Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(4D):1384-1391 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Original Research Article

Arterial blood gases changes in upper abdominal surgeries. A prospective study

Dr. Raja Suhail Shounthoo[1], Dr Anjum Shamim[2], Dr Aijaz Ahmad Zargar[3], Dr (Professor) Abdul Hameed[4].
[1]Postgraduate, [2,3]Senior Resident, [4]Professor, Department of Anaesthesia, Government medical college Srinagar, Jammu & Kashmir, 190010, India.

***Corresponding author**
Dr. Anjum Shamim
Email: anj.khan786@gmail.com

Abstract: Postoperative pulmonary complications (PPCs) are defined as pulmonary abnormalities occurring in postoperative period which produce clinically significant, identifiable disease or dysfunction that adversely affects the patients' clinical course and manifests in changes in blood gases coefficients. Upper abdominal surgical procedures are associated with a high risk of postoperative pulmonary complications (PPCs) which manifest in the ABG (arterial blood gases) of the patients. Despite recent advances in preoperative management, postoperative respiratory morbidity is still a common problem especially following upper abdominal surgery. The objective is to study the risks of postoperative complications, a pre-operative medical evaluation of the patients was done by performing ABG (arterial blood gases) both pre and post operatively and study the changes in them. The Aim is to see the impact of upper abdominal surgeries (cholecystectomy or gastrectomy) on post-arterial blood gas (ABG) in elderly patients. To compare and analyse the change in ABG parameters preoperatively and post operatively. In methods we performed a randomly controlled prospective hospital study including eighty patients. Patient's ≥ 60 years of age were taken randomly of both the sexes which were of ASA status 2 to 3, planned for elective, non-laparoscopic, upper abdominal surgeries (cholecystectomy or gastrectomy). The selected individuals were subjected to preoperative assessments and ABG preoperatively. After surgery and proper recovery from the anesthesia ABG was again carried out in the post-operative period on the first and second post-operative days as was done pre-operatively and the changes in their ABGs were noted. The results in our study arterial pH, PO_2 and PCO_2 were studied preoperatively and on the first and second post operative day following upper abdominal surgeries. There is change in pH, PO_2 and PCO_2 on the first and second post operative day following upper abdominal surgeries , the change being more on first post operative day than the second .Improvement was seen beyond the second post operative day and there-on. In conclusion the Following upper abdominal surgeries , there is change in arterial pH, PO_2 and PCO_2 on the first and second post operative day following upper abdominal surgeries , the change being more on first post operative day than the second in PO_2 and PCO_2 , not so much in the arterial pH of patients blood. Hence these ABG measurements allows patients with pulmonary abnormality to be objectively screened and could be useful for predicting operative risk related to abnormal pulmonary function.
Keywords: ABG (arterial blood gases), partial pressure of oxygen ($PO_{2)}$), partial pressure of carbon dioxide ($PCO_{2)}$), elective upper abdominal surgery

INTRODUCTION:

The relationship between preoperative variables and postoperative pulmonary complications in surgical patients has been the subject matter of numerous studies. Despite recent advances in preoperative management, postoperative respiratory morbidity is still a common problem especially following upper abdominal surgery [1]. Postoperative pulmonary complications following abdominal surgery are frequent and associated with increased morbidity; mortality and length of hospital stay [2].

Upper abdominal surgical procedures are associated with a high risk of postoperative pulmonary complications, which are defined as, pulmonary abnormalities occurring in the postoperative period that produce clinically significant, identifiable disease or dysfunction adversely affecting the patients' clinical course[3].The incidence rate of postoperative pulmonary complications depends on the surgical site, the presence of risk factors, and the criteria used to define a postoperative pulmonary complication [4]. Reported incidence of postoperative pulmonary complications in upper abdominal surgery range from 17% to 88% [5]. Pulmonary complications include atelectasis, pneumonia, respiratory failure and tracheobronchial infections. There are numerous risk factors, like

Patient-Related:
• Age ≥60 years
• ASA class ≥II
• Heart failure
• Partial or total functional dependence
• Chronic obstructive pulmonary disease
• Weight loss
• Delirium
• Cigarette smoking
• Alcohol use
• Abnormal findings in chest examination

Procedure-Related
• Thoracic surgery
• Abdominal surgery
• Neurosurgery
• Head and neck surgery
• Emergency surgery
• Vascular surgery
• Use of general anesthesia
• Blood product transfusion

Laboratory Test–Related
• Albumin level <35 g/L
• Abnormal chest radiograph
• BUN level >7.5 mmol/L (>21 mg/dL)

Advances in anesthetic and surgical techniques with improved perioperative care, have substantially reduced related mortality [6].

A preoperative anaesthetic evaluation enables clinicians to accomplish two distinct yet related goals. To predict the risk of perioperative complications, and to eliminate or reduce the risk of complications perioperatively. The first goal is usually accomplished by careful history taking and examination of patients and through risk assessment indices that predict the incidence of complications. The evidence necessary to develop and validate risk indices is obtained through observational, cohort, and case-control studies. The second goal is accomplished through preoperative and perioperative risk reduction interventions. The evidence necessary to prove that interventions reduce the incidence or severity of complications is obtained through randomized, controlled trials. Knowledge of anaesthesia related risk factors can optimize patient care through improved communication between medical, surgical and anaesthesia teams. Pulmonary comorbidity is one of the most common underlying problems, which is widely believed to increase the risk of postoperative respiratory complications [7]. COPD, pneumonia, and sleep apnoea are common in the elderly. Arterial blood oxygen tension decreases progressively with age-induced ventilation: perfusion mismatch, diffusion abnormalities, and anatomical shunts [8].

Laboratory results like Arterial blood oxygen tensions; monitor patient- and procedure-related determinants of risk for perioperative pulmonary complications have recently been reviewed in the literature [9]. Some of these factors can be modified to alter risk. The pulmonary status shown in Arterial blood oxygen tension of patients with recent exacerbations or infections should be allowed to improve whenever possible. Administration of antibiotics, bronchodilators, and steroids, referral to pulmonologists or internists, and postponing surgery are important in patients at high risk by monitoring Arterial blood oxygen tensions repetitively. Training patients preoperatively in lung expansion manoeuvres, such as deep-breathing exercises and incentive spirometry, reduces pulmonary complications more than training postoperatively does. Additionally, a change in perioperative management, including altering the planned surgical procedure if possible, discussing alternatives to general anaesthesia, especially when peripheral nerve blocks are an option, and educating the patient about the benefits of epidural pain management, may provide effective measures to decrease pulmonary complications [10].

METHODS:

A hospital based prospective observational study was conducted at the SMHS hospital which is one of the associated hospitals of Government Medical College, Srinagar. After obtaining approval from Hospital Ethics Committee, a written informed consent was taken from the patients for participation in this study. Eighty patients were included in the study. The selected individuals were subjected to arterial blood gas analysis pre and post operatively.

Inclusion criteria
1. Patient's ≥ 60 years of age were taken for the study.
2. Patients of both the sexes were selected.
3. Patients with ASA status 2 to 3 were included.
4. Patients planned for elective, non-laparoscopic, upper abdominal surgeries (cholecystectomy or gastrectomy) were included.
5. Patients were included randomly.

Exclusion criteria
1. Unstable cardiovascular status(heart blocks, dysrhythmias, heart block, recent MI)
2. Recent cerebrovascular event , increased intracranial pressure, impaired cognitive function
3. known COPD and bronchial asthma patients
4. Chemotherapy patients

STUDY DESIGN AND CONDUCT:

Patients selected for the study were admitted at least 24 hours prior to the planned surgical procedure. An informed consent was taken from the participants found fit for the study. A pre-anaesthetic evaluation was done at this stage. A thorough history including history of any co-morbid diseases, previous anaesthetic exposure, medications, allergy to any drugs and personal habits were elicited. A thorough general physical examination including airway assessment, as well as systemic examination of cardiovascular system, respiratory system and central nervous system were performed. All the baseline parameters (like weight, height, vitals) were measured. A preoperative arterial blood gas analysis (ABG) was done.

Anaesthetic procedure was standardized for the study group. Patients were induced with inj. Propofol 2mg/kg, muscle relaxation was accomplished with inj. Atracurium 0.5mg/kg, and anaesthesia was maintained with Oxygen, Nitrous Oxide and Isoflurane. For maintenance of intraoperative muscle relaxation inj. Atracurium 0.2mg/kg was used. For analgesia, intraoperatively patients were given inj. Tramadol 1mg/kg IV, inj. Paracetamol 1gm IV infusion, and local infiltration with bupivacaine 0.25% at the incision site. At the end of the surgical procedure, residual neuromuscular blockade was antagonized with inj. Neostigmine 50µg/kg IV and inj. Glycopyrrolate 10µg/kg IV.

Arterial Blood Gas (ABG) analysis was again carried out in the post-operative period on the first and second post-operative days as was done pre-operatively. No rescue analgesia was used, and patients with pain score of >4 on VAS scale were excluded from the study.

STATISTICAL ANALYSIS:

Statistical software SPSS (version 20.0) and Microsoft Excel were used to carry out the statistical analysis of data. Descriptive Statistics of data including the means and standard deviations for numerical variables and the percentages of different categories for categorical variables was obtained. Student's independent t-test was employed for inter group analysis of data. Intra group analysis was carried out with the help of Paired t-test. Graphically the data was presented using bar diagrams. A P-value of less than 0.05 was considered statistically significant.

RESULTS:

The total number of individuals in the studied population was 82, age ranging from 60-85 years and mean age 65.1±6.31 years. The total number of individuals in 60-70 years age group was 57 (69.5%). In the age group of 70-80 years, total number of individuals was 22 (26.8%). In the age group 80-90 years the number of individuals was 03(3.7%) as in table 1 and fig. 1.

Table 1: Age distribution of patients

Age (years)	No.	Percentage	Mean±SD	Range
60-70	57	69.5	65.1±6.31	60-85
70-80	22	26.8		
80-90	03	3.7		
Total	82	100		

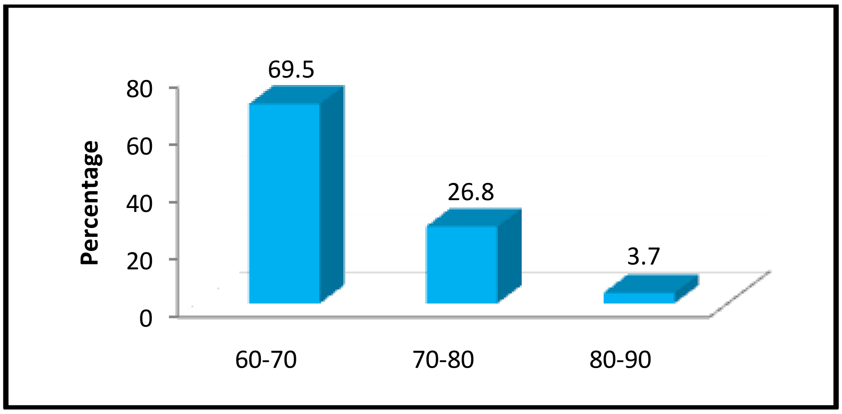

Fig. 1: Age distribution of patients

Table 2: Gender distribution of patients

Gender	No.	Percentage
Female	46	56.1
Male	36	43.9
Total	82	100

The total number of individuals in the studied population was 82, among which there were 46 (56.1%) females and 36(43.9%) males, with a male female ratio of 0.78 as in table 2 and fig. 2.

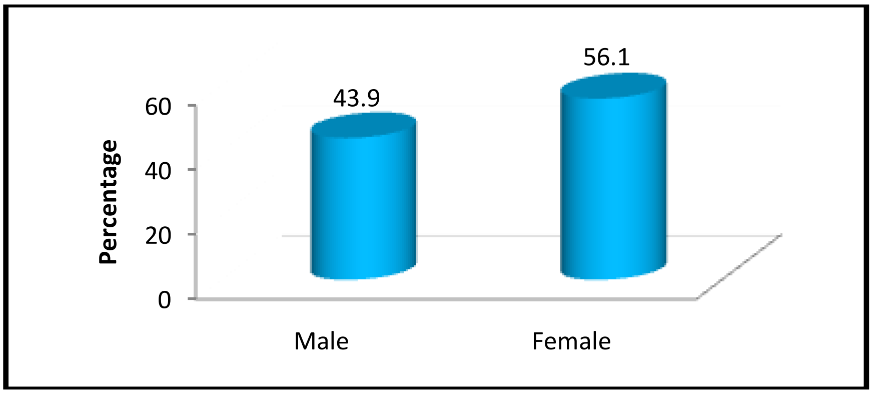

Fig-2: Gender distribution of patients

Table 3: Showing mean weight and height in patients

Variable	**Mean**	**SD**	**Range**
Weight (kgs)	56.3	7.09	40-74
Height (cms)	157.8	11.15	144-193

The mean weight of the studied population was 56.3±7.09 kgs (Range=40-74 kgs), and the mean height of the studied population was 157.8±11.15 cms (Range=144-193 cms) as in table 3 and fig 3.

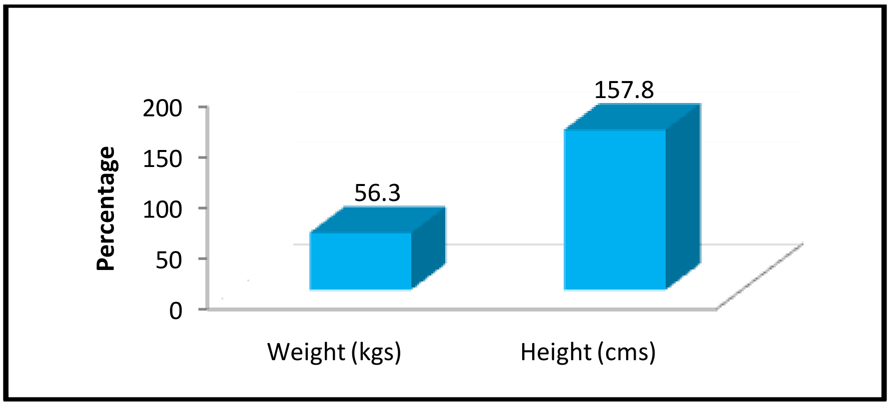

Fig-3: Showing mean weight and height in patients

Table-4: Showing type of Surgical Incision in patients

Type of Surgery/ incision	**No.**	**Percentage**
Cholecystectomy (R. sub costal incision)	67	81.7
Gastrectomy (Upper mid-line incision)	15	18.3

Of the 82 patients in the study group 67 (81.7%) patients were subjected to Open cholecystectomy using right sub costal incision and 15 (18.3%) were subjected to Gastrectomy via an upper midline incision depicted in table 4 and fig 4.

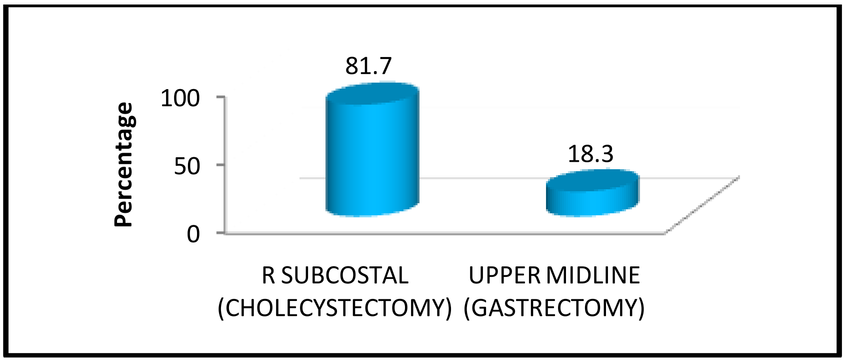

Fig. 4: Showing Incision type in patients

Table 5: Comparison of Changes in pH in all patients

Time Interval	**Mean**	**SD**	**Diff.**	**P-value**
Preop	7.39	0.027	-	-
Postop Day 1	7.38	0.052	0.014	0.112
Postop Day 2	7.39	0.027	-	0.371

The mean pH in the preoperative period was 7.39±0.027. The mean postoperative pH was 7.38±0.052 and 7.39±0.027 on first and second postoperative days respectively; there was a slight decrease in pH on first postoperative day (7.38±0.052) which returned to baseline on the second postoperative day (7.39±0.027). However, the change was statistically non-significant (P-value 0.112 & 0.371 respectively) as in table 5 and fig. 5.

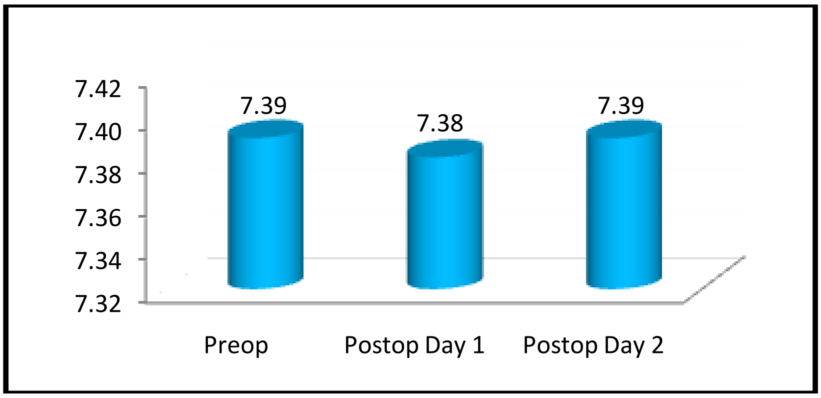

Fig. 5: Comparison of Changes in pH in all patients

Table 6: Comparison of Changes in PCO_2 in all patients

Time Interval	**Mean**	**SD**	**Diff.**	**P-value**
Preop	39.48	2.65	-	-
Postop Day 1	41.35	4.84	-1.87	0.001*
Postop Day 2	40.02	3.97	-0.54	0.227

***Statistically Significant Difference from preoperative PCO2**

The mean preoperative PCO_2 was 39.48±2.65mmHg. The mean postoperative PCO_2 was 41.35±4.84mmHg and 40.02±3.97mmHg on first and second postoperative days respectively. There was a slight CO_2 retention on the first postoperative day (41.35±4.84mmHg), a statistically significant rise (P-value 0.001). Although, some amount of PCO_2 retention continued on the second postoperative day (40.02mmhg±3.97), however being statistically non-significant (P-value 0.227) as in table 6 and fig. 6.

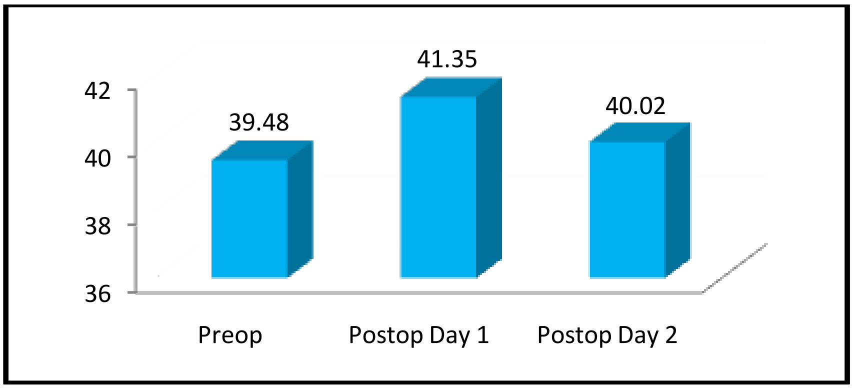

Fig. 6: Comparison of Changes in PCO2 in all patients

Table 7: Comparison of Changes in PO_2 in all patients

Time Interval	**Mean**	**SD**	**Diff.**	**P-value**
Preop	81.01	1.88	-	-
Postop Day 1	65.4	3.69	15.61	<0.001*
Postop Day 2	75.1	1.88	5.91	<0.001*

***Statistically Significant Difference from preoperative PO2**

The mean preoperative PO_2 was 81.01±1.88mmHg. The postoperative PO_2 was 65.4±3.69mmHg and 75.1±1.88mmHg on first and second postoperative days respectively. There was a decrease in PO_2 on first postoperative day (65.4±3.69mmHg) suggesting hypoxemia, which persisted on second postoperative day (75.1±1.88mmHg) as in table 7 and fig. 7. The drop in the PO_2 was statistically significant on both postoperative days (P-value of <0.001).

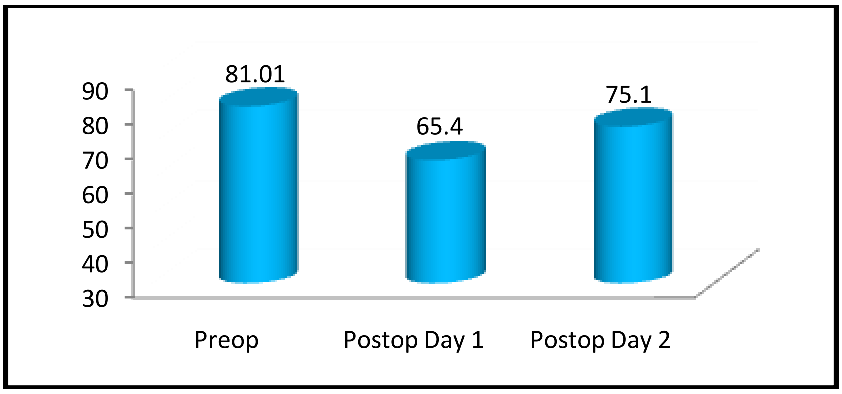

Fig. 7: Comparison of Changes in PO2 in all patients

DISCUSSION:

Postoperative respiratory insufficiency is a known complication in patients who have undergone major abdominal surgery. Smoking, old age and co-existing pulmonary diseases are principal factors in the development of postoperative respiratory insufficiency [11]. The contribution of pain to the impairment of pulmonary function has been demonstrated in many studies [12]. Other important predictors of adverse pulmonary outcome include site of surgery, duration and type of anaesthesia, and preoperative hypersecretion of mucus [13]. Most significant being the site of surgery [14]. The primary goal of present study was to determine the impact of upper abdominal surgeries on ABG in patients. The arterial blood gas analysis included pH, partial pressure of carbon dioxide (PCO2), partial pressure of oxygen (PO2) and oxygen saturation (SO2).

The present study included a total of 82 patients with age ≥60 years, ASA class II, submitted for upper abdominal surgeries. Similar number of patients was studied by A. J. Karayiannakis, *et al.;* in 1996 who had compared postoperative pulmonary function after laproscopic and open cholecystectomy. A total of 46 female and 36 male patients were studied over a period of 18 months [15]. Preoperative and postoperative ABG was carried out in all the patients. Comparative analysis was made based on gender, body mass index and the type of surgical incision. The mean age of studied patients was 65.1±6.31 years, comparable with the mean age of patients studied by Jin Huh *et al.;* in 2013, where the mean age of the patients was 67.0±6.3 years [16]. Cholecystectomy using a right sub costal incision was performed in 67 patients (81.7%), and gastrectomy in 15 patients (18.3%), via an upper midline incision. Postoperative arterial blood gas analysis of the study subjects showed a slight fall in pH from a preoperative value of 7.39 to 7.38 on the first postoperative day, pH returned to baseline on the second postoperative day. The same can be explained by a concurrent change in the PCO2 values from a mean preoperative PCO2 of 39.48 mmHg to PCO2 of 41.35 mmHg on first postoperative day, reflecting a significant CO2 retention, due to poor patient respiratory effort(p-value 0.001), this change in PCO_2 became non-significant by the second postoperative day (p-value 0.227). The mean postoperative PO2 dropped from a preoperative value of 81.01mmHg to 65.4mmHg on the first postoperative day, with a marginal improvement on second postoperative day to a value of 75.1mmHg, however drop in mean PO2 remained statistically significant on both the postoperative days. (P-value <0.001 on both the postoperative days). Ronald G. Latimer *et al.;* have reported similar findings in their study, where they observed a preoperative pH of 7.41±0.031 with a slight reduction in the postoperative pH to a value of 7.40±0.04, however on the second postoperative day the pH tended towards a slightly alkalotic side with a mean value of 7.43±0.031. Ronald G. Latimer *et al.;* reported a preoperative PCO2 of 34.9±4.2 mmHg, which increased to 36.5±5.2 mmHg on the first postoperative day indicating significant CO2retention; however the value of PCO2 decreased to 35.4±4.1 mm Hg by the second postoperative day. They also observed oxygen desaturation in their patient population postoperatively which persisted throughout their seven day study period [17]. The study conducted by Mahul P *et al.;* revealed a preoperative mean PO2 of 86mmHg, which was reduced to a mean value of 75mmHg on the first postoperative day, however on second postoperative day a marginal improvement was noticed in the mean PO2 which rose to a value of 81 mmHg. As per their results the postoperative hypoxemia was statistically significant on both the postop. Days (p-value <0.05) [18].

SUMMARY

The present study was conducted in the Postgraduate Department of Anaesthesiology and Critical Care and performed at SMHS hospital, which is one of the associated hospitals of Government Medical College, Srinagar. In this prospective observational study, elderly patient's ≥ 60 years of age, undergoing upper abdominal surgeries were subjected to preoperative arterial blood gas (ABG) analysis. Patients were subjected to general anaesthesia during the surgery using standard anaesthetic technique. ABG analysis was again repeated in the postoperative period, on first and second postoperative days.

The present study included a sample size of 82 patients (36M & 46F), with a mean age of 65.1±6.31 years, mean weight 56.3±7.09 kg and mean height 157.8±11.15cms, of ASA class II. Open cholecystectomy (R. Sub costal incision) was performed on 67 patients and gastrectomy (Upper midline incision) was performed in 15 patients.

The mean pH in preoperative period was 7.39±0.027; mean pH on first and second postoperative days was 7.38±0.052 and 7.39±0.027 respectively. There was slight drop in pH on first postoperative day (7.38±0.052) which returned to baseline on the second postoperative day (7.39±0.027) [(p-value 0.112 & 0.371 respectively)]. A significant rise in the PCO_2 was observed on the first postoperative day (p-value 0.001); however, the CO_2 retention became less significant (p-value 0.227) but persisted on the second postoperative day. Similarly, significant hypoxemia was observed in the postoperative period, marked by a fall in mean PO_2 by 15.61% on first postoperative day which became less severe on the second postoperative day with a persistent fall in mean PO_2 by 5.91% (p-value<0.001).

CONCLUSION:

Fall in both pH & PO_2 with CO_2 retention was observed during post-operative period. Decline in lung function was more significant in patients undergoing gastrectomy compared to cholecystectomy. However, an improvement in all the parameters of ABG was observed from the second postoperative day.

CONFLICT OF INTERESTS:

The authors declare that there is no conflict of interests regarding publication of this paper.

REFERENCES:

1. Dureuil B, Cantineau JP, Desmonts JM; Effects of upper or lower abdominal surgery on diaphragmatic function.Br J Anaesth 1987; 59:1230-5.
2. Tablan OC, Anderson LJ, Arden NH, Breiman R.P, Butler J.C, McNeil M.M; Guideline for prevention of nosocomial pneumonia. Infect Control Hosp Epidemiol 1994; 15(9):587-627.
3. O'Donohue WJ Jr; Postoperative pulmonary complications: when are preventive and therapeutic measures necessary? Postgrad Med 1992; 91:167–170, 173–175.
4. Hallbook T, Lindblad B, Lindroth B, Wolff T; Prophylaxis against pulmonary complications in patients undergoing gall-bladder surgery. Ann Chir Gynaecol 1984; 73(2):55–58.
5. Garibaldi RA, Britt MR, Coleman ML *et al.;* Risk factors for post-operative pneumonia. Am J Med 1981; 70:677–680.

6. Djokovic JL, Hedley-Whyte J; Prediction of outcome of surgery and anesthesia in patients over 80. JAMA 1979; 242: 2301-6.
7. Kanat F, Golcuk A, Teke T, Golcuk M; Risk factors for postoperative pulmonary complications in upper abdominal surgery. ANZ J Surg 2007; 77:135-41.
8. Sorbini CA, Grassi V, Solinas E, Muiesan G; Arterial oxygen tension in relation to age in healthy subjects. Respiration 1968; 25: 3-13.
9. Yamasawa F, Kawashiro T, Yokoyama T, Ohtsuka N; Standard values and normal limits for arterial blood gases in healthy elderly Japanese subjects. Nihon Kyobu Shikkan Gakkai Zasshi. 1992; 30(3):430-4.
10. Ballantyne J.C, Carr D.B, Suarez T, Lau J, Chalmers T.C, Angelillo I.F, *et al.;* The comparative effects of postoperative analgesic therapies on pulmonary outcome: Cumulative meta-analyses of randomized, uncontrolled trials. Anesth. Analg 1998; 86(3): 598-612.
11. Poe RH, Kallay MC, Dass T, Celebic A; Can postoperative pulmonary complications after elective cholecystectomy are predicted. Am J Med Sci 1988; 29-34.
12. Karayiannakis AJ, Makri GG, Mantizioka A, Karousos D, Karatzus G; Post operative pulmonary function after laparoscopic and open cholecystectomy. Br J Anaesth 1996; 77:448-52.
13. Vodinh J, Touboul C, Lefloch JP, Becquemin JP, Harf A; Risk factors of postoperative pulmonary complications after vascular surgery. Surgery 1988; 105: 360-5.
14. Klotz HP, Canadinas D, Platz A, Horvath A, Dindo D, Schlumpf R *et al.;* Preoperative risk assessment in elective general surgery. Br J Surg 1996; 83(12):1788-91.
15. Karayiannakis AJ, Makri GG, Mantizioka A, Karousos D, Karatzus G; Post operative pulmonary function after laparoscopic and open cholecystectomy. Br J Anaesth 1996; 77:448-52.
16. Huh J, Sohn TS, Kim JK, Yoo YK, Kim DK; Is routine preoperative spirometry necessary in elderly patients undergoing laparoscopy-assisted gastrectomy? Journal of international medical research. 2013; 41(4):1301-9.
17. Gracey DR, Divertie MB, Didier EP; Preoperative pulmonary preparation of patients with chronic obstructive pulmonary disease. Chest 1979; 76:123-29.
18. Mahul P, Burgard G, Costes F, Guillot B, Massardier N, ElKhouri Z *et al.;* Postoperative respiratory function and cholecystectomy by laparoscopic approach. Ann Fr Anesth Reanim. 1993; 12(3):273-7.