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"Relationship between recovery profile after inhalational anaesthesia and mean end tidal carbon dioxide concentration in laparoscopic cholecystectomy: A pilot observational study"

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ABSTRACT The aims and objectives of this pilot observational study were to analyse the relationship between mean end tidal carbon dioxide concentration in patients undergoing laparoscopic cholecystectomy with recovery time from anaesthesia and occurrence of emergence reactions.

Materials and methods : Mean end tidal CO2 (ETCO2),recovery times and emergence-agitation score of 20 ASA I and II patients undergoing laparoscopic cholecystectomy under General anaesthesia was calculated and analysed statistically for any correlation.

Results : The mean ETCO2 was 37.29 mmHg (Range 36.33- 38.22 mmHg), mean recovery time was 6.6 mins and mean emergence-agitation score was 3.3 out of 5. No significant correlation was found between the mean ETCO2 level and the recovery time or the emergence-agitation score of the patients. Since the mean ETCO2 was within normal limits, the study suggests that with maintenance of normocapnia there is minimal effect on the recovery profile of patients undergoing laparoscopic cholecystectomy.

KEYWORDS : End-tidal CO2, Recovery from anaesthesia, Emergence-agitation, Laparoscopic cholecystectomy

INTRODUCTION

Laparoscopic cholecystectomy is a common surgical procedure which has gained immense favour due to earlier recovery and reduced morbidity.[1] Recovery time from anaesthesia is a function of rapid removal of the anaesthetic drugs from the system of the patient. Removal of the anaesthetic agent from the system of the patient depends on the alveolar ventilation of the patient, solubility of the drug in blood and tissue and cerebral blood flow.[2,3] The pneumoperitoneum by carbondioxide can produce cardiovascular and respiratory pathophysiologic effects including hypercapnia which may affect recovery time. Carbon dioxide is known to be a CNS depressant, and increased concentration of CO_2 in the blood leads to CO_2 narcosis which may delay recovery.[4,5] On the contrary some studies have shown that hypercapnia actually enhances recovery.[6] while some studies show that normocapnic hyperventilation hastens recovery [7,8]. This study was therefore undertaken to relook into the effect of CO2 levels on recovery following laparoscopic cholecystectomy.

Aim:

To analyse the relationship between recovery profile and mean end tidal carbon dioxide concentration in patients undergoing laparoscopic cholecystectomy.

Objectives:

1. To find the co-relation between mean end tidal carbon dioxide concentration and recovery time from anaesthesia.
2. To assess the relationship between the mean end tidal carbon dioxide concentration and emergence-agitation.

Materials and Methods:

After obtaining Institutional Ethical Committee clearance and written informed consent, this pilot observational study was conducted on 20 ASA Grade I and II individuals between 16-60 years undergoing elective laparoscopic cholecystectomy using systemic random sampling. Patients with cardiopulmonary disease, pulmonary hypertension, raised ICP, and BMI more than 35kg/m^2 were excluded from the study. All patients were anaesthetised with the standard institutional protocol of premedication with intravenous glycopyrollate 0.2 mg, midazolam 1.0 mg and fentanyl 2mcg/kg. Induction was with Inj propofol 2 mg/kg, muscle relaxation achieved with Inj vecuronium 0.1mg/kg for intubation and maintained with a mixture of oxygen 40%, nitrous oxide 60% and isoflurane to achieve a MAC of 1 and further doses of vecuronium as needed. The patients were mechanically ventilated with volume controlled ventilation. Reversal of neuromuscular blockade was done using neostigmine(50mcg/kg) along with glycopyrollate (10mcg/kg) on return of spontaneous ventilation and patient extubated using clinical criteria.

Following parameters were recorded:

1. The mean ET CO_2 concentration over the duration of procedure .
2. The duration of CO_2 insufflation and average insufflation pressure throughout the laparoscopic surgery.
3. Hemodynamic and ventilatory parameters every 5 mins
4. Recovery time i.e time from cutting off anaesthetic gases to eye opening of the patient in response to gentle verbal command.
5. Emergence agitation score on recovery as per scale(Table 1)

Table 1: Emergence-agitation Scale

S. No.	Recovery Profile	Score
1.	Sleeping	1
2.	Awake and calm	2
3.	Irritable and crying	3
4.	Inconsolable crying	4
5.	Severe restlessness and disorientation	5

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS version 20.0. Continuous data were expressed as mean +/- standard deviation or median, categorical variables as frequencies, number or percentage. Two independent sample t-test was used to compare the baseline parameters of the patients. Spearman's rank correlation and Pearson's correlation coefficient was used to check for any correlation between the mean ETCO2 and recovery time and emergence score.

RESULTS

1. There were 7 female and 13 male patients.
2. Summary of the data of the various recorded parameters is given in Table 2. The mean ETCO2 was 37.29 mm Hg, mean recovery time 6.6 mins and the mean Emergence- agitation score was 3.3 out of 5.

Table 2: Summary of recorded parameters

Parameter	Mean ± SD	Min-Max
ETCO2(mmHg)	**37.29 ± 0.46**	**36.33-38.22**
Recovery time (min)	**6.6 ± 1.93**	**2-9**
Agitation Score	**3.3 ± 0.86**	**2-5**
Heart Rate (beats per min)	86.02 ± 2.8	80.22-90
MAP(mmHg)	76.19 ± 2.48	73.11-82
Peak airway pressure(mmHg)	19.01 ± 0.58	18-20
Respiratory Rate	13.89 ± 0	13.89-13.89
Tidal Volume	529 ± 18.18	500-555

3. Correlation of mean ETCO2 with various parameters is shown in Table 3. There was no significant correlation found between the ETCO2 and the recovery time or the emergence-agitation score.

Table 3: Correlation of mean ETCO2 with outcome parameters

Parameter	Correlation Coefficient (r)	P value	95% confidence interval for r
Agitation Score	**-0.119**	**0.617**	**-0.533 to 0.341**
Recovery Time (mins)	**0.0546**	**0.8192**	**-0.3975 to 0.4854**
Heart Rate(bpm)	-0.231	0.3271	-0.6111 to 0.2356
MAP(mmHg)	-0.275	0.2407	-0.640 to 0.191
Peak airway pressure(mmHg)	-0.1654	0.4858	-0.5665 to 0.2990
Respiratory Rate	0	1	
Tidal Volume	-0.022	0.9246	-0.4605 to 0.4241

DISCUSSION

This was an observational study conducted on 20 ASA I and II patients undergoing elective laparoscopic cholecystectomy under GA. The objective of the study was to assess the relation between ETCO2 and the recovery profile of these patients. CO2 insufflation can cause hypercapnia. Hyperventilation to hasten recovery produces hypocapnia with resultant reduced cerebral blood flow and reduced elimination of volatile anaesthetic from the brain. Sakata et al [6] using added CO2 in the anaesthetic mixture found that hypercapnia with hyperventilation leads to a more rapid recovery after GA with sevoflurane probably due to increase in cerebral blood flow and better systemic tissue oxygenation. Vesely[7] and Katznelson [8] found instead that normocapnia with hyperventilation leads to faster recovery. The present study however found no significant correlation of ETCO2 levels with recovery time and emergence. All the patients had ETCO2 levels in the normal range which may be the reason for this lack of correlation. The present study also did not use hyperventilation as a strategy to reduce recovery times which may also be a reason for lack of correlation. A surprising finding in the study was that the mean emergence score was 3.3 out of 5 indicating a higher emergence with the current anesthesia protocol.

CONCLUSION:

This observational study on a small sample shows no significant correlation between the mean ETCO2 levels during laparoscopic cholecystectomy and the recovery time and emergence after inhalational General Anasthesia . It is possible that a larger study with wider range of ETCO2 levels among patients would bring out a correlation.

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