



A PROSPECTIVE STUDY OF POSTOPERATIVE PULMONARY COMPLICATIONS FOLLOWING UPPER ABDOMINAL SURGERIES

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ABSTRACT **AIM:** The aim of the study is to follow prospectively a group of patients undergoing elective upper abdominal surgeries and to observe those developing pulmonary complications post-operatively along with factors associated with an increased risk of developing post-operative pulmonary complications using a standard preoperative and postoperative evaluation. **METHOD:** Total of 110 patients admitted with upper abdominal pathologies undergoing elective upper abdominal surgeries in the department of General Surgery, during the period of October 2016 to October 2018 were observed for any pulmonary complications. **RESULTS:** Study had 51 females and 59 males. 38 patients developed PPC, 19 were males and 19 females. The age distribution of these patients are 14 out of 38 patients (14%) were in the age group of 21-40 years, 16 out of 38 patients (16%) were in the age group of 41-60 years, 8 out of 38 patients (8%) were in the age group of more than 60 years. Out of 38 patients who developed PPC 15 (60.5%) were smokers and 23 (39.5%) were non-smokers. 21 (55.3%) were underweight, 14 (36.8%) were normal weight, 2 (5.3%) were overweight and 1 (2.6%) was class II obesity. 25 (65.8%) had normal preoperative PFT, 6 (15.8%) patients had mild obstructive disease, 4 (10.5%) had moderate obstructive disease and 3 (7.9%) had restrictive disease. Among 38 patients with PPC 7 (18.4%) had gastric surgeries, 4 (10.5%) had liver surgeries, 9 (23.7%) underwent surgeries on gall bladder and CBD, 17 (44.7%) had pancreatic surgeries, 1 (2.6%) had surgery on spleen. Among 38 patients who developed PPC all of them had cough with sputum and raised WBC count, 32 had fever, 37 had abnormal breath sounds, 2 had decreased oxygen haemoglobin saturation less than 90%, 13 (34.2%) patients had unilateral pleural effusion, 10 (26.3%) had bilateral pleural effusion, 3 (7.9%) had unilateral consolidation and 12 (31.6%) had normal chest x-ray and 11 (10%) had positive sputum culture. **CONCLUSION:** Patients undergoing upper abdominal surgeries are at a higher risk of developing Postoperative pulmonary complications. Age and Sex are not the significant risk factors for developing PPC. There is a significant correlation between the altered pre-operative pulmonary functions diagnosed by pulmonary function tests and developing PPC. BMI is not a significant risk factor to determine occurrence of PPC. Smoking may not be a significant risk factor to develop PPC. There is a significant relation between the type of upper abdominal surgery and the occurrence of PPC. Cough with sputum, Fever and Abnormal breath sounds are the most common signs and symptoms seen in patients developing PPC. Pleural effusion is the most common radiological evidence of pulmonary pathology seen in patients with PPC. All patients with postoperative positive sputum culture developed PPC.

KEYWORDS : Postoperative Pulmonary Complications, Upper Abdominal Surgeries

INTRODUCTION

Pulmonary complications following upper abdominal surgery have a relatively high incidence rate when compared to surgeries performed on other parts of the body'. The closer the incision is to the diaphragm, the greater the reduction in postoperative lung volumes¹.

Post-operative pulmonary complications (PPCs) occur in 5–10% of patients undergoing non-thoracic surgery and in 22% of high risk patients. Even in minor surgeries, the incidence can be 1–2%. As many as one in four deaths occurring within a week of surgery is related to pulmonary complications, thus making it the second most common serious morbidity after cardiovascular event^{3,4}.

The pulmonary system includes a complex milieu which includes the conducting airways, pulmonary parenchyma, the alveolar capillary interface, an intricate mechanism for control of breathing, complex muscular interplay, and elaborate defense mechanisms. Yet, despite the sophistication of the respiratory system, pulmonary complications are the single most common source of morbidity in the critically ill surgical patient. Postoperative pulmonary complications occur most commonly in those undergoing major abdominal and/or thoracic procedures. Uniformly, these complications result in a predictable set of symptoms including tachypnea, hypoxemia, and hypercapnia followed by respiratory failure each of which are associated with increased morbidity and mortality².

Common postoperative pulmonary complications following general surgery are Pulmonary embolus, obstructive sleep apnoea, ARDS, ventilator failure (PaCO₂ > 60 mmHg, pH < 7.20), atelectasis, infection-pneumonia and bronchitis, bronchospasm, aspiration of gastric contents, exacerbation of chronic pulmonary disease. Also intraoperative risk factors for postoperative pulmonary complications are thoracic or upper abdominal incisions, general anaesthesia, duration of anaesthesia/surgery, emergent procedures².

AIM AND OBJECTIVE

The aim of the study is to follow prospectively a group of patients undergoing elective upper abdominal surgeries and to observe those developing pulmonary complications post-operatively along with factors associated with an increased risk of developing post-operative pulmonary complications using a standard preoperative and postoperative evaluation.

To assess correlation of upper abdominal surgeries along with factors associated with an increased risk of developing post-operative pulmonary complications with regard to postoperative a) Cough with abnormal sputum production b) Temperature above 38 degree Celsius c) Abnormal auscultatory findings. d) Oxygen hemoglobin saturation less than 90% e) Raised white cell count f) Radiological evidence of any pulmonary pathology in chest x-ray (collapse/consolidation/pleural effusion/pneumothorax) (Chest x-ray is done only if patient has respiratory symptoms) g) Positive sputum culture (Sputum culture is done only if patient has respiratory symptoms)

MATERIALS AND METHODS

- Minimal sample size required is 110 with Prevalence-20%, Power = 80%, and effect size is 0.12, Level of significance 5% and determined using software G* power version 3.1
- After ethical committee approval and informed consent, 110 patients undergoing upper abdominal surgeries are followed which includes Gastrectomies, Laparoscopic/Open cholecystectomy, Splenectomy, Whipples procedure and other pancreatic surgeries, Hepatic surgeries, Cystogastrostomy in pseudocyst of pancreas, gastric surgeries with resection and anastomosis such as gastrojejunostomy, also benign and cancer resections on the stomach, liver, pancreas, biliary tree; CBD exploration, surgeries involving biliary tract, Resection of hydatid cyst in liver, Nissen's fundoplication, Heller's cardiomyotomy for achalasia cardia and Sleeve gastrectomy.
- The source of data was patients in Department of General Surgery at a tertiary care hospital who are admitted and undergoing upper

abdominal surgeries during the period of October 2016 to October 2018.

- Written informed consent will be taken from Patient Guardian.
- Detailed case will be taken from predesigned proforma. A predesigned Proforma shown below drafted for the study will be used.
- Preoperative and postoperative investigations and tests are done as designed in the proforma.
- A postoperative pulmonary complications was considered when four or more of the following criteria are present: (According to Melbourne Group Scale- MGS)^{5,6,7}
- a) Cough with abnormal sputum production b) Temperature above 38 degree Celsius c) Abnormal auscultatory findings. d) Oxygen hemoglobin saturation less than 90% e) Raised white cell count f) Radiological evidence of any pulmonary pathology in chest x-ray (collapse/consolidation/pleural effusion/pneumothorax) (Chest x-ray is done only if patient has respiratory symptoms) g) Positive sputum culture (Sputum culture is done only if patient has respiratory symptoms)
- Patients developing pulmonary complications are identified and recorded.

INCLUSION CRITERIA

- Age : >18 years
- Patients undergoing major (Defined as postoperative hospital stay of >1 day) elective (Patients admitted any day before the day of surgery or the night before) upper abdominal surgery in the study period will be included.
- Consecutive patients undergoing upper abdominal surgeries such as Gastrectomies, Laparoscopic/Open cholecystectomy,
- Splenectomy, Whipple procedure and other pancreatic surgeries, Hepatic surgeries, Cystogastrostomy in pseudocyst of pancreas, gastric surgeries with resection and anastomosis such as gastrojejunostomy, also benign and cancer resections on the stomach, liver, pancreas, biliary tree, CBD exploration, surgeries involving biliary tract, Resection of hydatid cyst in liver, Nissen's fundoplication,
- Heller's cardiomyotomy for achalasia cardia and Sleeve gastrectomy were included.

EXCLUSION CRITERIA

- Emergency upper abdominal surgeries
- History of - chronic cough, wheezing, dyspnoea, haemoptysis, pre-existing pulmonary and /or cardiac disease, COPD, asthma, pulmonary tuberculosis and lung cancer.

RESULTS

Our study had 110 patients. 3(2.7%) patients were in the age group of 0-20 years, 48(43.6%) were in the age group of 21-40 years, 35(31.8%) were in age group of 41-60 years and 24(21.8%) were above 60 years. Out of these 38 patients developed postoperative pulmonary complications. The age distribution of these patients having pulmonary complications; 0% in age group of 0-20 years, 14 out of 38 patients (14%) were in the age group of 21-40 years, 16 out of 38 patients (16%) were in the age group of 41-60 years, 8 out of 38 patients (8%) were in the age group of more than 60 years.

Study had 51 females and 59 males. 38 patients developed PPC. Out of 38 19 were females (50%) and 19 were males (50%). Out of 110 patients 41(62.7%) were smokers and 69(37.3%) were non-smokers. Out of 38 patients who developed PPC 15(60.5%) were smokers and 23(39.5%) were non-smokers.

Out of 110 patients 25(22.7%) were diabetic, 14(12.7%) were hypertensive and 1(0.9%) patient was a known case of Ischemic heart disease. Out of 38 patients with PPC, 10(26.3%) were diabetic and 7(18.4%) were hypertensive.

Among 110 patients 58(52.7%) patients were underweight, 42(38.25%) were normal weight, 7(6.4%) were overweight, 2(1.8%) were class I obesity and 1(0.9%) was class II obesity. Out of 38 patients who developed PPC 21(55.3%) were underweight, 14(36.8%) were normal weight, 2(5.3%) were overweight and 1(2.6%) was class II obesity.

Out of 110 patients 90(81.8%) had normal PFT, 9(8.2%) patients had mild obstructive disease, 4(3.6%) had moderate obstructive disease and 7(6.4%) had restrictive disease. All these patients were asymptomatic. Among 38 patients who developed PPC 25(65.8%) had

normal PFT, 6(15.8%) patients had mild obstructive disease, 4(10.5%) had moderate obstructive disease and 3(7.9%) had restrictive disease. fig.1

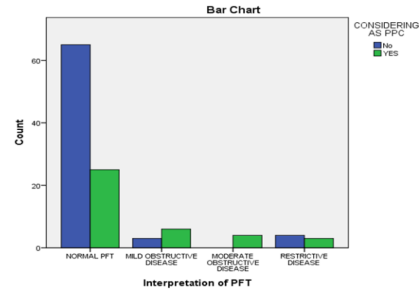


Fig.1 : Relationship between Preoperative PFT and PPC

In 110 patients, 34(30.9%) patients underwent stomach surgeries (Partial gastrectomy + Gastrojejunostomy, Cystogastrostomy, Triple bypass, Radical gastrectomy, Bariatric surgery, Sleeve gastrectomy, Laparoscopic Nissen's Fundoplication, Heller's Cardiomyotomy), 9(8.2%) had surgeries on liver (Excision of hydatid cyst of liver, Hepaticojejunostomy), 14(12.7%) had surgeries on gall bladder and CBD (Lap converted to open cholecystectomy, CBD exploration, CBD exploration + Cholecystectomy, Cholecystectomy + Choledochojejunostomy + Jejunojejunostomy + Hutson Access loop + Choledocholithotomy, Open cholecystectomy), 31(28.2%) had pancreatic surgeries (Puestow's procedure, Enucleation of pancreatic tumour, Whipple's procedure, Pancreaticojejunostomy + Cystojejunostomy + Choledochoduodenostomy + cholecystectomy, Distal pancreatectomy + Splenectomy, Laparotomy + Necrosectomy + Peritoneal lavage), 3(2.7%) had surgeries on spleen (Splenectomy) and 19(17.3%) had laparoscopic surgery on gall bladder (Laparoscopic cholecystectomy).

Among 38 patients with PPC 7(18.4%) had gastric surgeries, 4(10.5%) had liver surgeries, 9(23.7%) underwent surgeries on gall bladder and CBD, 17(44.7%) had pancreatic surgeries, 1(2.6%) had surgery on spleen. fig.2

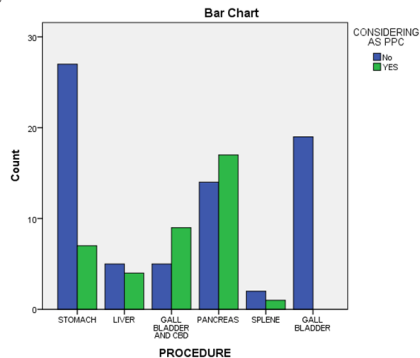


Fig2. : Relationship between Type of surgical procedure and PPC

In 110 patients 52(47.3%) patients had postoperative cough with sputum. Among 38 patients with PPC all of them had cough with sputum. fig.3.

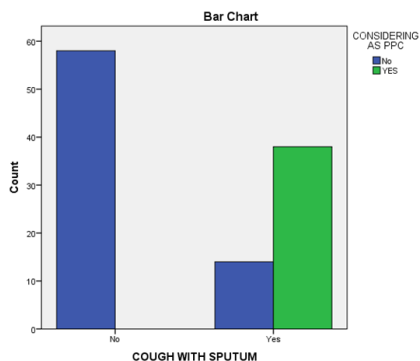


Fig 3. : Postoperative cough with sputum

Among 110 patients 41(37.3%) had postoperative fever and in 38 patients with PPC 32(84.2%) developed fever.

Among 110 patients 46(41.8%) patients had abnormal breath sounds (ronchi,crepitations) postoperatively and in 38 patients who developed PPC 37(97.4%) had abnormal breath sounds.fig 4.

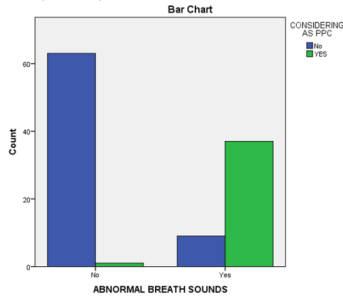


Fig 4. : Postoperative abnormal breath sounds

In 110 patients 2(1.8%) had oxygen Hb saturation less than 90% and also those 2(5.3% developed PPC among 38 patients with PPC. Fig 5.

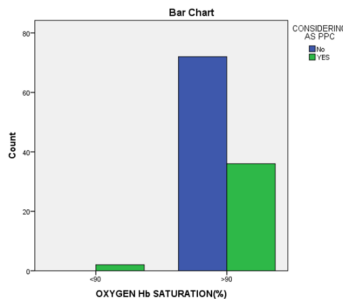


Fig 5. :Postoperative oxygen haemoglobin saturation percentage

In 110 patients 60(54.5%) had increase in total count and among 38 patients who developed PPC all 38(100%) had raise in WBC count.

Chest X-ray was done only for the patients who had respiratory symptoms.Among 110 patients chest x-ray was not done for 58(52.7%) patients.Then 15(13.6%) patients had unilateral pleural effusion,10(9.1%) had bilateral pleural effusion,3(2.7%) had unilateral consolidation and 24(21.8%) had normal chest x-ray. In 38 patients with PPC 13(34.2%) patients had unilateral pleural effusion,10(26.3%) had bilateral pleural effusion,3(7.9%) had unilateral consolidation and 12(31.6%) had normal chest x-ray.fig 6.

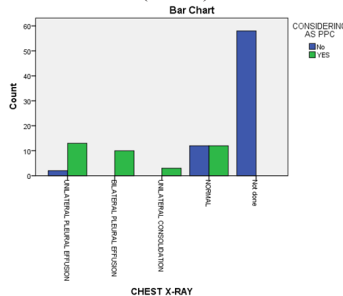


Fig 6. : Postoperative radiological evidence of pulmonary pathology in chest x-ray

Sputum culture was done only for the patients who had respiratory symptoms.Among 110 patients 11(10%) had positive sputum culture and all of them had developed PPC.fig 7.

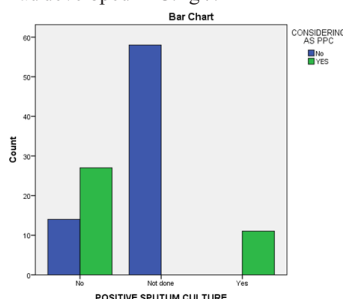


Fig 7: Postoperative sputum culture

study incidence of postoperative pulmonary complications is 34.5% .

38 patients out of 110 developed postoperative pulmonary complications after upper abdominal surgery.

CRITERIA	P VALUE	INFERENCE
Age	.246	Not significant
Gender	.578	Not significant
Smoking	.729	Not significant
Diabetes mellitus	.514	Not significant
Hypertension	.193	Not significant
Ischemic heart disease	.466	Not significant
BMI	.532	Not significant
Pre operative PFT	.003	Significant
Type of surgical procedure	<.001	Significant
Post operative Cough with sputum	<.001	Significant
Post operative fever	<.001	Significant
Post operative abnormal breath sounds	<.001	Significant
Post operative spo2	.049	Significant
Post operative increase in WBC count	<.001	Significant
Post operative chest x ray	<.001	Significant
Post operative sputum culture	<.001	Significant

DISCUSSION

A sample of 110 patients were followed to determine the correlation between upper abdominal surgeries and postoperative pulmonary complications.

In our study, among 110 patients 38 patients developed postoperative pulmonary complications.

According to age distribution of the patients in our study pulmonary complications is more in the age groups of 41 - 60 years (16 patients) followed by 21 – 40 years (14 patients) respectively.8 patients are more than 60years. Age is not of a much significance in our study with a P-value of 0.246.

In the study,both males and females are equally affected with PPC.This shows that both the sex are at equal risk to develop PPC after upper abdominal surgery.Among 38 patients who developed PPC 23 were smokers, with a P- value of 0.729.This shows smoking may not be a significant risk factor to the occurrence of PPC.But among 41 smokers in the study 15 have developed PPC.There is also no significant relation between chronic diseases such as Diabetes mellitus, Hypertension, Ischemic Heart Disease and the occurrence of PPC as per statistical analysis in our study with a P-value of 0.514 , 0.193 , 0.466 respectively for each diseases.On comparing BMI with PPC in our study,among the patients who developed PPC 55.3%(21 patients) of the patients were underwent.But overall BMI is not of a much significance in relation to PPC after upper abdominal surgery in our study with a P-value of 0.532.Preoperative pulmonary function tests show that there is significant relation between preoperative pulmonary function and PPC with a P-value of 0.003. Patients with asymptomatic obstructive or restrictive pulmonary diseases are at risk of developing PPC.

In our study PPC occurred more among the patients who underwent pancreatic surgeries followed by patients who underwent surgeries of Liver,Gall bladder and CBD which is significant risk factor with a P-value of 0.001. PPC is not observed in the patients who underwent laparoscopic cholecystectomy.Hence significant relation is seen between the type of upper abdomen surgery and the occurrence of PPC.Among the 38 patients with PPC all patients had cough with sputum which is a significant symptom in postoperative patient in our study with a P-value of 0.001.Fever was also noted in majority of the patients in our study who developed PPC with a significant p-value of 0.001.Almost all patients who developed PPC in our study had abnormal breath sounds like ronchi or crepitations which was a important sign in a patient with PPC with a significant P-value of 0.001.Patients who had decreased oxygen haemoglobin saturation of less than 90% developed PPC.2 patients who had decrease in saturation percentage developed PPC which is significant with a P-value of 0.049.This shows that oxygen haemoglobin saturation is one of the indicators to diagnose PPC.There was a elevation in total leucocyte count postoperatively in all the patients with PPC.Total count gives a direct clue to diagnose underlying pulmonary infection in a postoperative patient.Hence total count was a significant indicator in our study with a P-value of 0.001.In our study Chest X-ray was done for the patients who had respiratory symptoms like cough with sputum or abnormal breath breathsounds.Unilateral Pleural effusion was the

most common pulmonary pathology seen in chest X-ray followed by bilateral pleural effusion being the next common pathology among the patients who developed PPC. Pneumonia was seen in 3 patients postoperatively. But even absence of pleural effusion does not rule out PPC as 12 patients with PPC had no pleural effusion in chest X-ray. But presence of pleural effusion has significant relationship with the PPC with a P-value of 0.001. Sputum culture was sent for the patients who had respiratory symptoms like cough with sputum or abnormal breath sounds. Positive sputum culture was seen in 28.9% of the patients among those who developed PPC. In 110 patients 11 patients had positive sputum culture and all of them developed PPC.

There is a wide variation in the incidence of PPCs from 2% to 40%^{8,9}. Postoperative pulmonary complications contribute significantly to overall perioperative morbidity and mortality rates. Such complications account for about 25% of deaths occurring within 6 days of surgery. The frequency rate of these complications varies from 5- 70%. This wide range is due to variations among studies in the definition of postoperative pulmonary complications¹⁰.

In our study, the incidence of Post-operative pulmonary complications is 34.5% with variability in patient and procedure related factors.

SUMMARY

In our two years single institution prospective study, we followed 110 patients who underwent upper abdominal surgeries. The patients included in the study were more than 18 years of age with 54% males and 46% females. We found a significant relationship between the upper abdominal surgeries and postoperative pulmonary complications. On the other hand there were patient and procedure related variable factors which are significantly related to the occurrence of postoperative pulmonary complications.

CONCLUSION

In our study, it was found that:

- Patients undergoing upper abdominal surgeries are at a higher risk of developing Postoperative pulmonary complications.
- Age and Sex are not the significant risk factors for developing PPC.
- There is a significant correlation between the altered pre-operative pulmonary functions diagnosed by pulmonary function tests and developing PPC.
- BMI is not a significant risk factor to determine occurrence of PPC.
- Smoking is not a significant risk factor to develop PPC.
- There is a significant relation between the type of upper abdominal surgery and the occurrence of PPC.
- Cough with sputum, Fever and Abnormal breath sounds are the most common signs and symptoms seen in patients developing PPC.
- Pleural effusion is the most common radiological evidence of pulmonary pathology seen in patients with PPC.
- All patients with postoperative positive sputum culture developed PPC.

In view of these results, we conclude that postoperative pulmonary complications continue to be a significant morbidity following upper abdominal surgeries. Pre-operative risk factors include altered pre-operative pulmonary functions, type of surgery and nature of the procedure. Most common postoperative pulmonary complications being cough with sputum, fever, abnormal breath sounds and pleural effusion. Early identification and appropriate treatment goes a long way to tide over the progress to a life threatening state.

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