Section: Anesthesiology

Original Research Article

A PROSPECTIVE COMPARATIVE STUDY TO ASSOCIATE ARTERIAL BLOOD GAS CHARACTERISTICS IN SMOKER AND NON-SMOKERS UNDERGOING LAPAROSCOPIC SURGERIES

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Abstract

Background: Post-operative complications after general anaesthesia is very high in smokers, this response is exaggerated after laparoscopic surgery due to insufflation with CO2, metabolic response to surgical stress of laparoscopic surgery seems to be less in non-smokers. Aim of the study was to associate different arterial blood gas parameters and metabolic response of pneumo-peritoneum in smokers compared to non-smokers during general anaesthesia in laparoscopic surgery. **Materials and Methods:** Two groups of patients, 30 in each of smokers and non-smokers undergoing general anaesthesia for elective laparoscopic surgeries were studied after proper informed consent, baseline hemodynamic parameters with arterial blood gas parameters during different intervals were documented and compared between two groups. Statistical analysis used: Chi-square test, unpaired student 't' test, Kolmogorov-Smirnov test. **Result:** pCO_2 and end-tidal CO_2 were significantly higher in smokers at all intervals, pH was significantly lower and HCO_3^- was higher in smokers after creation of pneumo-peritoneum. Increase in pCO_2 due to pneumo-peritoneum was higher in the smoker. **Conclusion:** Significant difference was observed between smokers and non-smokers in arterial blood gas characteristics. Metabolic response to CO2 insufflation was observed to be greater in smokers than non-smokers.

INTRODUCTION

Laparoscopic surgeries are increasingly gaining popularity pertaining to their less invasive nature, smaller incisions, better patient compliance and satisfaction, less post-operative pain, decreased blood loss and overall reduction in many complications and hospital stay. This not only benefits patient but also surgeon and anaesthetist too.[1-3]

For an anaesthetist one of the notable events which cause numerous physiological and haemodynamic changes is insufflation with carbon dioxide (CO2). Absorption of carbon dioxide (CO2) used in insufflation can cause hypercapnia and respiratory acidosis. This further activates the sympathetic nervous system and sensitises the myocardium to catecholamines. This along with a decrease in preload and venous return due to increased intra-abdominal pressure may cause a gross decrease in cardiac output.[4,5]

Cigarette smoking is one of the biggest causes of morbidity and mortality in the world. It is estimated that smoking kills nearly six million people worldwide every year. Death rate is 70% greater in male smokers than in non-smokers.[6]

Chronic smoking causes number of pathological derangements in the lungs from inflammation to oxidative stress, creates imbalance of protease and anti-protease, pulmonary hypertension, ciliary dysfunction with mucosal hypersecretion causes airway limitations all resulting in decreased lung compliance and cardiopulmonary reserve.[7,8] In these patients pneumo-peritoneum in laparoscopic surgeries, further aggravates acid-base status of the body and may result in poor post-operative outcome and increased complications.

Aims of the study were to associate different arterial blood gas parameters like pH, pCO2, HCO3 in smokers and compare it with that of non-smokers,

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compare changes in arterial blood gas values during pre-, intra- and post-operative stages, and to establish changes in arterial blood gas parameters after pneumo-peritoneum and compare those changes between smokers and non-smokers.

MATERIALS AND METHODS

After approval from Institutional Ethics Committee, this prospective comparative study was carried out at a tertiary care centre over a period of 10 months. Study comprised of two groups with 30 patients each. Group I had patients with history of smoking for more than 10 years and Group II had no history of smoking. All the patients included were of 18 to 60 years of age from either sex, undergoing elective laparoscopic surgery under ASA grade I or II. Excluding the patients with no consent, ASA grade III or IV, emergency surgeries, hypertension, uncontrolled DM, pulmonary or cardiac pathologies, systemic infections, malignancies or history of alcohol or drug abuse.

Pre-Anaesthetic Evaluation and Induction

Detailed history was taken along with physical examination, systemic examination, and airway examination. Basic laboratory investigations like haemoglobin, total leukocyte count, differential count and platelet count, liver function test, renal function test, chest x-ray, electrocardiogram (ECG) and coagulation profile were done.

On the day of surgery fasting status was confirmed and written informed consent was taken, and all baseline haemo-dynamic parameters were recorded. All the standard monitoring systems like ECG, pulse oximeter, non-invasive blood pressure and capnography were monitored during surgery.

Pre-medication was given with Inj. Fentanyl (2 µg/kg) IV and Inj. Glycopyrrolate (0.2 mg) IV. After pre-oxygenation with 100% oxygen for 3 min, induction was done with Inj. Propofol (2–2.5 mg/kg) IV and Inj. Succinylcholine (1-1.5 mg/kg) IV. Endo-tracheal intubation was done with appropriate size endotracheal tube, which was confirmed by bilateral equal air entry, adequate chest-rise and capnography. Anaesthesia was maintained with Oxygen (50%), N2O (50%) and Isoflurane along with intermittent Inj. Vecuronium (0.02 mg/kg) IV. After completion of surgery neuro-muscular blockade was reversed with Inj. Neostigmine (0.05 mg/kg) IV and Inj. Glycopyrrolate (0.01 mg/kg) IV. All patients were monitored for 24 hrs postoperatively.

Ventilation

Ventilation was initially maintained with a tidal volume (TV) of 8 ml/kg with a respiratory rate of 14/min followed by TV of 6 mL/kg with the rate of 16/min after the creation of pneumoperitoneum in both groups. During surgery, intraabdominal pressure (IAP) was maintained at 12 mmHg. Permissive hypercapnia was allowed till the point of any haemo-dynamic derangement.

Arterial Blood GAS

Before taking sample modified Allen's test was performed to check the patency of collateral vessels. The sample was drawn in 3 different settings with the help of 2 mL heparinised syringe. The first sample was drawn 10 min before induction, the second one was drawn 10 min after pneumo-peritoneum and last sample was drawn 30 min after extubation.

Study Parameters

During surgery baseline haemodynamic parameters were noted along with end-tidal carbon dioxide (ETCO2) levels before the creation of pneumo-peritoneum, after pneumo-peritoneum and after deflation of pneumo-peritoneum. pH, pCO2 and HCO3 were recorded from the three ABG samples.

Statistical Analysis

For categorical data, the Chi-square test was used. For comparing two independent study groups unpaired student't' test was used. Normality of data was tested using the Kolmogorov-Smirnov test. The critical value of 'P' indicating the probability of significant difference was taken as <0.05 for comparison.

RESULTS

In the smoker group, out of 30 participants 21 were male (70%) and 9 were females (30%). In the non-smoker group, out of 30 participants 11 were male (36%) and 19 were females (63%). In total 53% were male and 46% were female. [Table 1]

Mean duration of pneumo-peritoneum was similar in both groups, 42.38±10.7min in smokers versus 43.8±8.90min in non-smokers (p=0.5784). Both groups had no differences in mean age(p=0.2798). There was no significant difference between mean heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure between two groups. But the difference between oxygen saturation were significant(p=0.0018). [Table 2]

Values of pCO2 and ETCO2 were significantly higher in the smoker group at all stages of sampling and measurement(p<0.001). There was no significant difference in mean baseline pH values but was significantly lower in smokers after pneumo-peritoneum and extubation.Bicarbonate values were significantly higher in the smoker group after pneumo-peritoneum and extubation. [Table 3]

Increase in pCO2 due to creation of pneumo-peritoneum was significantly higher in the smoker group(p=0.0312). Difference of increase in HCO3 and decrease in pH due to pneumo-peritoneum was not significant between two groups. [Table 4]

Table 1: Demographic Distribution between smokers and non-smokers

Gender	Smoker	Non-smoker	total
Male	21	11	32

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Female	9	19	28
Total	30	30	60

Table 2: Comparison of demographic and baseline clinical parameters between smokers and non-smokers (Unpaired Student t-test, *p<0.01 significant)

Parameters	Smokers	Non-smokers	t	P
Age (years)	38.04±5.92	39.80±6.56	1.0909	0.2798
Heart rate	88.30±8.66	84.82±7.90	1.6261	0.1094
Systolic blood pressure (mmHg)	128.60±9.56	124.38±10.06	1.6655	0.1012
Diastolic blood pressure (mmHg)	82.90±8.33	80.74±9.25	0.9504	0.3458
Mean arterial pressure (mmHg)	97.13±5.65	95.28±6.28	1.1995	0.2352
spO2 (%)	98.28±0.36	98.74±0.68	3.2746	0.0018*

Table 3: Comparison of blood gas parameters at various intervals between smokers and non-smokers (Unpaired Student t test, *p<0.05 significant)

Parameters	Smokers	Non-smokers	t	p
ETCO2 values (mmHg)				
Pre pneumo-peritoneum	36.76±5.48	31.47±6.21	3.4984	<0.001*
During pneumo-peritoneum	42.39±6.83	33.70±6.18	5.1675	<0.001*
After pneumo-peritoneum	40.88±7.26	31.92±7.13	4.8229	<0.001*
pH				
Pre pneumo-peritoneum	7.40±0.056	7.41±0.035	0.8294	0.4103
During pneumo-peritoneum	7.36±0.044	7.38±0.027	2.122	0.0381*
After pneumo-peritoneum	7.37±0.038	7.41±0.040	3.971	<0.001*
PCO2 (mmHg)				
Pre pneumo-peritoneum	39.58±6.80	35.82±4.27	2.5648	0.0129*
During pneumo-peritoneum	43.63±4.82	36.26±3.98	6.4579	<0.001*
After pneumo-peritoneum	41.04±4.56	35.63±3.83	4.9756	<0.001*
HCO3 (mmol/L)				
Pre pneumo-peritoneum	24.45±5.26	23.19±3.97	1.0472	0.2993
During pneumo-peritoneum	26.38±4.94	23.59±3.45	2.5362	0.0139*
After pneumo-peritoneum	26.26±5.37	23.06±3.76	2.6737	0.0097*

Table 4: Comparison of change in blood gas parameters due to pneumo peritoneum between smokers and nonsmokers (Unpaired Student t test, *p<0.05 significant)

Parameters	Smokers	Non-smokers	t	p
Increase in ETCO2	5.63±8.97	2.23±7.31	1.6094	0.113
Decrease in pH	0.04±0.07	0.03±0.046	0.6539	0.5158
Increase in pCO2 (mmHg)	4.05±7.83	0.44±4.34	2.2087	0.0312*
Increase in HCO3 (mmol/L)	1.93±6.06	0.4±3.91	1.162	0.25

DISCUSSION

Smoking is known to decrease pulmonary function and is associated with chest wall abnormalities, which results in reduced chest expansion and flexibility so increases the vulnerability to CO2 retention.[9,10] Laparoscopic surgeries further increase chances of postoperative pulmonary complications, especially in smokers.There are many studies done which analyses effect of pneumo-peritoneum on clinical and biochemical parameters.[11-15]

Comparison of these changes between smokers and non-smokers were done in pilot study by Amiya K. Barik et al,[1] in patients undergoing laparoscopic cholecystectomy. This study was done to further emphasize the hazardous outcome that can occur in smokers undergoing laparoscopic surgeries. In our study, no differences were observed in baseline hemodynamic parameters, which is consistent with, Amiya K. Barik et al,[1] except for systolic blood pressure which was significantly higher in the smoker group of Amiya K. Barik et al,[1] possibly due to sympathetic stimulation.

Oxygen saturation was found to be significantly lower in smoker group, which also aligns with most literature as published by Tail et al.[2] ETCO2 and pCO2 values were significantly higher in the smoker group at all-time intervals including the baseline.Kelman et al,[3] in a study also found significant increase in ETCO2 after insufflation. pH values were significantly lower, and bicarbonate was significantly higher during the period of pneumo-peritoneum and after extubation in the smoker group compared to non-smokers. Zulfikaroglu et al,[4] also found in their study similar metabolic changes in patients undergoing laparoscopic surgery.

In this study, the change in pCO2 value due to the effect of pneumo-peritoneum in the smoker group was higher than a non-smoker, and also was statistically significant, this justifies that there are higher chances of CO2 retention in smokers than in non-smoker. While the difference of changes in pH and bicarbonate were not statistically significant. Landin et al,[5] in laparoscopic inguinal hernia surgeries found smoking to be a modifiable risk factor and found a significant association between smoking and postoperative pulmonary complications.

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CONCLUSION

There is a significant difference in baseline arterial blood gas characteristics between smokers and non-smokers. Metabolic effects of CO2 insufflation and increased IAP appear to be more enhanced in smokers. Smokers coming for laparoscopic surgery should be optimized aggressively and special caution should be taken in longer duration surgeries.

REFERENCES

1. Barik AK, Kumar A, Dhar M, Ranjan P. A prospective comparative study of arterial blood gas parameters in smoker versus non-smoker patients undergoing laparoscopic cholecystectomy. Indian J Anaesth. 2020;64(5):397-402. doi:10.4103/ija.IJA_953_19
2. Tait AR, Kyff JV, Crider B, Santibhavank V, Learned D, Finch JS. Changes in arterial oxygen saturation in cigarette smokers following general anaesthesia. Can J Anaesth1990;37:423-8.
3. Kelman GR, Swappy GH, Smith I, Benzie RJ, Gordon NL. Cardiac output and arterial blood-gas tension during laparoscopy. Br J Anaesth1972;44:1155-62.
4. Zulfikaroglu B, Koc M, Soran A, Isman FK, Cinel I. Evaluation of oxidative stress in laparoscopic cholecystectomy. Surg Today 2002;32:869-74.
5. Landin M, Kubasiak JC, Schimpke S, Poirier J, Myers JA, Millikan KW, et al. The effect of tobacco use on outcomes of laparoscopic and open inguinal hernia repairs: A review of the NSQIP dataset. Surg Endosc2017;31:917-21.
6. Mishra GA, Pimple SA, Shastri SS. An overview of the tobacco problem in India. Indian J Med Paediatr Oncol 2012;33:139-45.
7. Kuznetsova TD, Erikova LV, Sokolov EV. [Effect of smoking on the respiratory function of the lungs in adolescents]. Pediatriia 1985:26-8.
8. Tait AR, Kyff JV, Crider B, Santibhavank V, Learned D, Finch JS. Changes in arterial oxygen saturation in cigarette smokers following general anaesthesia. Can J Anaesth1990;37:423-8.
9. Tantisuwat A, Thaveeratitham P. Effects of smoking on chest expansion, lung function, and respiratory muscle strength of youths. J Phys Ther Sci 2014;26:167-70.
10. Kuperman AS, Riker JB. The variable effect of smoking on pulmonary function. Chest 1973;63:655-60.
11. Kelman GR, Swappy GH, Smith I, Benzie RJ, Gordon NL. Cardiac output and arterial blood-gas tension during laparoscopy. Br J Anaesth1972;44:1155-62.
12. Iwasaka H, Miyakawa H, Yamamoto H, Kitano T, Taniguchi K, Honda N. Respiratory mechanics and arterial blood gases during and after laparoscopic cholecystectomy. Can J Anaesth1996;43:129-33.
13. Zulfikaroglu B, Koc M, Soran A, Isman FK, Cinel I. Evaluation of oxidative stress in laparoscopic cholecystectomy. Surg Today 2002;32:869-74.
14. Critchley LA, Critchley JA, Gin T. Haemodynamic changes in patients undergoing laparoscopic cholescystectomy: Measurement by transthoracic electrical bioimpedance. Br J Anaesth1993;70:681-3.
15. Chopra G, Singh DK, Jindal P, Sharma UC, Sharma JP. Haemodynamic, end-tidal carbon dioxide, saturated pressure of oxygen and electrocardiogram changes in laparoscopic and open cholecystectomy: A comparative clinical evaluation. Int J Anesthesiol 2008;16.

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