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Original Research Article

Analysis of clinico-demographic risk factors for postoperative pulmonary complications following gastrointestinal surgery

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ABSTRACT

Background: Postoperative pulmonary complications (PPC) are one of the commonest complications following gastrointestinal surgery. They lead to increased mortality, increased length of intensive care unit (ICU) stay, and higher cost of treatment. Identifying the risk factors of PPC helps in predicting its occurrence and to develop preventive measures. The objectives of the present study were to study the clinical and demographic risk factors for PPC following gastrointestinal surgery.
Methods: The study was designed as an observational descriptive analytic study. All the patients ≥18 years of age undergoing gastrointestinal surgery were included. The patients with preoperative lung pathology requiring ICU care or ventilatory support and patients with lung metastasis were excluded. The demographic and clinical parameters at admission were recorded. The details of pulmonary complications like the time of occurrence after surgery and the mode of treatment for pulmonary complications were noted. The risk association was assessed for statistical significance.
Results: A total of 100 patients were underwent various gastrointestinal surgeries during the study period. The incidence of PPC was 34% in our study. Age, education status, smoking, and presence of comorbidities were found to be positively associated with an increased incidence of PPCs. The serum albumin of less than 3.5gm and the haemoglobin of less than 8 gm were also associated with an increased incidence of PPC. Pleural effusion was the commonest PPC seen in 15 (44.1%) patients followed by pneumonia in 9 (26.5%).
Conclusions: Age, smoking, education status, serum albumin, haemoglobin, emergency surgery, elective postoperative ventilation, nasogastric intubation and blood loss in the intraoperative period were found to associated with increased risk of PPCs.

Keywords: Post-operative pulmonary infections, Laparotomy, Gastrointestinal surgery

INTRODUCTION

Postoperative pulmonary complications (PPC) are one of the commonest complications following gastrointestinal surgery. They lead to increased mortality, increased length of intensive care unit (ICU) stay, prolonged hospital stay and higher cost of treatment.[1] The incidence of PPC following gastrointestinal surgery varies widely in the literature. 20-69% of PPC are atelectasis and 9-69% are pneumonia, which is due to the difference in the type of pulmonary complications included, clinical diagnostic criteria and the target population.[2] Even in minor surgeries, the incidence can be 1-2%. Identifying the risk factors of PPC helps in predicting the occurrence of it, to take necessary preventive measures in the preoperative period and the effective treatment

postoperatively. Studies have shown that advanced age, obesity, smoking, history of respiratory disease, American Society of Anaesthesiologists classification and incision site have been highly associated with PPCs.[1,2] The factors like preoperative serum albumin and globulin, preoperative lipidemia, chemical therapy, intratracheal intubation, the volume of intraoperative fluid transfusion and blood transfusion, nasogastric intubation and antacids therapy have shown to be associated with PPCs in few studies. However, the predictive value for PPC of some of these factors remains controversial, including preoperative pulmonary function, arterial blood gas analysis, and postoperative analgesia.[3,4] There is also scarcity in studies regarding postoperative pulmonary complication from south India.[4] Hence, this study was done to find the clinical and demographic risk factors for PPC following gastrointestinal surgery.

METHODS

The study was designed as an observational study and conducted in the Department of Surgery, JIPMER from July 2018 to September 2018. All patients ≥18 years of age undergoing gastrointestinal surgery in the Department of Surgery were included in the study. The patients with preoperative lung pathology requiring ICU care or ventilatory support, and patients with gastrointestinal malignancy with lung metastasis were excluded. The diagnosis of pulmonary complication was made by the treating surgeon along with the opinion of pulmonary medicine physician either clinically or radiologically. The following details were collected from the patients who develop postoperative pulmonary complication using a data collection proforma. The demographic parameters such as, age, gender, occupation, socio-economic status, education, addictive behavior, etc., were noted. The clinical parameters like nature of gastrointestinal diseases, duration of illness, indication for surgery, preoperative nasogastric tube insertion, type of surgery, blood loss were noted. The details of pulmonary complications like time of occurrence after surgery, arterial blood gas analysis, mode of treatment for pulmonary complications were also recorded. The morbidity was assessed based on the duration of ICU stay, the development of respiratory failure, and the duration of ventilator support. The risk association was assessed for statistical significance.

Statistical analysis

As the study was observational, all the patients undergoing gastrointestinal surgery in the Department of Surgery were included in the study. The estimated sample size as per the hospital data was calculated as 100. All the statistical analysis was prepared by SPSS version 20.0. The categorical data was expressed as numbers and a Chi-square test or Fisher exact test was used to evaluate the distribution differences. The continuous variables were expressed as the mean±S.D. The Student's t-test was used to assess statistical significance.

RESULTS

In the study, a total of 100 patients underwent various gastrointestinal surgeries during the study period. Out of these, 34 patients developed PPC. The incidence of PPC was 34% in our study.

Table 1 showed the distribution of demographic parameters in the patients who developed PPC and patients without PPC. The mean age of the population included in the study was 42.4 years. The mean age in the group with PPC was 49.5 years. The mean age in the group without PPC was 38.7 years. This difference was statistically significant (p-0.04). The distribution of male and female patients in both groups was not statistically different. All the patients had income below Rs. 2000 in the study group. Among the 34 patients who developed PPC 23 (67.6%), they had less than primary school education. In the non-PPC group, 42 (63%) patients had at least a primary school education. The difference was statistically significant (p-0.02).

Table 1: Distribution of demographic parameters between the two groups.

Parameter		PPC present (n=34) (%)	PPC absent (n=66) (%)	P value
Age (in years)	<40	10 (29.4)	39 (59.1)	0.002
	>40	24 (70.6)	27 (40.9)	
Gender	Male	22 (64.7)	47 (71.2)	0.06
	Female	12 (35.3)	29 (28.8)	
Literacy	<Primary school	23 (67.6)	24 (36.6)	0.003
	>Primary school	11 (32.4)	42 (63.4)	
Smoking	Present	26 (76.4)	32 (48.4)	0.02
	Absent	8 (23.6)	34 (51.6)	
Alcohol	Present	21 (61.7)	36 (54.5)	0.07
	Absent	13 (38.3)	30 (45.5)	
Co-morbidities	Present	26 (76.4)	28 (42.4)	0.001
	Absent	8 (23.6)	38 (47.6)	

Table 2: Distribution of laboratory parameters between the two groups.

Parameter		PPC present (n=34) (%)	PPC absent (n=66) (%)	P value
Serum albumin (gm)	<3.5	28 (82.3)	32 (48.4)	0.001
	>3.5	6 (17.7)	34 (41.6)	
Hemoglobin (gm%)	<8	23 (67.6)	29 (43.9)	0.03
	>8	11 (32.4)	37 (46.1)	
Urea and creatinine	Normal	18 (52.9)	34 (51.5)	0.06
	Abnormal	16 (47.1)	32 (48.5)	

Table 3: Type and nature of surgery done in the two groups.

Parameter		PPC present (n=34) (%)	PPC absent (n=66) (%)	P value
GI tract	Upper	15 (44.1)	43 (65.1)	0.04
	Lower	19 (45.9)	23 (34.9)	
Nature	Elective	8 (23.5)	26 (39.3)	0.03
	Emergency	26 (76.5)	40 (50.7)	
Pathology	Non malignancy	22 (64.7)	42 (63.6)	0.05
	Malignancy	12 (35.3)	24 (36.4)	
Length of preoperative stay	<7	27 (79.4)	44 (66.6)	0.02
	>7	7 (21.6)	22 (33.4)	
Duration of surgery	<2 hours	12 (35.3)	32 (48.4)	0.03
	>2 hours	22 (64.7)	44 (41.6)	
Postoperative ventilation	<3 days	14 (41.1)	45 (68.1)	0.02
	>3 days	20 (58.9)	21 (31.9)	
Preoperative nasogastric tube	No	8 (23.5)	26 (39.3)	0.03
	Yes	26 (76.5)	40 (60.9)	
Type of surgery	Resection	13 (38.2)	39 (59.1)	0.06
	Stoma/others	21 (61.7)	37 (40.9)	
Blood loss	<500 ml	7 (20.5)	45 (68.1)	0.03
	>500ml	27 (79.5)	21 (31.9)	

Smoking habit was found to be present 26 (76.4%) in patients with PPC as compared to 8 (23.65%) patients without PPC. The difference in the incidence of smoking habit between the two groups was statistically significant. Alcohol drinking habit was present in 21 (61.7%) patients with PPC and 36 (54.5%) patients without PPC. The presence of comorbidities was found to be higher in patients who developed PPC and the difference between the groups was found to be statistically different between the 2 groups was similar ($p<0.05$).

Table 2 showed the distribution of laboratory parameters between the two groups. The serum albumin of less than 3.5 gm was present in 28 (82.3%) patients with PPC as compared to 32 (48%) patients without PPC. The haemoglobin was low (<8 gm%) in 23 patients with PPC and in 29 patients without PPC. The serum levels of urea and creatinine were abnormal in 18 patients with PPC and in 34 patients without PPC.

Table 3 revealed the type and the nature of surgery done in the two groups. Overall, upper gastrointestinal tract surgery was the commonest surgery performed (58%). The incidence of PPC in the patients who underwent upper gastrointestinal and lower gastrointestinal surgery was almost similar (44.1% vs 45.9%). The emergency surgery was the commonest type of surgery done among both the groups. PPC was found in 76.5% of patients who underwent emergency surgery and 23.5% of patients who had elective surgery. This difference was statistically significant ($p<0.05$). Benign diseases were the commonest pathology in the study population who underwent surgery. 64.7% of the patients who underwent surgery for benign conditions, had developed PPC and 35.3% of patients with malignancy developed PPC. The difference was not found to be significant. There was no significant difference in the number of the preoperative stay duration on the development of PPC. All the patients underwent surgery under General anaesthesia. 58.9% of the patients with elective postoperative ventilation for >3 days developed PPC. The incidence of PPC was more in the patients with pre-operative nasogastric tube as compared to patients without nasogastric tube (76.5% vs 23.5%). Non-resection procedures were the commonest surgery performed. The difference in the incidence of PPC between resection and non-resection surgery was not statistically significant. 80% of the patients with >500 ml blood loss developed PPC as compared to 21% of patients with less than 500 ml blood loss.

Table 4 showed the time of occurrence of PPC in the study population. The mean time period for the incidence of PPC was 4.3 days. Table 5 showed the different PPC seen in the study population. Pleural effusion was the commonest PPC seen in 15 (44.1%) patients followed by pneumonia in 9 (26.5%) patients. Among the 8 patients with pneumonia, 4 patients had ventilator-associated pneumonia. Atelectasis and lung collapse was present in 8 patients. Acute respiratory distress syndrome (ARDS) was present in 2 cases. 10 patients had 2 complications. Arterial blood gas was found to be abnormal in 28 patients with PPC. 14 patients received intervention in the form of antibiotics, therapeutic aspiration, etc. The average duration of ICU stay was 3.2 days.

Table 4: Time of occurrence of PPC in the study population.

Time of occurrence of PPC	Number (%)
<3 days	20 (58.8)
3-6 days	10 (29.4)
>6 days	4 (11.8)

Table 5: Distribution of PPC in the study population.

Diagnosis	Number (%)
Pneumonia	9 (26.5)
Pleural effusion	15 (44.1)
Basal atelectasis	8 (23.5)
ARDS	2 (5.9)

DISCUSSION

Age of the patient has been documented to be one of the commonest risk factors for developing PPC.[5-7] The overall incidence of PPC has increased by 9% in patients over 59 years old. Age ≥60 years are a risk factor for PPCs. In our study, the age of more than 40 years was found to be significantly associated with PPC and comparable to previous studies. This finding may be attributed to the higher incidence of associated comorbidities in the elderly age group patients, like chronic heart disease and respiratory diseases.

In our study, the percentage difference in the occurrence of PPC was found to be similar in both the gender. However, due to a general higher incidence of gastrointestinal surgeries in the male population, there were a slightly higher percentage of male patients with PPCs in the study population. In our study, we found that poor socioeconomic status and illiteracy was found to be associated with the development of PPCs. In our study nearly 70% of the patients with PPC were illiterate. This finding was found to be similar to previous other studies. Awareness of the complications, ability to understand and comprehend the nature of the disease and follow the advice of the treating physician would influence the lung function in the immediate postoperative period and prevent the development of PPC.

Smoking is an important risk factor for PPCs. The risk of PPC in smokers was found to be 1.5 times higher than that in non-smokers.[5-7] In our study, there was no difference in the alcohol drinking habit between the two groups. In our study, we also found that the presence of comorbidities was strongly higher in the PPC group which was statistically significant. Studies have shown that there is a higher chance of PPC in patients with chronic obstructive pulmonary disease and heart disease.[6,7]

In our study, we found that the serum albumin of less than 3.5 was associated with an increased chance of PPCs. Several other similar studies also demonstrated the same findings.[6,8,9] Low serum albumin increases the possibility of developing PPC by decreasing the healing capacity and being associated with other comorbidities like heart and kidney diseases. Preoperative haemoglobin level has been identified as a marker for nutritional status. Low levels are associated with a poor recovery in the post-operative period. In our study, we found that serum haemoglobin level of less than 8 gm was found to be associated with an increased chance of PPC. This finding is comparable to similar other studies on risk factors for PPCs. In the present study, the percentage of the upper gastrointestinal surgeries done was more than the lower gastrointestinal surgeries. This distribution difference was because of the higher incidence of upper gastrointestinal surgery cases which were in the study period. Peptic ulcer perforation is one of the common surgeries done in the emergency department. We found that the incidence of PPC was equal in both the upper gastrointestinal and lower gastrointestinal surgery patients. Few studies have shown that upper gastrointestinal surgeries had a higher risk of PPCs as compared to lower gastrointestinal surgeries.[9,10] Poor lung expansion and pain in the upper chest preventing lung expansion are the reason for the development of PPC. In the present study, there was a preponderance of emergency cases. The incidence of PPC was also higher in the emergency group which is comparable to similar studies in the past.[9] Emergency cases have poor optimization of the physiological reserve due to the nature of the pathology and infection. This explains the higher incidence of PPCs in the emergency surgery group.

Prolonged preoperative hospital stay and increased duration of surgery are also shown to be associated with the development of PPCs.[8] In our study, we found that there higher risk of PPC occurrence in patients who had more than 1 week preoperative stay in hospital and operative time for more than 2 hours. However, it was not found to be statistically significant. Exposure to hospital infections and the development of resistance to infection can be explained as the cause of increased risk. The longer duration of operative period leads to fluid imbalance and an increased chance of infection and poor lung expansion in the post-operative period. Nasogastric intubation has been found to increase the chance of PPC by causing micro aspiration of the oral and pharyngeal

secretion and gastric contents.[9,10] The risk for infection increases with the length of intubation. In our study, we also found that patients who had a preoperative nasogastric tube inserted had a higher incidence of PPCs.

Pleural effusion was identified as the commonest postoperative pulmonary complication in our study. This finding is comparable to other similar studies done in the past. In a study by Jiang, pneumonia was found to be the commonest PPC followed by tracheobronchitis. The imbalance in the fluid management, poor post-operative chest physiotherapy leading on to poor lung drainage can be identified as the pathogenesis behind the development of pleural effusion in these patients. Atelectasis was another common PPC seen in our patients. The combination of PPCs was also present in the study which was also found in other similar studies.[1,2,11,12] In our study, the average time taken to develop PPC was 4.3 days. This finding was found to be similar to other similar studies.[11,12] Though, the pathogenesis behind the development of PPC are fluid imbalance and poor chest physiotherapy in the post-operative period most of the PPCs are identified only after a substantial period of time. This may be due to the non-availability of a definitive investigation to detect early stage of PPC. A chest X-ray has poor sensitivity in picking up early-stage PPCs.

CONCLUSION

The postoperative pulmonary complication is a common complication following gastrointestinal surgery. Age, education status, serum albumin, haemoglobin, emergency surgery, elective postoperative ventilation, nasogastric intubation and blood loss in the intraoperative period were found associated with increased risk of PPCs.

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REFERENCES

1. Canet J, Mazo V. Postoperative pulmonary complications. Minerva Anestesiol. 2010;76:138-43.
2. Choudhuri AH, Chandra S, Aggarwal G, Uppal R. Predictors of postoperative pulmonary complications after liver resection: Results from a tertiary care intensive care unit. Indian J Crit Care Med. 2014;18:358-62.
3. Toori KU, Khan JS, Nomani AZ, Hussain SW, Hashmi S. A prospective study of factors predicting PPC in patients undergoing non cardiothoracic surgery under general anaesthesia in developing country. Anaesth Pain Intensive Care. 2012;16:252-6.
4. Kelkar KV. Post-operative pulmonary complications after non-cardiothoracic surgery. Indian J Anaesth. 2015;59(9):599-605.
5. Brueckmann B, Villa-Uribe JL, Bateman BT, Grosse-Sundrup M, Hess DR, Schlett CL, et al. Development and validation of a score for prediction of postoperative respiratory complications. Anesthesiology. 2013;118:1276-85.
6. Blum JM, Stentz MJ, Dechert R, Jewell E, Engoren M, Rosenberg AL, et al. Preoperative and intraoperative predictors of postoperative acute respiratory distress syndrome in a general surgical population. Anesthesiology. 2013;118:19-29.
7. Musallam KM, Rosendaal FR, Zaatari G, Soweid A, Hoballah JJ, Sfeir PM, et al. Smoking and the risk of mortality and vascular and respiratory events in patients undergoing major surgery. JAMA Surg. 2013;148:755-62.
8. Fleisher LE, Linde-Zwirble WT. Incidence, outcome, and attributable resource use associated with pulmonary and cardiac complications after major small and large bowel procedures. Perioper Med. 2014;3:7.
9. Smith PR, Baig MA, Brito V, Bader F, Bergman MI, Alfonso A. Postoperative pulmonary complications after laparotomy. Respiration. 2010;80:269-74.
10. Jiang SP, Li ZY, Huang LW, Zhang W, Lu ZQ, Zheng ZY. Multivariate Analysis of the Risk for Pulmonary Complication after Gastrointestinal Surgery. World J Gastroenterol. 2005;11:3735-41.
11. Miskovic A, Lumb AB. Postoperative pulmonary complications. BJA Br J Anaesth. 2017;118:317-34.
12. Davies OJ, Husain T, Robert CM, Stephens BA. Postoperative pulmonary complications following non-cardiothoracic surgery. BJA Educ. 2017;17:295-300.

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