure. But the heart rate was significantly higher in the control group than the study groups during pneumoperitoneum.

Volume 6, Issue 1; January-February 2023; Page No 429-438

References

1. Baraka A,Jabbour S,Hammoud R et al End tidal carbondioxide tension during laparoscopic cholecystectomy.Correlation with baseline value prior to CO2 insufflation Anaesthesia 49:775,1994.
2. Dexter SP, et al: Haemodynamic consequences of high and low-pressure capno peritoneum during laparoscopic cholecystectomy. Surg. Endoscopy 13: 376-1999.
3. El-Minawi MF et al Physiological changes during CO2 and N2O pneumoperitoneum during diagnostic laparoscopy. Journal of Reproductive Medicine 1981 26 338- 346.
4. Goodale RL,Beebe DS,Mc Nevin MP et al Haemodynamic, ventilatory and metabolic effects of laparoscopic cholecystectomy American Journal of Surgery 1993:166:533-37.
5. Hirvonen EA et al: Hemodynamic changes due to trendelenberg position & pneumoperitoneum during laparoscopic hysterectomy Acta Anaesthesiology Scandinavia 39: 949, 1995.
6. Hodgson c Mc Clelland RM Newton JR,Some effects of the peritoneal insufflation of carbon dioxide during laparoscopy Anaesthesia 1970;25;382-90
7. Joris JL Noriot DP,Legrand MJ et al Haemodynamic changes during laparoscopic cholecystectomy Anaesthesia and Analgesia 1993; 76;1067-71.
8. Kashtan J. et al; Haemodynamic effect of increased abdominal pressure. J. Surgery Residency 30: 249, 1981.
9. Liu S-Y Leighton TA Davies I et al, Prospective analysis cardiopulmonary responses in laparoscopic cholecystectomy J.laparoendoscopic surgeries 1991;126:997-1000.
10. Muelett CE,Viale JP Sagnard PE et al.Pulmonary carbondioxide elimination during surgical procedures using intra or extra peritoneal carbon dioxide insufflation Anaesth Analgesia 1993;76;622-26.
11. Puri GD ,Singh H ,Ventilatory effects of laparoscopy under general anaesthesia.British journal of anaesthesia 1992;68:211-13.
12. Putensen Himmer G , Putensen CH ,Lammer H et al Functional Residual capacity ,Post operative lung function and gas exchange following open laparotomy or laparoscopy for cholecystectomy Anaesthesiology 1992 ; 77;A 1253.
13. Rademaker. BM, et al: Effects of pneumoperitoneum with Helium on hemodynamics and oxygen transport: A comparison with carbondioxide. J. Laparoendoscopic surgery, 5:15, 1995.
14. Rittenmeyer H carbion dioxide toxicity related to a laparoscopic procedure J Post anaesthetic care 1994;9; 157-61.
15. Safron DB,Orlando R III Physiologic effects of pneumoperitoneum, American Journal of Anaesthesia 1992: 58;717-21

Volume 6, Issue 1; January-February 2023; Page No 429-438