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A PROSPECTIVE, RANDOMIZED STUDY TO ASSESS THE EFFECT OF PNEUMOPERITONEUM ON ARTERIAL AND ENDTIDAL CARBONDIOXIDE PRESSURE GRADIENT DURING LAPAROSCOPIC SURGERY IN ADULTS

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ABSTRACT

BACKGROUND: To assess the effects of pneumoperitoneum on arterial and end tidal carbondioxide pressure gradient during laparoscopic surgery in adults .

METHODOLOGY: Sixty, ASA 1&2 patients between 20 to 60 years posted for elective laparoscopic appendicectomy or cholecystectomy were selected . Intra abdominal pressure was maintained between 10-12 mmHg. Preinsufflation of CO2 and intra operatively 15 minutes after insufflation ABGs were analysed. The changes in PaCO2 ,ETCO2 , P(a-Et)CO2 gradient ,PH, bicarbonate and hemodynamic changes were studied.

CONCLUSION: There was significant increase in ETC02 ,PaCO2, P(a-Et)CO2 gradient, after CO2 insufflation but within normal range. There was decrease in pH without bicarbonate change with slight increase in heart rate and diastolic blood pressure.
The arterial and ETCO2 pressure gradients were under the normal limits even after pneumoperitoneum. The normal pressure P(a-Et)CO2 gradient implies adequate ventilation to alveoli and perfusion . ETCO2 correlate well with PaCO2 as best parameter to diagnose hypercarbia.

KEYWORDS : ETCO2 end tidal carbondioxide, ABG arterial blood gas,PaCO2 arterial carbondioxide

INTRODUCTION

Hans Christian Jacobaeus of Sweden performed the first laparoscopic surgery on humans in 1910.

Reduction of post-operative pain and ileus, better cosmetic results less hospital stay less post-operative atelectasis , and wound infection are the advantages of laparoscopy.

Carbon dioxide is the most commonly used gas for pneumoperitoneum Alternatives are helium , argon , nitrogen , oxygen , nitrous oxide . CO2 has been found to be superior because it is non inflammable, inert, non irritant , readily available, low cost and cheap, with a high blood gas partition coefficient (0.48) .
It is rapidly buffered in the blood by bicarbonate and excreted via the lungs. Absorption of carbon dioxide from the pressurised pneumoperitoneum causes clinically relevant cardiopulmonary and hemodynamic alteration.

Carbon dioxide is 20 times more soluble than oxygen ; which is insufflated in a pressurised form at 10 to 12 mmHg. If duration of surgery is prolonged, systemic absorption of carbon dioxide will be more. Due to its high solubility , the incidence of gas embolism is rare . However , it is a peritoneal irritant.

Therefore to determine the adequacy of alveolar ventilation it is important to know PaCO2 .Capnography constitute a useful and non-invasive means of continuously measuring ETCO2. which reflects the PaCo2.

Use of capnography monitoring can reliably and quantitatively provide vital respiratory parameters in intubated patients. Alterations in cardiac output , distribution of pulmonary blood flow and metabolic activity can also be reflected by the change of carbondioxide concentration in expired gas.

American society of anaesthesiologists mandates the use of capnography in all patient undergoing anaesthesia .

In this study ,the effects of pneumoperitoneum on $PaCO_2$-$ETCO_2$ gradient during laparoscopic appendicectomy and cholecystectomy will be assessed.

PETCO2 AS AN ESTIMATE OF PaCO2:

Measurements of PETCO2 constitute a useful non-invasive tool to monitor PaCO2 and hence, ventilator status of patients during anaesthesia.

In normal individuals , (a-ET)PCO2 may vary from 2-5 mmHg.

It decreases with large tidal volume and low frequency ventilation.

Changes in PETCO2 can often be regarded as indicative of changes in PaCO2.

The PETCO2 is more useful if its relationship to PaCO2 can be established initially by blood gas analysis. There after changes in PaCO2 may be assumed to occur in parallel with those in PETCO2 thus avoiding repeated arterial puncture.

MATERIALS AND METHODS:

We conducted a prospective randomised study after approval from institutional ethical committee and a written consent was obtained from patients. The study was conducted in Sixty patients of ASA status 1 and 2 undergoing elective laparoscopic appendicectomy or laparoscopic cholecystectomy lasting a minimum of 45 minutes The exclusions are Patients suffering from respiratory disease like chronic bronchitis, emphysema, bronchial asthma , respiratory failure Congestive heart failure, Renal failure, Patients were kept fasting overnight. They were given aspiration prophlaxis with Inj- Ranitidine 50 mg IV , Inj- Metoclopramide 10 mg IV, One hour before surgery . patients premedicated with inj Glycopyrrolate 10Mcgs /kg i.m. 45 minutes before surgery. After the placement of standard ASA monitoring devices and preoxygenation, all the patient were induced with Inj: Propofol 2.5mg/kg IV, Inj: Fentanyl 2mcg/kg IV and Inj: Vecuronium 0.1mg/kg IV . Intubated with appropriate size endotracheal tube . patient's left radial artery cannulated,flushed with hepsaline ,arterial sample sent for analysis, Throughout surgery intra abdominal pressure was maintained at 10 -12 mmHg. Arterial blood gas analysis was sent 15 minute after insufflation .

Heart rate , systolic blood pressure , diastolic blood pressure ,mean arterial pressure , peak airway pressure , ETCO2 were measured for obtaining baseline values and 15 minutes after insufflation.at the end of surgery, residual blockade was reversed with inj.neostigmine 50 mcgs/kg and inj.glycopyrrolate 10 mcgs/kg dose and extubated.

OBSERVATION AND RESULTS

We compared the relationship and correlated between arterial carbondioxide and end tidal carbondioxide pressure gradient before and after CO2 pneumoperitoneum along with hemodynamic changes.

Normal values:
EtCO2 35-45mmHg PaCO2 35-45mmHg pH 7.35-7.45
HCO3:22-24 mmhg
PaCO2-etCO2 gradient 2-5 mmHg

DEMOGRAPHIC PROFILE

The sample of 60 patients was taken for the study data was expressed as

mean ± SD . Statistical analysis was done with student's t test . A p value < 0.05 was considered significant.

The descriptive statistics of the variables studied are represented as two way tables.mean and standard deviation.for variables measured on a continuous scale ,when testing for two groups,independent sample test is used to test for statistical significance in the differences of two mean.

ETCO2 BEFORE & AFTER C02 INSUFFLATION
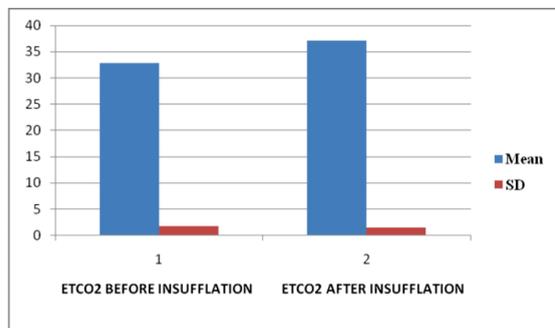
p value is 0.001, which is less than .05, thus it is **significant.**

PACO2- ETCO2 Independent Samples Test

PaCO2 BEFORE AND AFTER CO₂ INSUFFLATION

p value is less than 0.05, which is statistically significant

PACO2 – ETCO2 PRESSURE GRADIENT

N	Valid	60
	Missing	0
Mean		3.75
Std. Deviation		1.146

PaCO2 – ETCO2 GRADIENT AFTER CO2 INSUFFLATION

N	Valid	60
	Missing	0
Mean		4.27
Std. Deviation		.935

PaCO2- ETCO2 diff	Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
	Equal variances assumed	.118	.732	- 2.732	118	.007	-.5216667	.1909771	-.8998534	-.1434799
	Equal variances not assumed			- 2.732	113.432	.007	-.5216667	.1909771	-.9000112	-.1433221

p value is 0.007, less than 0.05, statistically **significant**

DISCUSSION
HEMODYNAMIC EFFECTS

Our study demonstrates that the intra abdominal pressure of 12 mmHg maintained for laparoscopic surgery produced hemodynamic changes characterised by increase in heart rate, mean arterial pressure,diastolic BP without change in systolic BP which has p value less than 0.05,which was statistically significant and the mean systolic blood pressure pre and post co2 insufflation is insignificant which was in accordance to [14]JORIS et al and [23]MURALIDHAR et al.GUPTA SHOBHANA et al,MAKWANA et al.

In our study we maintained tidal volume 10 ml/kg.and respiratory rate 12-14 /min.

ETCO2 AND PaCO2

ETCO2 increased from 32.77 to 37.08 mmHg, and PaCO2 increased from 36.52 to 41.36 mmhg respectively during the procedure, and the p value was < 0.05 for both. Thus it is statistically significant, but the ETCO2 and the PaCO2 were under clinically normal range . According to[22] MULLET et al rapid rise in PaCO2 and ETCO2 occurs within 10 minutes of insufflation. So we took data after 15 minute CO2 insufflation.
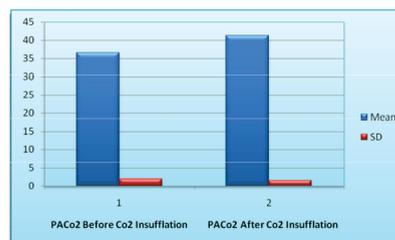
Similar to the findings of 22MULLET et al ,19 MEININGER et al,11ISHIKAWA et al and [21]MONAGLE et al, there was a progressive increase in ETCO2 and PaCO2 during CO2 insufflation in our study. The maximum rate of increase in CO2 occurred in the first 15 minutes, there after increase in carbon dioxide reached plateau and remain the same for 15- 45 minutes.

A correlation between PaCO2 and ETCO2 was observed in our study , this is similar to findings of [25]NYARWAYA et al and[2] BARAKA et al who also noted a correlation between the PaCO2 and ETCO2.

P(a-ET) GRADIENT

The mean difference of PaCO2 and ETCO2 pressure gradient was 3.75 mmHg , before insufflation and the mean difference of PaCO2 and ETCO2 pressure gradient after pneumoperitoneum was 4.27mmHg. In healthy patients with normal ventilation –perfusion ratio, the pressure gradient is 2-5 mmHg. The p value for PaCO2 and ETCO2 gradient was 0.007 , statistically significant . Although the p value is statistically significant, it remains within normal physiological range and similar with [2]BARAKA et al , [25]NYARWAYA et al,[3]BHAVANI SHANKAR et al studies.

SUMMARY

We studied the effects of pneumoperitoneum on P(a-et)co2 gradient during laparoscopic surgery.

There is no significant difference in the age, sex, duration of surgery, systolic blood pressure whereas there was significant increase in mean arterial blood pressure, heart rate, diastolic blood pressure, end tidal carbon dioxide after co2 insufflation.

There is significant increase in PaCO2 after CO2 insufflation and gradient but the increase is less than 45 mmHg.

CONCLUSION

We have demonstrated that during laparoscopic cholecystectomy or appendicectomy , abdominal carbondioxide insufflation causes increase in ETCO2 and PaCO 2 signifcantly higher than preinsufflation value but within physiological range. A correlation was observed between the PaCO2 and ETCO2 throughout duration of insufflation.ETCO2 can be used an index of PaCO2 with the provision that the clinician be aware that an increased P(a-ET)CO2 gradient which reflects reduced cardiac output. The arterial and end tidal carbon dioxide pressure gradients are under the normal limits even after CO2 pneumoperitoneum in ASA 1 and 2 patients.

This results suggest that endtidal capnography and pulse oximetry can be used as non invasive techniques for monitoring CO2 elimination and arterial oxygenation during laparoscopic surgery in ASA1 and 2 patients.

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