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EVALUATION OF HAEMODYNAMIC AND CAPNOGRAPHIC CHANGES IN OPEN AND LAPAROSCOPIC CHOLECYSTECTOMY

Anaesthesiology

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ABSTRACT

Introduction: Laparoscopic cholecystectomy is one of the most commonly performed operations worldwide and gold standard treatment for benign gall bladder pathology. Increasing practice of lap cholecystectomy demands concurrent advancement in anaesthetic technique and monitoring standard.

Objectives: Comparison of haemodynamic and ETCO2 changes intraoperatively during laparoscopic and open cholecystectomy and evaluation of any additional effects of insufflated CO2.

Study Design: Hospital based observational study done over 24 months

Subjects and methods: 60 patients of both sex scheduled to undergo elective cholecystectomy under general Anaesthesia, selected on the basis of the inclusion criteria , were included in this study. Patients are assigned into two groups namely Group O[planned for open cholecystectomy] and Group L[laparoscopic cholecystectomy], each group having 30 patients. Heart rate, systolic BP, diastolic BP, mean arterial pressure, EtCO2, SpO2 and ECG monitored continuously and record maintained before surgery, during induction, intubation, extubation and every 10 min interval up to the completion of surgery in both group.CO2 insufflation and exsufflation time also noted in laparoscopic cholecystectomy cases.

Result: Age, sex, weight, height, ASA grade and duration of surgery of all the patients of both the groups were comparable. The HR, MAP and ETCO2 of group L started increasing during the intraoperative period and P values these were statistically significant from t=20 minutes after intubation to t=60 min. In our study CO2 insufflation done within 8 to 15 minutes after intubation. .It is clear from our study that pneumoperitoneum created during laparoscopic cholecystectomy might have caused this increase in HR,MAP and ETCO2. There was a decrease in SpO_2 in Group L during the intraoperative period i.e from t=20 minutes after intubation to t=80 min after intubation and the P values during this period were statistically significant.

Conclusion: From our study we come to the conclusion that in laparoscopic cholecystectomy there is significant increase in HR, MAP, ETCO2 and decrease in SPO2 following insufflation of the abdomen with CO2 and institution of the reverse Trendlenberg position.

KEYWORDS

HR-heart rate, MAP-mean arterial pressure, SPO2-oxygen saturation, ETCO2-end tidal carbon dioxide concentration.

INTRODUCTION:

Minimal access surgical procedures have been improved to reduce trauma to the patient, morbidity, mortality, and hospital stay, with consequent reductions in health care costs. 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.

Biliary diseases known since ages constitute major portion of digestive tract disorders and requires surgical intervention for total cure. Since the introduction of the first laparoscopic cholecystectomy procedure,[1] laparoscopy has expanded impressively both in scope and volume. More than 1,00,000 laparoscopic cholecystectomies are performed every year in India. It quickly became apparent that laparoscopy results in multiple benefits compared with open procedures like small incision, improved cosmetic aspects, less postoperative pain, and quick recovery time to normal activities [2,3].

The pneumoperitoneum and the patient positions required for laparoscopy induce pathophysiologic changes that complicate anaesthetic management. An understanding of the pathophysiologic consequences of increased intra-abdominal pressure (IAP) is important for the anaesthesiologist who must ideally prevent or, when prevention is not possible, adequately respond to these changes and who must evaluate and prepare the patient preoperatively in light of these disturbances.

Intraoperative pulmonary changes are due to decreased pulmonary compliance secondary to upward movement of the diaphragm during insufflation, and to changes in CO2 homeostasis secondary to absorption of insufflated CO2 from the peritoneum. pulmonary compliance is decreased to 35–40% and also a non-negligible increase in the maximum respiratory system resistance occurs [4, 5, 6,7]. Hypoxemia may occur from a ventilation perfusion mismatch and intrapulmonary shunting [8] but is rare in healthy patients. Since Laparoscopic cholecystectomies are frequently performed procedure in our hospital and on an average of 20-30 cases are done per month, to understand the pathophysiological changes associated with pneumoperitoneum we have conducted this study.

AIMS AND OBJECTIVES

Comparison of haemodynamic and ETCO2 changes intraoperatively during laparoscopic and open cholecystectomy and evaluation of any additional effects of insufflated CO2 during laparoscopic cholecystectomy under general anaesthesia.

MATERIALS AND METHODS

Hospital based observational study was done in the department of Anaesthesiology, VIMSAR, Burla, Odisha November 2018 to October 2020 [24 months]. 60 patients of both sex scheduled to undergo elective cholecystectomy under general Anaesthesia, selected on the basis of the inclusion criteria , were included in this study. Patients are assigned into two groups namely Group O [planned for open

cholecystectomy] and Group L [laparoscopic cholecystectomy], each group having 30 patients. Heart rate, systolic BP, diastolic BP, mean arterial pressure, EtCO2, SpO2 and ECG monitored continuously and record maintained before surgery, during induction, intubation, extubation and every 10 min interval up to the completion of surgery in both group.CO2 insufflation and exsufflation time also noted in laparoscopic cholecystectomy cases.

RESULTS

Out of 60 patients 9 (15%) were male, and 51 (85 %) were female. The mean age of the study population was 48.98 years with minimum 38 years and maximum 58 years. The mean height and weight of patients in group O was 158.20 centimeter and 58 kilograms while in group L was 158.97 cms and 60.97 kgs. The duration of surgery in both groups was similar with mean of Group O 135.30 minutes and group L of 133.77 minutes.

Table 1: Demographic profile and Duration of surgery

Variables	Group O (Mean±SD)	Group L (Mean±SD)	P value
Age (years)	49.467 **±5.015**	48.5± **4.939**	0.455
Sex[F:M]	26:4	25:5	0.718
Height [in cm]	158.20 ± [4.366]	158.97± [4.94]	0.527
Weight [in kg]	58± [5.36]	60.97± [7.71]	0.089
ASA grade [1:2]	21:9	25:5	0.222
Duration [in min]	135.30± [18.2]	133.77± [15.43]	0.726

The comparison of Heart rate between both the groups is shown in fig-1. Heart rate became statistically significant from 20 min after intubation to 60 min .The P value became again insignificant from 80 min to completion of surgery.The values indicate an increase in MAP in group L in the intra operative period which is statistically significant from 20 minutes after intubation to 60 minutes . There is a gradual decrease in MAP in group O from 10 minutes after intubation to completion of surgery. The comparison of SpO_2 between both the groups shows there was a decrease in SpO_2 in Group L during the intraoperative period i.e from t=20 minutes after intubation to t=80 min after intubation and the P values during this period were statistically significant**.**

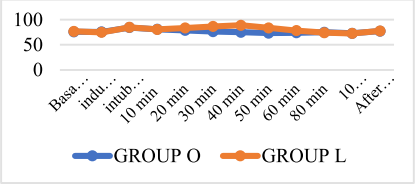

Fig-1: Comparison of mean heart rate between both the groups

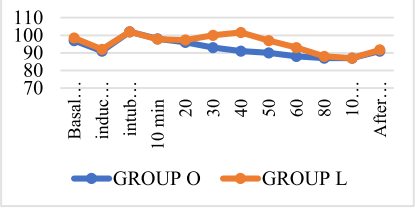

Fig-2: Comparison of Mean Arterial Pressure between both the groups

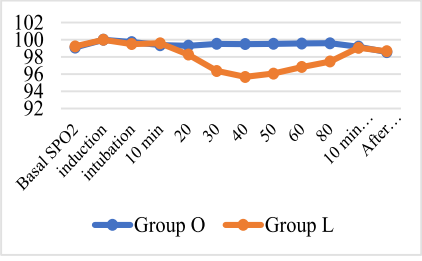

Fig-3: Comparison of SpO_2 between both the groups

The comparison of $EtCO_2$ between both the groups is shown in fig-4. There was an increase in $EtCO_2$ in Group L throughout the intraoperative period starting from from t=20 minutes after intubation to 10 min before extubation which is statistically significant.

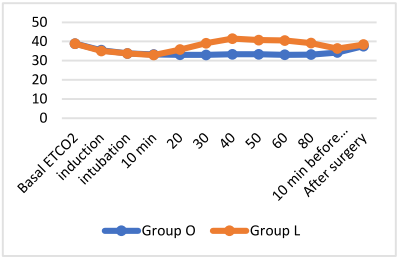

Fig-4: Comparison of $EtCO_2$ in both the groups

DISCUSSION

n our study out of 60 patients 9 (15%) were male, and 51 (85 %) were female. In group O, 4 were male and 26 females. In group L, 5 males and 25 females.The mean age of the study population was 48.98 years with minimum 38 years and maximum 58 years. Mean age in group O was 49.467 years and in group L was 48.5 years.The mean height and weight of patients in group O was 158.20 cm and 58 kg while in group L was 158.97 cm and 60.97 kgs.The duration of surgery in both groups was similar with mean of Group O 135.30 min and group L of 133.77 min. The data shows Age, sex, weight, height, ASA grade and duration of surgery of all the patients of both the groups were comparable.

Haemodynamic parameters:

The values indicate an increase in MAP in group L in the intra operative period which is statistically significant from 20 minutes after intubation to 60 minutes . These findings of our study are similar to the findings by **Mrinmoy das et al** [2007] [9] who conducted a study on Haemodynamic changes during laparoscopic cholecystectomy: effect of clonidine premedication and found in spite of maintaining normocapnia and keeping intra-abdominal pressure below 14 mm hg significant rise in systolic blood pressure, diastolic blood pressure and mean arterial pressure was noticed in group not receiving clonidine. **Osman Kurukahvecioglu et all** [2008] [10] conducted a study on Intermittent pneumatic sequential compression [ISC] of the lower extremities restores the cerebral oxygen saturation during laparoscopic cholecystectomy and found that mean blood pressure values did not change significantly after pneumoperitoneum in the group not receiving ISC.**Se-yuan liu et al** [2009] [11] conducted a study on prospective analysis of cardiopulmonary responses to laparoscopic cholecystectomy and found significant increase in MAP after creation of pneumoperitoneum. **D.Jee et al** [2009] [12] conducted a study on Magnesium sulphate attenuates arterial pressure increase during laparoscopic cholecystectomy. Systolic and diastolic arterial pressures were increased in both group after creation of pneumoperitoneum but increase was lesser in Magnesium group [patients received magnesium sulphate 50 mg/kg immediately before pneumoperitoneum].**Mukesh Kumar Vijay et al** [2010] [13] conducted a study on Hemodynamic, Respiratory, and Immunological Effects of Urological Laparoscopic Surgery and found that There were no significant changes in MAP, SBP and DBP. **Dr Dhiraj Bhandari et all** [2012] [14] conducted a study on Haemodynamic changes associated with laparoscopic cholecystectomy: Effect of oral clonidine premedication. They found rise in systolic, diastolic and mean arterial pressure was more than 20 percent in the group not receiving clonidine.**Hyun jeong kwak et al**.[2013] [211][15] conducted a study on high positive end expiratory pressure preserves cerebral oxygen saturation during laparoscopic cholecystectomy under propofol anaesthesia.. They found that in both the groups MAP increased significantly after CO2 insufflation when compared with baseline values. **Rania M Ali** [2015] [16] conducted a study on Effect of intraperitoneal Magnesium sulphate on hemodynamic changes and its analgesic and antiemetic effect in laparoscopic cholecystectomy. They found rise in mean arterial pressure in group not receiving intraperitoneal magnesium sulphate. In their study MAP was significantly higher at 10,20 and 30 minute after pneumoperitoneum, and at the time of extubation and after surgery. **Singh SP et al** [2017] [17]conducted a study on Comparative evaluation of hemodynamic and capnographic changes in low pressure versus normal pressure pneumoperitoneum in laparoscopic cholecystectomy. He found a significant increase in SBP and DBP aftert 30 minutes of

induction.**Behzad Nematihonar et al** [2018] [214][18] conducted a study on Effects of Low Pressure of Laparoscopic Cholecystectomy on Arterial Pressure of Carbon Dioxide and Mean Blood Pressure. He found Mean Arterial Pressure (MAP) in standard pressure pneumoperitoneum group was lower than the low pressure pneumoperitoneum group at 5 and 10 minutes after CO2 insufflation and before the time of CO2 desufflation (P=0.001, P=0.006 and P=0.001, respectively). **Nzar Nuri Rasheed Sherwani et al** [2019] [19]conducted a study on The effect of intra-abdominal carbon dioxide pressure on blood pressure in laparoscopic surgeries. The patients underwent high co2 pressure had significantly lower levels of both systolic and diastolic BP, heart rate from pre operative to post anaesthesia and postoperative period in compared to low pressure group **.**Increase in Heart rate in group L became statistically significant intraoperatively from 20 min after intubation to 60 min after intubation .The P value became again insignificant from 80 min to completion of surgery. Our findings in this study is similar to findings by **Mrinmoy das et al** [2007] [9], **Osman Kurukahvecioglu et al** [2008] [10], **D.Jee et al** [2009] [12], **Dr Dhiraj Bhandari et al** [2012] [14], **Hyun jeong kwak et al** [2013] [15], **Rania M Ali** [2015] [16], **Singh SP et al** [2017] [17]found increase in heart rate was significant. **Asif Umar et al** [2013] [20] conducted a study on Evaluation of Hemodynamic Changes Using Different Intra-Abdominal Pressures for Laparoscopic Cholecystectomy and found increase in HR after insufflation. He concluded that low pressure pneumoperitoneum is feasible for laparoscopic cholecystectomy and minimizes the adverse hemodynamic effects of CO2 insufflation. No significant changes in HR was found in a study by **Mukesh Kumar Vijay et al** [2010][13] **Nzar Nuri Rasheed Sherwani et al** [2019]]19] found decrease in HR in normal pressure pneumoperitoneum in comparison to low pressure pneumoperitoneum.

SPO2 Comparison

The comparison of SpO_2 between both the groups shows there was a decrease in SpO_2 in Group L during the intraoperative period i.e from t=20 minutes after intubation to t=80 min and the P values during this period were statistically significant. **Mukesh Kumar Vijay et al** [2010] [13]found that the mean (SD) preoperative pO2 was 140.28 (25.61) mmHg, which was significantly higher than the mean intraoperative pO2 of 133.9 (24.43) mmHg ($P < .05$).**Osman Kurukahvecioglu et all** [2008] [10] found that peripheral blood oxygen saturation did not change significantly after pneumoperitoneum.

Capnography

The comparison of $EtCO_2$ between both the groups shows there was an increase in $EtCO_2$ in Group L starting from from t=20 minutes after intubation to 10 min before extubation which is statistically significant. This rising of $EtCO_2$ values can be explained by pneumoperitoneum due to CO2 insufflation. This finding is similar to the findings by **Se-yuan liu et al** [2009] [11], **Hyun jeong kwak et al**.[2013] [15], **Singh SP et al** [2017][17]. **Mukesh Kumar Vijay et al** [2010] [13] found that the mean change in ETCO2 at 15-minute intervals was significantly higher than the ETCO2 before insufflation. **Behzad Nematihonar et al** [2018] [18] found PaCO2 was statistically lower in low pressure pneumoperitoneum group before CO2 desufflation (P= 0.001)

CONCLUSION

From our study we come to the conclusion that in laparoscopic cholecystectomy there is significant increase in HR,MAP,ETCO2 and decrease in SPO2 following insufflation of the abdomen with CO2 and institution of the reverse Trendlenberg position. These effects of pneumoperitoneum can be attenuated by understanding the physiological changes and safe management of specific alterations by inhalational agents, vasodilatory drugs and controlled mechanical ventilation.

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