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A Study of Post Operative Pulmonary Complications in Cases Undergoing Major Abdominal Surgery

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Abstract:
Background*: Pulmonary complications in the postoperative period significantly hamper recovery of the patient and are a major contribution to increased duration of hospital stay, morbidity and mortality. The incidence is 5-10% in patients undergoing abdominal surgery, rising to almost 22% in high risk patients. The definition, though widely variable, includes complications such as pneumonia, atelectasis, bronchitis, pleural effusion, aspiration, acute lung injury and bronchospasm. Atelectasis is the main cause of post-operative pulmonary complications and in most cases is preventable to a certain extent. Acute lung injury is the most serious that may prove fatal in most cases.*
Materials and Methods*: The present research enlisted the help of 100 hospitalised individuals. In addition to the regular pre-operative workup, patients admitted from the OPD had a chest radiograph taken before surgery. Pre-operative breathing exercises were needed of all patients undergoing elective surgery. Patients requiring emergency surgery, as well as those with a history of respiratory illness, were screened using a pre-operative chest radiograph. The patient was watched for any symptoms of pulmonary issues or worsening of an existing ailment until the seventh postoperative day in all cases. The subjects were categorised into PPC and Non PPC groups and various observations were made.*
Results*: The mean age of the study population was 49.48±17 and the most common presentation was abdominal pain (n=37). There was a significant difference between the two groups in baseline characteristics such as the history of present illness (p=0.03), diabetes mellitus (p=0.002), hypertension (p=0.0002), and respiratory illness (p=0.0004). Smoking also showed a statistically significant difference between the groups. There is a trend toward a reduction in the development of PPC when preoperative spirometry is used in patients undergoing elective surgery (p=0.08), but there is no significant difference when preoperative spirometry is used in cases requiring emergency surgery (p=0.46).*
Conclusion: *In individuals who had preoperative spirometry, a tendency for lower PPCs was noted in elective instances. General anesthesia and upper abdominal incisions are associated with higher incidence of PPCs.*
Key Word*: Post-operative complications; Pulmonary Complications, Abdominal Surgery, Spirometry*

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I. Introduction

Postoperative pulmonary complications (PPCs) are known to occur following major thoracic and abdominal surgery, and they are frequently linked to increased morbidity, mortality, and length of stay in the hospital. Abdominal surgical operations have a negative impact on pulmonary function. Postoperative complications, particularly pulmonary issues, which are associated with higher mortality, morbidity, and duration of hospital stay, impact the outcomes following abdominal surgery.[1] Pneumonia, atelectasis, respiratory failure, and worsening of chronic obstructive pulmonary disease are examples of postoperative pulmonary consequences. COPD patients are at a higher risk of developing PPCs.[2]

PPCs are still common in patients undergoing thoracic and abdominal surgery, and their occurrence has far-reaching consequences for both the patient and the health-care system.[1,3] Reduced lung volumes and reduced airway clearance can result from complications associated to anaesthesia, artificial ventilation, tissue injury, immobility, and discomfort, which can lead to PPCs.[4]

The occurrence of PPCs varies depending on the type of surgery performed. PPCs after thoracoabdominal procedures such as esophagectomy or aortic aneurysm repair show rates ranging from 15% to 32%.[5,6] PPC is less common after open lung, heart, or abdominal surgery, with an incidence rate of 1 to 20%.[7,8] Postoperative pulmonary problems affect 5–10% of individuals after nonthoracic surgery, and up to 22% for high-risk patients.

Even with minor procedures, the rate can be as high as 1–2%.[9] In a prospective longitudinal study of 1000 patients conducted in Royal Perth Hospital from 1988 to 1989, it was discovered that the total incidence of PPCs was 23.2 percent.[10] PPCs need more time in the hospital and cost the patients more money. The prevalence of PPCs ranges from 2% to 40% [11], which is likely owing to a lack of consistency in the types of medical disorders considered PPCs.

Many PPCs, such as atelectasis and pneumonia, appear to be linked to a disturbance in respiratory muscle action. After a few minutes after anaesthesia, atelectasis can occur in almost all patients in numerous zones of the lung, significantly impairing the pulmonary gas exchange.[12] Intraoperative changes in the pattern of breathing can persist postoperatively. Hence, the present study is undertaken with the aim of assessing the postoperative pulmonary complications in cases undergoing major abdominal surgery and to evaluate the importance of pre-operative breathing exercises in cases undergoing elective surgery in aiding post-operative recovery.

II. Material and Methods

The study was conducted on patients who were admitted for the purpose of undergoing major abdominal surgeries in the Department of General Surgery, NRI Medical College and Hospital, Chinakakani, Andhra Pradesh, India from November 2019 to October 2021.

Study Design: Prospective Observational Study
Study Location: NRI Medical College and Hospital, Chinakakani
Study Duration: November 2019 to October 2021.
Sample size: 100 patients.
Subjects & selection method: Those patients who got admitted for the need of undergoing major abdominal surgery. The patients were later divided into two groups, those who developed postoperative pulmonary complications and those who did not develop postoperative pulmonary complications.
Aim: To study the post-operative pulmonary complications in cases undergoing major abdominal surgery.

Inclusion criteria:
1. Age: > 18 years to 75 years
2. Presenting to the outpatient department and posted for elective major abdominal surgery
3. Patients undergoing emergency exploratory laparotomy
4. Patients willing to provide consent

Exclusion criteria:
1. Age: ≤ 18 years or >75yrs
2. Patients refusing to give written consent

Procedure methodology:

The current study was done by recruiting 100 patients who were admitted in the hospital. Informed consent was taken and the study was started after obtaining approval from the Ethics Committee of the Institution. A pre-operative chest radiograph was performed on the patients admitted from the OPD, in addition to the standard pre-operative workup. A detailed history of previous respiratory illness was noted. Any patient having elective surgery was required to do pre-operative breathing exercises. A pre-operative chest radiograph was used to screen patients requiring emergency surgery, as well as a history of respiratory infection. In all cases, the patient was monitored until the seventh postoperative day for any signs of pulmonary problems or worsening of an existing condition.

For the purpose of this study, PPC is defined as any unintended pulmonary abnormalities that occurred as a result of surgery and produced detectable dysfunction and conditions affecting the respiratory system that might have a detrimental effect on the patient's clinical course following surgery. According to the pretested study proforma, a thorough physical examination was done and all the data was collected and the outcomes were recorded and were followed up till discharge.

Statistical analysis

Data was presented as absolute numbers, mean, and standard deviation, or percentages. Patient characteristics were analysed using descriptive statistics. Logistic regression was performed so as to determine predictors of PPCs. A p-value less than or equal to 0.05 was considered statistically significant. All the analysis was done using SPSS version 15.

III. Results

A total of 100 patients who were undergoing major abdominal surgery were recruited in the study. There were 47 women and 53 men among the group. The mean age of the study population was 49.48±17. The most common presentation was abdominal pain (n=37). Nine individuals out of a total of 100 had a history of respiratory disease such as COPD(n=3), asthma(n=3), PTB(2) and pneumonia(n=1). Thirty-one patients were habituated to smoking and thirty were addicted to alcohol in the study population. A respiratory system evaluation revealed reduced BS in one (1%) patient and wheezing in four others (4%). Spirometry was performed by 58 (58%) patients prior to surgery.

Fig 1 : Shows Preoperative and Postoperative spirometry usage in total cohort

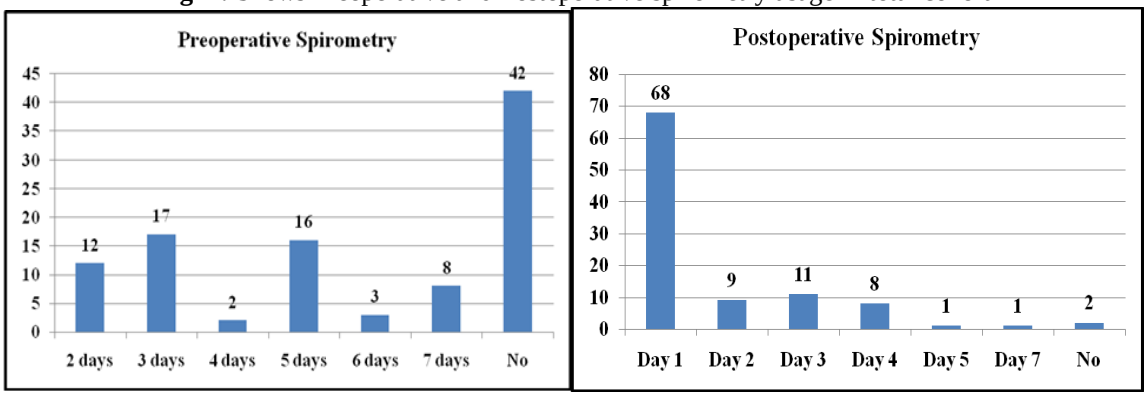


Table 1: Intra-operative characteristics of total cohort

Variable	Unit	n=100 (n (%))
Type of surgery	Elective	62(62.00)
	Emergency	38(38.00)
Types of Anaesthesia	EA+GA	41(41.00)
	EA+SA	6(6.00)
	GA	51(51.00)
	SA	2(2)

EA: Epidural Anesthesia; SA: Spinal Anesthesia

Postoperatively respiratory support was given for 30 (30%) patients and 70 (70%) patients required no respiratory support. Two (2%) of the 30 patients were on BIPAP for three days, three (3%) were on mechanical breathing, and 25 (25%) were on oxygen support.

Patients with no PPC and those with PPC were compared. When compared to the No PPC group (44.55±15.56), the mean age of patients in the PPC group was significantly higher (60.96±16.24), indicating a significant difference between the groups ($p<0.0001$). There was a significant difference between the groups in baseline characteristics such as the history of present illness ($p=0.03$), diabetes mellitus ($p=0.002$), hypertension ($p=0.0002$), and respiratory illness ($p=0.0004$). Smoking [16(22.86%) vs 15(50.00%), $p=0.007$)] showed a statistically significant difference between the groups. Presence of pallor ($p=0.04$) and jaundice ($p=0.02$) showed statistically significant difference between the two groups and the other parameters showed no significance.

Figure 2: Preoperative spirometry usage between PPC and No PPC groups

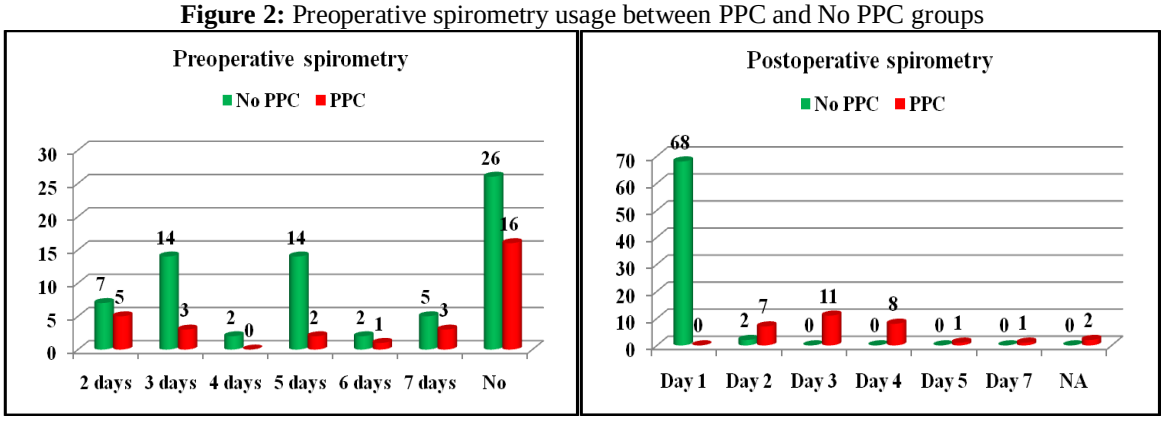


Table 2 : Intraoperative variables such as Type of surgery and anaesthesia were delineated

Variable	Unit	No PPC (n=70) n(%)	PPC (n=30) n(%)	p value
Type of surgery	Elective	45(64.29)	17(56.67)	0.47
	Emergency	25(35.71)	13(43.33)	
Anesthesia	EA+GA	23(32.86)	18(60.00)	0.04
	EA+SA	6(8.57)	0(0.00)	
	GA	39(55.71)	12(40.00)	
	SA	2(2.86)	0(0.00)	

Table 3 : Analysis of preoperative spirometry in developing PPC in cases undergoing elective and emergency surgery

	Preoperative spirometry not done n(%)	Preoperative spirometry done n(%)	P value
Elective surgery (n=62)			
No PPC	2(40.00)	43(75.44)	0.08
PPC	3(60.00)	14(24.56)	
Emergency surgery (n=38)			
No PPC	24(64.86)	1(100.00)	0.46
PPC	13(35.14)	0(0.00)	

There is a tendency suggesting a decrease in the development of PPC with the use of preoperative spirometry in cases receiving elective surgery (p=0.08), while there is no significant difference with the use of preoperative spirometry in cases undergoing emergency surgery (p=0.46). (Table 3)

In total cohort, use of preoperative spirometry did not show any difference in the improvements of postoperative outcomes (figure 3) and PPC (figure 4) when compared with the patients who have not used preoperative spirometry.

Figure 3 : Evaluation of effect of preoperative spirometry on the outcomes in total cohort

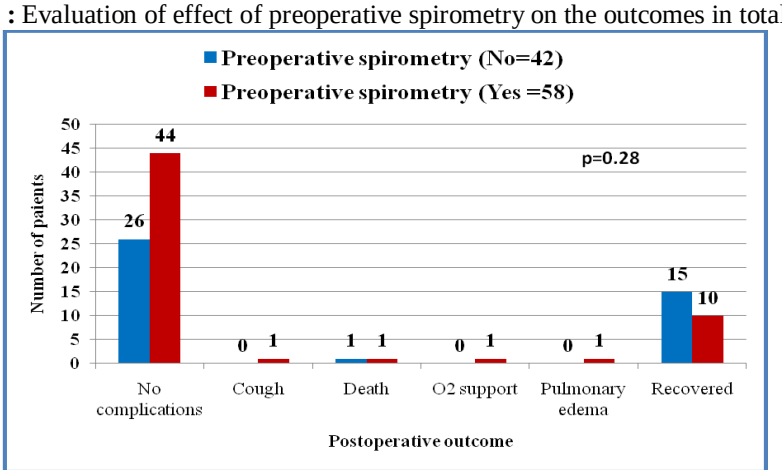
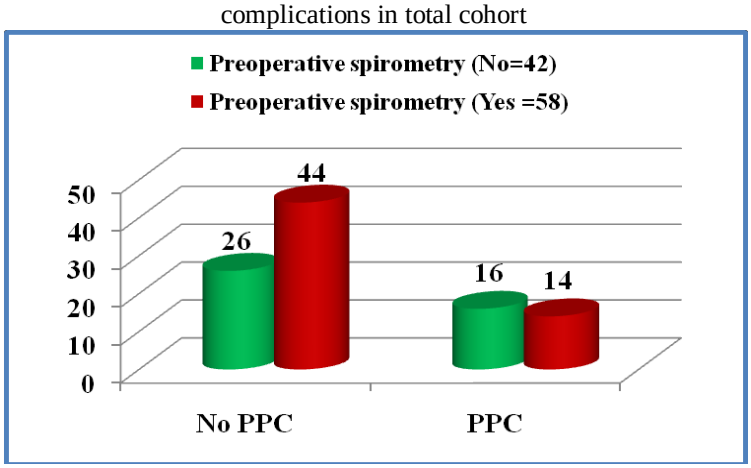


Figure 4: Evaluation of effect of preoperative spirometry on the development of postoperative pulmonary complications in total cohort



IV. Discussion

Pulmonary problems can have a negative impact on a patient's recovery following surgery. [13] They may also necessitate the use of extra oxygen or respiratory assistance, such as non-invasive or invasive mechanical ventilation. The association between preoperative factors and PPCs in surgical patients has been studied extensively. Despite recent breakthroughs in preoperative care, postoperative respiratory morbidity remains a regular occurrence, particularly after upper abdominal surgery. [14,15] Patients should be examined before to surgery to identify those who are at high risk of developing complications, and preventive steps should be implemented to reduce the occurrence of PPCs. The rate of postoperative pulmonary problems varies between 10% and 80%. [16]

Atelectasis, respiratory infections, bronchoconstriction, and respiratory failure are the most usually observed PPCs. [15,17] PPC risk is routinely calculated in a variety of populations and surgical procedures, [14,18] making it difficult to determine the link between PPC's and previous spirometric abnormalities. The incidence of PPC in this study is 30% which is in concurrence with the published literature such as by Stein et al[19], Wightman et al [20], Praveen CB et al [21] who reported 34.9%, 19%, and 40.2% respectively. Multiple studies have found age >60 or 65 yr to be a risk factor. [22,23] More detailed age stratification showed an increased risk of a PPC as age increases.

For PPCs, smoking is a risk factor. [22,24] According to Praveen CB et al [21], smokers were more likely than non-smokers to experience postoperative pulmonary problems. Ex-smokers had a statistically significant decrease in PPCs (relative risk (RR) 0.81, CI 0.70–0.93), according to a meta-analysis comparing current and ex-smokers (for >4 weeks). [25] Current smokers were more likely to acquire a PPC than ex-smokers, who were more likely than never-smokers, especially if they had smoked for more than 10 pack-years. [26] Smoking was found to be an independent risk factor for developing PPC in this study, and quitting smoking before major surgery lowers postoperative morbidity.

Spirometry and arterial blood gases (ABGs) are good predictors of PPC before surgery. Low preoperative SpO2 has recently been discovered to be a substantial independent risk factor for PPCs. The value of a preoperative chest X-ray (CXR) has also been questioned. Again, clinical examination is unlikely to predict

an aberrant CXR, but if one is discovered, it is predictive of a PPC. [27] In the current study, a chest x-ray in the PPC revealed a cavity in 1 (1.43%) patient, chronic asthma in 1 (1.43%), fibrosis in 1 (1.43%), COPD in 5 (16.67%) patients, and significant vascular marks in 21 (70.00%) patients, with p=0.0003.

Diaphragmatic dysfunction is caused by upper abdominal surgery. As a result, postoperative lung function parameters such as vital capacity and functional residual capacity are reduced. Hall et al Chest, 1991 did a prospective study on 400 patients. They found that upper abdomen surgery was a significant risk factor (p=0.0001). [10] Brunn et al, Chest 1997 found in 400 patients that incisions> 30 cm and closer to the diaphragm had more chances of leading to PPCs (0.026). When compared to a lower abdominal incision, a laparotomy with an upper abdominal incision can have up to 15 times the chance of a PPC [22].

Because general anaesthesia disrupts several elements of respiratory function, it may appear self-evident that the incidence of PPCs is lower in individuals who get regional anaesthesia (RA). Canet and colleagues observed a 7.5 percent vs. 2.0 percent incidence of acquiring at least one PPC with and without GA in a prospective multicentre analysis of [2] 64 individuals. Anesthesia and surgery that lasts more than 2 hours are both linked to the development of PPC. The results of the current study also are in alignment with the results of published evidence which showed the development of PPC when used GA alone and GA +EA. In the present study Incentive, spirometry, and ambulatory support were provided postoperatively. Higher support was required in PPC group when compared to No PPC group (p=<.0001).

A systematic review of 12 controlled trials showed reduced PPCs and LOS in patients undergoing cardiac and abdominal surgery with the use of preoperative aerobic exercise and inspiratory muscle training (IMT) but not joint replacement surgery.[28] In the present study preoperative spirometry was done and observed a trend in decreased PPC in patients undergoing elective surgery.

Patients who develop a PPC have a higher mortality rate in the short and long term. One in every five patients with a PPC (14–30%) will die within 30 days following major surgery, compared to 0.2–3% of individuals without a PPC. [29,30] PPC patients have a much higher 90-day death rate: 24.4 percent vs. 1.2 percent. [31] Pulmonary function tests via spirometer were not possible in emergency cases. Anaesthetic parameters- a type of anesthesia, post-op analgesia could not be compared as they remained the same in most of the patients. In the present study, 6.67% mortality occurred in the PPC group whereas in non-PPC group the mortality was nil.

V. Conclusion

In patients who underwent preoperative spirometry, a trend was observed towards decreasing PPC's in elective cases. The most common parameters affected are FRCs and tidal volume. Increased age and smoking were associated with PPCs. General anesthesia and upper abdominal incisions are associated with higher incidence of PPCs.

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