Comparative Clinical Study Of Preinsufflation Versus Postdesufflation Arterial Blood Gas Analysis In Laproscopic Surgeries.

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Citation

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Abstract

Laparoscopy has shown appreciable growth in its clinical application because of its various benefits like small incision, reduced pain, better cosmetic results, quicker recovery, reduced hospital stay, lesser postoperative complications etc. Though considered a gentle surgery the procedure is indeed not risk free, because of “Pneumoperitoneum” required, which has significant haemodynamic and respiratory effects. After taking informed consent 30 patients of ASA grade I and II were observed for hemodynamic changes, ABG changes and ETCO2 changes before and after CO2 insufflation. We found nonsignificant hemodynamic changes, except rise in diastolic blood pressure, which changed significantly ($p < 0.01$), and non significant changes in PaCO2 & HCO3, but significant change in PH ($p < 0.05$) which which was within normal physiological range.

INTRODUCTION

Laparoscopy has shown appreciable growth in its clinical application and popularity, and world wide acceptance as a frequently performed surgery, due to its various advantages over the open technique. The various benefits include small incision reduced pain, better cosmetic results, quicker recovery, reduced hospital stay, lesser postoperative complications etc. Though considered a gentle surgery the procedure is indeed not risk free, because of “Pneumoperitoneum” required, which has significant haemodynamic and respiratory effects.

CO_2 is the commonest used gas amongst the various gases, as it is highly soluble in blood and its elimination can be augmented by increasing the minute ventilation[1]. Uptake of CO_2 from the pressurized pneumoperitoneum can cause clinically relevant hypercarbia and respiratory acidosis with physiological consequences, due to decreased lung compliance and insufficient ventilation.

Our Aim was to study 30 patients of ASA grade I and posted for elective laparoscopic surgery under General Anesthesia where we have compared hemodynamic changes, ABG changes and end tidal CO2 changes before and after CO2 insufflation.

MATERIALS AND METHODS

Our study included 30 patients aged 15-55 years of either sex weighing 45-70 kg under ASA grade I and II. Patients of ASA grade III and IV and those with respiratory, cardiovascular, renal diseases, obesity and pregnancy were excluded. The duration of surgery was ranged from 25 to 135 minutes.

Figure 1

TABLE -1 DEMOGRAPHIC DATA

	RANGE	AVERAGE
AGE	15 - 55 YEARS	36.56 ±6.786
SEX	18 MALE	12 FEMALE
WEIGHT	35 - 70 KG	60.56 ± 8.53
DURATION	25 - 135 MIN	109.56 ± 12.20

Patients underwent elective laparoscopic surgery which included Laparoscopic Appendicectomy, Laparoscopic Cholecystecomy, Laparoscopic Hernia repair, Laparoscopic Adhesiolysis, Laparoscopic hydatid cyst removal. Study conducted was prospective, controlled, clinical study after taking permission of the ethical committee and obtaining informed consent.

All patients were taken after routine preanaesthetic assessment and premedicated with Inj Glycopyrrolate 0.2

mg, Inj Midazolam 0.02 mg/kg and Inj Ranitidine 150 mg intravenously. All patients were monitored with ECG, NIBP, Pulse oximetery and Capnography by BPL Excello monitor apart from routine monitoring.

Preoperative samples of Arterial blood were collected before induction in a preheparinised 2ml. syringe anaerobically, by standard technique and samples tested for arterial blood gases. Preoxygenation was done with 100% O_2 for 3 minutes and all patient were induced with Inj. Sodium Thiopentone 5mg/kg and intubation performed with appropriate sized Portex cuffed endotracheal tube after Inj. Succinylcholine 1.5mg/kg. Anesthesia maintained with 66% N_2O in O_2 with traces of Sevoflurane and relaxation maintained with Inj. Vecuronium and IPPV maintained with tidal volume 10ml/kg and respiratory rate 15/min, thus increasing the minute volume by 25% using MAX Anesthesia ventilator. Inj Tramadol 1.5mg/kg intravenous was given as an analgesic. Residual effect was reversed by Inj. Neostigmine 0.05mg/kg and Inj. Glycopyrrolate 0.08mg/kg intravenously and patient extubated after return of reflexes and proper suctioning.

Introperative monitoring was done with multipara monitor-BPL Excello pulse, blood pressure, SpO_2, $EtCO_2$ and apart from that total amount of CO_2 insufflated measured and intraabdominal pressure kept to 15 mm of Hg. Incision site was infiltrated with 0.125% bupivacaine 20 minutes prior to desufflation, Inj. Ondansetron 4mg was given intravenously 10 minutes before extubation. Postoperative vital parameters monitored like pulse, blood pressure, SpO_2 and $EtCO_2$ and soon after desufflation, arterial blood samples were collected in a similar way as in pre-operative period, and analysed for arterial blood gases.

RESULTS

Out of total 30 patients, male: female ratio was 18:12. The mean age was 36.56 ± 6.786 years . During Surgery the change in the vital parameters noted, were within normal limits, due to adjustment in the respiratory parameters and the CO_2 being washed out easily, causing minimal changes. The Systolic blood pressure varied from 126.56 ± 6.45mmHg preoperatively to 128.44 ± 5.47 mmHg intraoperatively, and 129.55 ± 8.65mmHg postoperatively, where the p value remained p=0.1345 that is not significant. The diastolic blood pressure was also 77.44 ± 3.44 mmHg preoperatively and 80.08 ± 3.466 mmHg postoperatively where the p value was 0.004 which was statistically highly significant but was in clinically normal range. (Table 1.)

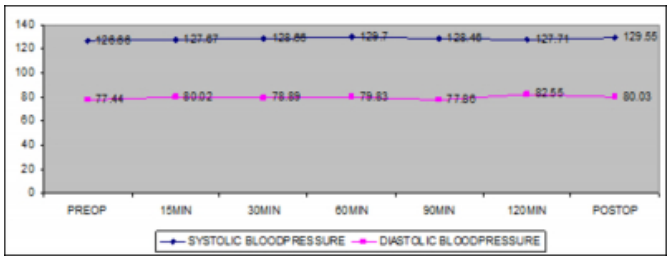
Figure 2

TABLE 1 CHANGE IN MEAN ARTERIAL BLOOD PRESSURE (mm of Hg)

	PREINSUFFLATION	PNEUMO PERITONEUM	POSTDESSUFFLATION	P Value
SYSTOLIC BLOOD PRESSURE	126.56 ± 6.45	128.44 ± 5.47	129.55 ± 8.65	0.01345 so p = notsignificant
DIASTOLIC BLOOD PRESSURE	77.44 ± 3.44	79.83 ± 4.09	80.08 ± 3.466	0.004 so p = significant

Figure 3

GRAPH-1 CHANGES IN BLOODPRESSURE



The heart rate was preoperatively 86.48 ± 4.76 bpm which came to 88.24 ± 5.673 bpm intraoperatively and 86.56 ± 4.344 bpm postoperatively where p value came to p=0.946 that is notsignificant. (Table 2.).

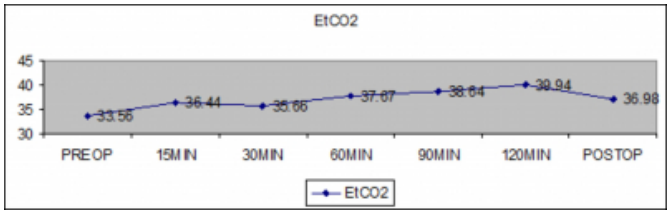
Figure 4

TABLE -2 CHANGE IN HEART RATE PER MINUTE

PREINSUFFLATION	PNEUMOPERITONEUM	POSTDESSUFFLATION	p value
86.48 ± 4.78	88.24 ± 5.673	86.56 ± 4.344	0.946= notsignificant

Figure 5

GRAPH-2 CHANGES IN ETCO2



The arterial gas levels due to pneumoperitoneum, showed the changes as fall in the pH from 7.4156 to 7.400(p> 0.05), that of PaCO2 from 35.344 to 36.476 mmHg (p>0.05), and HCO_3 levels from 24.8 to 24.3 mmol/L (p>0.05) which

proved to be statistically as well as clinically non-significant(Table,3,4),(Chart 3&4,5).

Figure 6

TABLE -3 CHANGES IN ARTERIAL BLOOD CO AND END TIDAL CO LEVELS

COMPARISION OF MEAN $EtCO_2$ (mm of Hg)				P value
MEAN	PREINSUFFLATION	PNEUMOPERITONEUM	POSTDESSUFFLATION	0.002
	33.56 ± 3.24	37.67 ± 4.33	36.98 ± 3.566	significant

Figure 7

TABLE:4 COMPARISION OF PREINSUFFLATION AND POSTDESUFFLATION BLOOD GAS LEVEL

COMPARISION OF PREINSUFFLATION AND POSTDESUFFLATION BLOOD GAS LEVEL				
	PREINSUFFLATIO N	POST D ESSUFFLATION	p VALUE	S/NS/H S
$PaCO_2$	35.344 ± 2.60	36.476±2.41	0.119	p>0.05 =NS
HCO_3	24.8±2.818	24.324±2.6	0.55	p>0.05 =NS
pH	7.41±0.034	7.40±0.038	0.033	p<0.05 =S

Figure 8

GRAPH –3 COMPARISON OF PaCO2 LEVEL

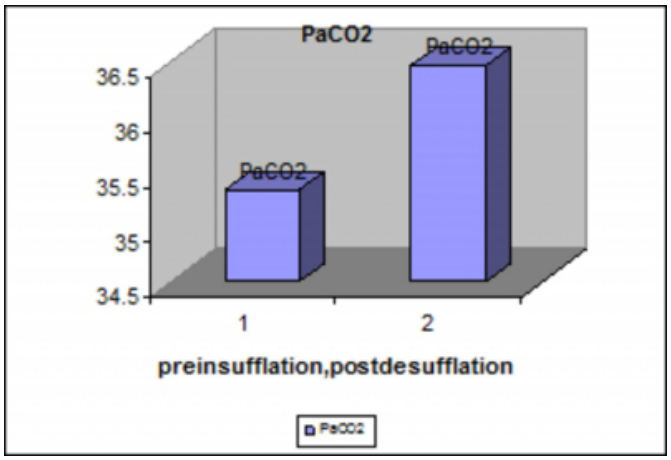


Figure 9

GRAPH 4 COMPARISON OF HCO3

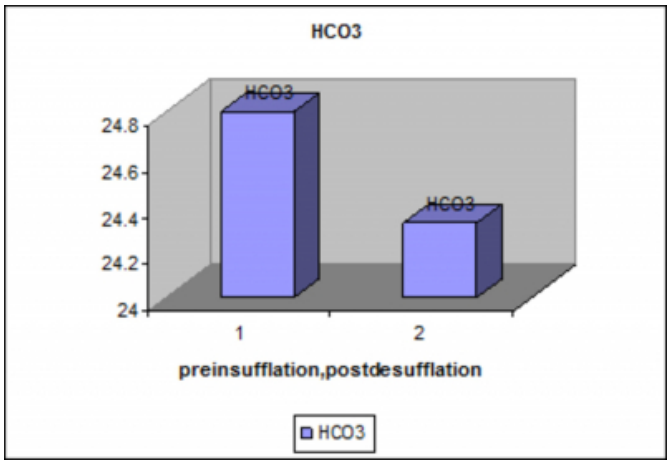
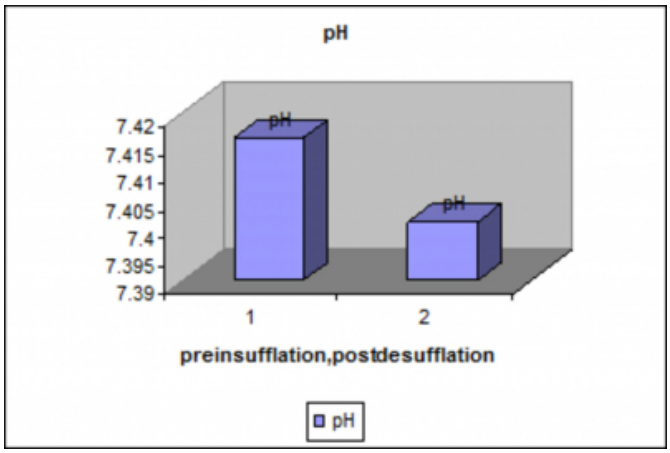


Figure 10

GRAPH – 5 COMPARISON OF PH



The statistical data was calculated by MedCalc software, where unpaired “t” test was done and that’s how “p” value was calculated after finding mean and standard deviation.

DISCUSSION

Laparoscopy has advantages of reduced hospital stay, small incision, little pain, less disfigurement and rapid return to normal activities and thus has become highly prevalent. The hemodynamic effects produced by the pneumoperitoneum depend on the amount of gas insufflated and the preoperative vital parameters and intravascular volume status in healthy patients. The intraabdominal pressure of greater than 12 mmof Hg Following has significant intraoperative hemodynamic effects which decreases the cardiac index by 35 -40% with anesthesia and positioning and further 50% reduction occurs with CO_2 insufflation which leads to venacaval compression and venous pooling. The CO_2

absorption and acid base changes occur, which might be respiratory or metabolic, which are dependent on the lung elimination or else causes CO_2 retention and respiratory acidosis or anaerobic metabolism.

CO_2 is 20 times more soluble than air and Oxygen and thus more rapidly absorbed from the peritoneal cavity [1]. CO_2 used as the gas for insufflation for pneumoperitoneum is absorbed from the peritoneum and then excreted from the lungs [6]. Keeping this in mind, if the ventilatory parameters are not adjusted accordingly, it causes hypercarbia, Respiratory acidosis and haemodynamic changes. In comparison to CO_2, Air, Oxygen, N_2O, Helium, etc have lower solubility so, duration of surgery and Intraabdominal pressure influence the CO_2 absorption in normal patients [9]. Thus to combat the adverse effects of CO_2, increasing the minute volume by hyperventilating helps [2].

In our study, we increased the minute volume by increasing the Respiratory rate to 15/min and Intraabdominal pressure was maintained below 15 mm of Hg [5, 6]. After increasing the Minute ventilation, $PaCO_2$ was maintained between 30 to 40 mm of Hg. Preoperatively, the $PaCO_2$ level was 35.344 ± 2.626 mmHg and postdesufflation the level was 36.476 ± 2.41251 mmHg, where the p value was 0.119 which was nonsignificant [8,10]. The $EtCO_2$ values were maintained between 33.56 ± 3.24mmHg and 36.98 ± 3.54 mmHg preinsufflation and postdesufflation respectively, which was statistically significant (p=0.002) [8].This changes were insignificant as the patients did not have any cardiovascular or respiratory abnormalities. [3] Minute volume was increased and as result pH, $PaCO_2$ and HCO_3 did not show any abnormalities and were in the clinical range [4].

Mullet and Colleagues noted that 25% increase in $PaCO_2$ was noted after CO_2 pneumoperitoneum [7]. Hirovonen Eiola A. noted $EtCO_2$ and $PaCO_2$ were well maintained within an acceptable range in healthy patients[8] .Wurst studied that increase of 40% minute volume, kept the $PaCO_2$ normal during the pneumoperitoneum [7]. El Minani ME. reported that in laparoscopic surgery with CO_2 pneumoperitoneum, there is increase in $PaCO_2$ significantly than N_2O[1] .Wittgen studied that during laparoscopy the arterial blood gases showed increase in pH and PaCO2 in patients with compromised cardio respiratory status[3] . Sene Demirowk studied the effects of intraperitoneal and extra peritoneal CO_2 insufflation where CO_2 intraperitonealy caused significant increase in $PaCO_2$ values [9] .GR Kelman studied cardiac output and Arterial blood gas analysis which showed no significant changes in Blood gas levels [10]. Pavlidas showed no statistically alteration, at anytime, in values of PaO_2, SpO_2, and HCO_3, Mean Arterial BP, and Heart rate especially in ASA grade I and II patients [11]. Hideo Iwaska showed that there was increase in $PaCO_2$ due to decreased compliance and thus, Respiratory acidosis in Laparoscopic Cholecystectomy in comparison with open Cholecystectomy [12].

Out of total 30 patients studied only one patient had intraoperatively Hypertension which was treated with Inj Nitroglycerine infusion 1 g/kg/min. The CO_2 load which increases gradually during pneumoperitoneum [9], due to release of CO_2 from the peritoneum, which is excreted from the lungs. This level can be checked by increase in the minute volume, thus raising the respiratory rate by 15/min during the pneumoperitomeum. The Airway pressure and haemodynamic parameters are highly dependent on the adjustments made during the ventilation [10].

CONCLUSION

The hemodynamics changes varied from baseline i.e. preoperative level, but remained within normal range i.e. both the heart rate and the Systolic blood pressure, but the diastolic blood pressure significantly changed. CO_2 load increases during Laparoscopic surgery which causes rise in the $EtCO_2$ compared to preoperative level which was statistically significant. The mean gradient between PaCO2 $_{and}$ the end tidal $CO_{2\ does}$ not change significantly during peritoneal insufflations of CO_2. The rise in $PaCO_2$ and HCO3 in the postdesufflation period remains clinically and statistically notsignificant and the pH reduce significantly but are within normal physiological range. This changes remain insignificant as the minute volume is raised by raising the respiratory rate to 15/min, which helps in better elimination of CO_2. The changes in $EtCO_2$ are more significant during the pneumoperitoneum, but after desufflation, CO2 excretion occurs and the blood gas values return to the baseline especially in healthy patients.

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