

**Original article:**

## **A Study of post operative pulmonary complications following upper abdominal operations**

**Abraham Mathew\*<sup>^</sup>, Sharath J. N\*\*<sup>,</sup> P.T.Thomas\*\*\*<sup>,</sup>**

\*Asst Professor, Dept of General Surgery, PIMS, Tiruvalla

\*\*Asst Professor, Dept of General Surgery, PIMS, Tiruvalla

\*\*\*Professor and HOD, Dept of General Surgery, PIMS, Tiruvalla

<sup>^</sup> **Corresponding author:** Dr. Abraham Mathew , Assistant Professor , Dept of General Surger , Pushpagiri Institute of Medical Sciences , Tiruvalla , Kerala 689101

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### **Abstract**

**Background:** Postoperative Pulmonary complications (PPC) following upper abdominal surgery have a high incidence rate. Many factors influence the incidence of PPC. We conducted this study to analyze the PPC and various factors to consider in this subset of patients.

**Methods:** A prospective study was done on patients who underwent upper abdominal operations in a single tertiary care centre over a period of 19 months. Development of PPC were observed and studied. Also parameters that are likely to increase the incidence of PPC were seen.

**Results:** One hundred patients were studied over the time span of 19 months, including both elective and emergency cases of upper abdominal operations. Of these 100 patients, 80 were electively performed and 20 were done on an emergency basis. 21 patients (21%) presented with pulmonary complications in the postoperative period. The single most common form of complication was tracheobronchitis, in 38.1% (8/21), followed by atelectasis in 23.8% (5/21). Incidence of these complications was higher in emergency surgery (8/20; 40%) as compared to elective surgery (13/80; 16.3%). Pre operative risk factors that have an increasing chances of PPC were chronic pulmonary disease (p value =0.001), smoking (p value = 0.001) and surgery duration > 210 minutes (p value = 0.001).

**Conclusion:** Emergency upper abdominal surgery, chronic pulmonary disease, smoking and prolonged surgery duration (>210 minutes) increase the chances of PPC in upper abdominal surgery.

**Keywords:** Post operative pulmonary complications; upper abdominal operation; elective; emergency

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### **Introduction:**

Pulmonary complications following upper abdominal surgery have a relatively high incidence rate when compared to surgeries performed on other parts of the body. <sup>1</sup>The closer the incision is to the diaphragm, the greater the reduction in post operative lung volumes. <sup>2</sup>

The emergency nature of the procedure has also been independently associated with higher rates of post-

operative complications like pneumonia and respiratory failure. <sup>3</sup>

The aim of the study is to follow prospectively a group of patients undergoing elective and emergency abdominal surgery and to identify those factors associated with an increased risk of developing post-operative pulmonary complication (PPC) using a standard preoperative evaluation.

## Materials and methods

A prospective, unicentric study was conducted with the approval of the Institutional Ethical Committee. All patients, above the age of 12 years, undergoing elective and emergency major upper abdominal surgery in the department of General Surgery of Pushpagiri Institute of Medical Sciences from 1st November 2012 to 31st May 2014 were included in the study.

Various baseline variables were recorded in a proforma for each patient. Those who underwent laparoscopy, thoracoabdominal surgeries and palliative operations like gastrostomy/jejunostomy were excluded from the study

After surgery, patients were followed up medically by the same medical team that evaluated preoperatively, till the patient got discharged or until the occurrence of death.

Definition of PPC: A postoperative pulmonary complication was considered when **four or more** of the following criteria are present: radiological evidence of collapse/ consolidation, temperature above 38°C, oxygen hemoglobin saturation less than 90%, abnormal sputum production, positive sputum culture, raised white cell count, or abnormal auscultatory findings.

The various possible PPC considered were as follows:-

**Pneumonia:** The diagnosis of pneumonia was based on the appearance of recent pulmonary infiltrate or haziness on chest radiogram associated with at least two of the following signs: purulent tracheal-bronchial secretion, body temperature elevation (greater than 38.3° C) and an increase in the number of circulating leukocytes in excess of 25% of the basal number.

**Tracheobronchitis:** Tracheobronchitis was diagnosed by the increase in amount or color modification or purulent aspect of tracheobronchial secretions with normal chest radiogram.

**Atelectasis:** Atelectasis was considered a complication when there was an acute respiratory symptom as indicated by a chest radiogram and radiological image was compatible with this diagnosis. **Acute Respiratory Failure:** If invasive mechanical ventilation was required, it was considered as acute respiratory failure.

**Bronchospasm:** Bronchospasm was diagnosed in the presence of wheezing on pulmonary auscultation associated with acute respiratory symptoms and need for drug therapy.

**Data analysis:** The percentage of patients, who develop post op pulmonary complication (PPC) was calculated individually for each of the variables- age, gender, pre-operative respiratory co-morbidities, smoking, nutritional status, type of surgery, site of incision, and duration of surgery. The analysis was made for various risk factors.

Univariate analysis was applied in order to study the independent variables: age, nutritional status, and body mass index, pre operative respiratory disease, smoking habit, surgery duration and type of surgery (elective or emergency).

Statistical analysis by the Chi square test/ Fisher's exact test was used to test the significance of these associations.

For all statistical evaluation, a two tailed probability value <0.05 was considered significant.

## Results (see table 1 and 2)

A hundred patients who underwent upper abdominal surgery were studied over a span of 19 months in a prospective method.

Gender- There was 64 males and 36 females. Out of the 64 males, 15 developed pulmonary complication following surgery as compared to 6 females but non-significant.

Age- Majority of the patients who underwent surgery were above the age of 55yrs (62%). 17% of these developed PPC.

Pre op lung disease- Of the 100 patients studied 24% had chronic respiratory problems in the form of asthma (6%) and chronic obstructive pulmonary disease (18%). Of the 24 % patients who had chronic pulmonary disease, 19 patients developed pulmonary complication after upper abdominal surgery. Patients with the presence of chronic pulmonary disease was associated with the development of post operative pulmonary disease and this was statistically significant (p value= 0.001).

Cardiac disease- Patient's cardiovascular status was evaluated by cardiologist and was diagnosed to have either mild or moderate risk for peri operative cardiovascular problems. It was found statistically significant that patients having cardiovascular diseases develop pulmonary complication in the post operative period. (p value= 0.001).

BMI- Majority of patients who underwent surgery belonged to normal range of BMI (18.5-24.9kg/m<sup>2</sup>), 89 out of 100. Of the patients who developed post-operative pulmonary complications, Seventeen patients were eutrophic (81%) and 4 patients (19%) were dystrophic, of whom 2 (9.5%) were undernourished and 2 (9.5%) obese

Preoperative respiratory symptoms-The preoperative respiratory complaints were present in 28 patients (28%): main complaints were shortness of breath in 10 patients, cough and shortness of breath in 9 patients.

Types of operation- Both elective and emergency cases were included. 20 cases were done on an emergency basis. The most frequent elective surgical procedure was cholecystectomy (40%). Most frequently performed emergency procedure was duodenal ulcer perforation, for 6 patients (6%). 8 out of the 20 patients (40%) who underwent emergency procedures developed pulmonary complication.

Incision- 54% patients had a midline incision compared to 46% patients who had transverse incision. 16 out of 54 patients had a midline incision, as compared to 5 out of 46 patients who underwent surgery through a transverse incision.

Duration of surgery- 22% patients had duration of surgery more than 210 minutes. An analysis of the group that presented with postoperative pulmonary complications showed that in the cases of 17 patients (81.0%) the surgery took more than 210 minutes and in the cases of 4 patients the surgery took less than 210 minutes.

Types of PPC- Of the 21 patients (21%) who had pulmonary complications in the postoperative period, the single most common form of complication was tracheobronchitis, in 38.1% (8/21), followed by atelectasis in 23.8% (5/21).

In the cases of the 21 patients with PPC, the main post operative respiratory complaints were: cough and expectoration in 8 patients, and shortness of breath in 6 patients. The only symptom that demonstrated statistical significance was cough (chi-squared test; p = 0.02).

Patients who had PPC had cough, expectoration, shortness of breath or wheeze as pulmonary symptom and this was statistically significant (p value = 0.001).

Clinical features- 81% of patients who developed post operative pulmonary complications had normal

respiratory system on auscultation on Post Operation Day 2. This may be because majority of the patients had tracheobronchitis as a complication, where respiratory system will be Body temperature-All the patients who had post operative pulmonary complications, was febrile clear on auscultation.

Chest X-ray post op- Out of 21 patients who developed pulmonary complications after major upper abdominal surgeries, 52.4% patients had haziness in the Chest X Ray taken in the post operative period. Majority of patients who developed post operative pulmonary complications had radiological evidence in the chest X-Ray taken in the post operative period and it was statistically significant.

Post op oxygen saturation- Majority of patients who developed post operative pulmonary complications had oxygen saturation <90% and it was statistically significant. 2 out of 21 patients developed acute respiratory failure for which they were intubated and ventilated

Physical diagnosis of the pulmonary complications: (bar chart 1)

1.Tracheobronchitis: 8 out of 21 patients who developed pulmonary complications were diagnosed

to have tracheobronchitis. Diagnosis was made when a patient with normal chest radiogram developed an increase in the amount or color modification or purulent aspect of tracheobronchial secretions.

2. Bronchospasm: Diagnosed in 2 patients in the presence sudden onset of wheezing on pulmonary auscultation associated with acute respiratory symptoms such as cough, expectoration or shortness of breath requiring medications.

3.Atelectasis: was diagnosed in 5 patients when there was recently developed haziness in chest radiogram along with onset of acute respiratory symptoms such as cough, expectoration, shortness of breath or wheeze and radiological image was compatible with this diagnosis.

4.Pneumonia: 4 patients were diagnosed to have pneumonia. The diagnosis of pneumonia was made when there was an appearance of recent pulmonary haziness on chest radiogram along with purulent sputum, elevated temperature and increase in total leucocyte count.

5.Acute Respiratory Failure: 2 patients who needed mechanical ventilation were diagnosed to have acute respiratory failure for which they were intubated and ventilated

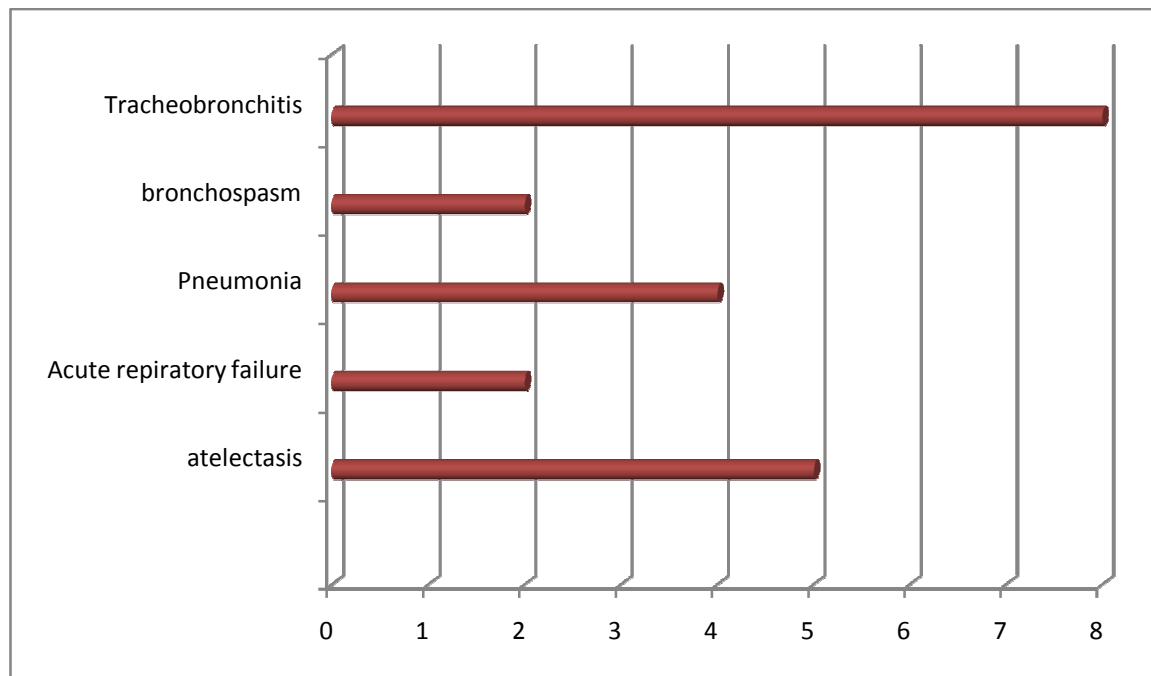
Table 1: Factors studied in all the patients and PPC ( total pt =100)

Factors	Number (N=100)	who got PPC(N=21)	$\chi^2$ Chi square	P value ( significant if < 0.05)
Age above 55 yrs	62	17	3.662	0.161
Male gender	64	15	0.637	0.425
Smoker	19	15	47.478	0.001
Moderate cardiac risk	9	6	12.432	0.001
Preop lung disease present	24	19	64.486	0.001

BMI>25	4	2	1.832	0.400
Emergency nature of operation	20	8	5.440	0.020
Midline incision	54	16	5.270	0.022
Duration of Surgery>210min	22	17	53.837	0.001

Table 2: Features in patients with post operative pulmonary complications ( total =21)

Feature	number	%	$\chi^2$ chi square	p value( significant if <0.05)
symptoms	21	100	90.520	0.001
Normal chest	17	93	5.877	0.05
Temp >38°C	21	100	90.520	0.001
O2 saturation<90%	16	76.2	66.732	0.001
Haziness in CXR	11	52.4	41.536	0.001
Positive sputum culture	19	90.5	83.387	0.001



Bar chart 1- The various post operative pulmonary complications (N=21)

## Discussion

Post-operative pulmonary complications (PPC) are defined as new onset or exacerbation of respiratory signs following surgery, occur frequently and are associated with increased rates of short- and long-term mortality, as well as increased cost of treatment.<sup>4</sup> They are an important cause of peri-operative morbidity and mortality. Pulmonary complications are reported in 12 to 70% of patients who undergo upper abdominal surgery, in comparison with a 4% incidence after lower abdominal surgery.<sup>5</sup>

Pulmonary complications represent "an accentuation of normal post-operative pulmonary changes".<sup>6</sup> The spectrum of complications can range from subclinical atelectasis to difficulty weaning a patient from the ventilator to post-operative respiratory failure/arrest. Factors contributing to post operative respiratory complications include diaphragm dysfunction, decreased mucociliary clearance, shallow and monotonous breathing and respiratory depression. Reduced ability to cough effectively due to incisional pain, and mechanical disruption of major expiratory muscles coupled with a decrease in regional ventilation, provides a good potential for pulmonary secretion formation.

The first step towards avoiding these complications, which should be taken during the pre operative period, is to detect the patients at risk of developing them.

In our study of 100 patients, the overall incidence of PPC was 21% and it was more for the cases done as an emergency 8/20 i.e. 40%. This can be attributed to poor general condition, non fasting state leading to aspiration of gastric contents and underlying peritonitis. Duodenal ulcer perforation was the commonest emergency operation- here bile

in the peritoneal cavity can itself cause reactionary pleural effusion.

Brooks (1997) evaluated how risk factors could be combined to best predict the development of a postoperative pulmonary complication following abdominal surgery and found out six risk factors: age > or = 60 years; impaired preoperative cognitive function; smoking history within the past 8 weeks; body mass index > or = 27; history of cancer; and incision site-upper abdominal or both upper/lower abdominal incision.<sup>7</sup> Our study also analyzed some of the factors that can influence the causation of pulmonary complications. We found that smoking habit, moderate cardiac dysfunction and presence of preoperative lung disease significantly related to PPC (see table 1). Age and gender were not significantly contributing to PPCs.

The most frequently identified risk factor for post operative pulmonary complication is chronic pulmonary disease (COPD, asthma), with a rate of postoperative complications that varies from 26% to 78%.<sup>8</sup> In our study, 19 patients who developed pulmonary complication in the post operative period had chronic pulmonary disease.

The emergency nature of the operation, midline incision and operations of more than 210 min (3hrs) were associated significantly with PPC (table 1). Midline incision divides the linea alba. Ali J et al<sup>9</sup> also had similar finding and found that integrity of the linea alba is essential for the efficient functioning of the recti muscles with resultant improvement in vital capacity and more efficient coughing.

In 2003, Ivete Alonso Bredda Saad et al found out that pulmonary complications are the most common forms of postoperative morbidity in thoracic and upper abdominal surgery, especially atelectasis and pneumonia. The first step in avoiding these

complications during the postoperative period is, to detect the patients who may develop them pre operatively and concluded that wheezing, body mass index, smoking and surgery duration increase the chances of postoperative pulmonary complications.<sup>10</sup> A study conducted in 2014 by Roberto de Cleve et al aimed to correlate the changes in FEV1, FVC and FEV1/FVC obtained in the postoperative period with the values of Intra abdominal pressure after abdominal surgery showed that superior and inferior abdominal surgeries affect lung function, causing hypoventilation unrelated to an increase in intra abdominal pressure. Patients at high risk of pulmonary complications should receive attention and respiratory care even if undergoing inferior abdominal surgery.<sup>11</sup>

Our study also analysed the various clinical and investigation findings that helped to diagnose PPC. (see table 2). Presence of respiratory symptoms and elevated body temperature were found in all 21 patients who developed PPC. Clinical signs were, in contrast, not significant as 17/21 of the patients had normal chest.

Oxygen saturation was significantly related to the onset of PPC (16/21).

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Chest X Ray haziness and sputum culture proved to be useful in confirming the diagnosis in majority of patients ( p value =0.001). The clinical spectrum of PPC ranged from tracheobronchitis to respiratory failure. Majority of the patients had tracheobronchitis 38%, followed by atelectasis 23.8%. Only 2 patients had respiratory failure , who improved with invasive ventilation. Though mortality was nil in our study, PPC are often life threatening with mortality rate as high as 20%.<sup>12</sup> The most important step is to identify high risk patients. Few specific measures can be managed peri operatively. Aggressive treatment of post operative pulmonary complication is mandatory if mortality is to be reduced.

## Conclusion

Post operative pulmonary complications continue to be a significant morbidity following upper abdominal operations. Preoperative risk factors include smoking history, preexisting lung disease and cardiac dysfunction. Emergency nature of the procedure, long duration operation and midline incision are the other factors that can increase the risk of PPC. Early identification and aggressive treatment goes a long way to tide over the progress to a life threatening state.

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