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Original Article

Pulmonary Medicine Section

Evaluation of Postoperative Pulmonary Complications after Emergency Abdominal Surgery- A Prospective Study

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ABSTRACT

Introduction: The clinical outcomes following the emergency abdominal surgery besides the surgical complications and the complications due to co-morbidities are influenced by Postoperative Pulmonary Complications (PPC). Continuous health care improvements are directed towards delivering quality care for postoperative patients is the need of the hour in prevailing patient-centric health services in the society.

Aim: To evaluate the outcomes after emergency abdominal surgery in relation to pulmonary complications.

Materials and Methods: A prospective observational study was conducted in the Department of Pulmonary Medicine and General Surgery at Peoples College of Medical Sciences and Research Centre, Bhopal, Madhya Pradesh, India for a period of one year. Thirty five patients who were operated for emergency abdominal surgery were included in the study. A predesigned and validated proforma was used for the collection of data. In the postoperative period, continuous clinical monitoring and evaluation was done periodically. The primary outcome was PPC like atelectasis, pneumonia, pleural effusion, pulmonary edema, acute respiratory failure. The European Perioperative Clinical Outcome (EPCO) definitions were used for the primary outcome. Descriptive statistics were used for data analysis. The association of pre and postoperative data with the occurrence of PPC was analysed using the Z-test for two sample proportions. The p-value <0.05 was taken as statistically significant.

Results: In the study group of 35 patients, 18 patients (51.4%) developed PPC as defined by the selected criteria. Nine (25.7%) patients had pneumonia, 4 (11.4%) patients had acute respiratory failure, 2 (5.7%) patients had pleural effusion, 2 (5.7%) patients had pulmonary edema and 1 (2.9%) patient had atelectasis. The habit of smoking (p=0.003), presence of pre-existing underlying lung disease (p=0.004), and low socioeconomic status (p=0.012) were associated with increased risk for PPC in patients undergoing emergency abdominal surgery with statistically significant results.

Conclusion: Pulmonary complications after emergency abdominal surgery are common and leads to the morbidity of patients and may result in fatal outcomes.

Keywords: Emergency laparotomy, Postoperative pneumonia, Pulmonary atelectasis

INTRODUCTION

The PPCs can be considered as a composite outcome measure. In 2015, a European joint taskforce published guidelines for perioperative clinical outcome (EPCO) definitions [1]. The taskforce defined pneumonia, respiratory failure, pulmonary embolism, Acute Respiratory Distress Syndrome (ARDS) by using composite measures like respiratory infection, pleural effusion, atelectasis, pneumothorax, bronchospasm, and aspiration pneumonitis. Pulmonary complications usually develop after abdominal surgery is a significant cause for patient suffering, prolonged hospital stay, and increased mortality rate [2-4]. The term PPC includes any derangement affecting the respiratory system after anesthesia and surgery. A systematic review for the American College of Physicians showed almost 16 studies (60%) used a combination of pneumonia and respiratory failure to define PPCs [5].

There is variability in the incidence of PPC as observed in different studies from 9 to 40%, which could be due to variations of study methodologies [6,7]. The respiratory symptoms of PPC present with non-specific symptoms and thus make its evaluation clinically difficult and challenging. Evidence is looked in the Chest X-ray (CXR) in the form of radiopacities in the pulmonary zones and the positive sputum reports for pathogens support the clinical diagnosis. Patients with Chronic Obstructive Pulmonary Disease (COPD) are at greater risk for the development of PPC [8].

More literature is available for complications after elective surgeries [9-11] but there is a paucity of studies [12] on emergency abdominal surgery complications. Hence, present study was aimed to evaluate the clinicopathological profile and predictors of PPC in the setting and to devise strategies for their prevention. In present study, primary objective was to determine the association of predetermined risk factors in predicting pulmonary complications in patients undergoing emergency abdominal surgery. The applied knowledge would result in enhancing the quality of postoperative care and surgical outcomes and would eventually reduce the financial health care burden.

MATERIALS AND METHODS

A prospective observational study was carried out on the patients who were operated for emergency abdominal surgery in Department of Pulmonary Medicine and General Surgery of Peoples College of Medical Sciences and Research Centre, Bhopal, Madhya Pradesh, India. Ethical approval was obtained (PCMS/OD/2018/2158) before conducting the study. This study was carried out for a period of October 2018 to December 2019 on 35 patients who were included in the study using the convenience criteria sampling. The patients above the age of 18 years with emergency laparotomy were included in the study after the informed consent. The elective cases, loss to follow up cases were excluded.

The primary outcome observed was PPC as defined in the criteria of European task force [1].

Pneumonia: CXR with at least one of the following: infiltrate, consolidation, cavitation; plus at least one of the following: fever >38°C with no other cause, white cell count <4000 or >12000 mm^3, >70 year of age with altered mental status with no other cause, plus at least two of the following: new purulent/changed sputum, increased secretions/suctioning, new/worse cough/dyspnoea/tachypnoea/bronchial breath

sounds, worsening gas exchange.

Acute respiratory failure: Postoperative PaO_2 <8 kPa (60 mm Hg) on room air, a PaO_2:FIO_2 ratio <40 kPa (300 mm Hg), or arterial oxyhaemoglobin saturation measured with pulse oximetry <90%, requiring oxygen therapy and mechanical ventilation.

Pleural effusion: CXR with blunting of costophrenic angle, loss of sharp silhouette of the ipsilateral hemidiaphragm in upright position, displacement of adjacent anatomical structures.

Atelectasis: Lung opacification with mediastinal shift or hilum shift towards the affected area, with compensatory hyperinflation in adjacent non-atelectatic lung.

The variables studied were age, gender, Body Mass Index (BMI), Smoking, Socio-economic status, past history of chronic pulmonary disease, the indication of surgery, incision site, duration of surgery, surgical procedure, clinical findings and investigations.

The data was collected in predesigned and validated proforma. The relevant registration, identification, demographic and clinical data (age, sex, weight, height, smoking habits and presence of comorbid conditions) was recorded. The indicated investigations for the respiratory system (CXR, arterial blood gases, etc.,) were carried out as deemed necessary on the clinical evaluation of the patient. The indication for surgery and duration was recorded. In the postoperative period, continuous clinical monitoring, and evaluation was done by the research team doctors and the principal researcher. The primary outcome was to evaluate the occurrence of PPC like atelectasis, pneumonia, pleural effusion, pulmonary edema, acute respiratory failure.

STATISTICAL ANALYSIS

Descriptive statistics were used for data analysis. The association of pre and postoperative data with the occurrence of PPC was analysed using the Z-test for two sample proportions using the Minitab Version 17. A p-value <0.05 was taken as statistically significant.

RESULTS

In the present study there were 27 males and; mean age was 42.03±21.83 years of the study population, and mean BMI 26.1±2.00 kg/m^2 [Table/Fig-1].

The proportional comparison of complications between age groups

Demographic characteristic	Result (n=35)	
Mean age	42.03±21.83 years	
Male: Female	27:8	
Mean BMI	26.1±2.00 kg/m^2	
Age (years)	Number of patients (n=35)	Complications developed (n=18)
18-25	5	1
25-34	6	1
35-44	4	1
45-54	8	5
55-64	10	8
>64	2	2
Clinical characteristics	**(n=35)**	**Percentage (%)**
BMI classification (WHO)kg/m^2		
< 21	1	2.85
21-30	33	94.3
>30	1	2.85
Lung diseases		
COPD	10	28.5
Pulmonary tuberculosis	3	8.6
Asthma	2	5.7
Bronchiectasis	1	2.9
None	19	54.3
Co-morbid conditions (n=7)		
Systemic Hypertension	2	5.7
Diabetes mellitus	3	8.6
IHD	2	5.7
Clinical findings (n=29)		
Cough	22	62.9
Fever	4	11.4
Shortness of breath	2	5.7
Chest pain	1	2.9
Primary outcomes: PPC (N=35)		
Pneumonia	9	25.7
Acute respiratory failure	4	11.4
Pleural effusion	2	5.7
Pulmonary oedema	2	5.7
Atelectasis	1	2.9
Nil	17	48.6

[Table/Fig-1]: Demographic and clinical profile of the study group.

18-45 years and >45 years was found to be statistically significant as Z value (18-45 years Vs >45 years) is -3.89, (p-value=0.002). The comparison of the proportion of complications between the male and female gender was found to be not significant (p-value=0.927).

Fourteen (40.0%) patients had high TLC counts and 21 (60.0%) patients had normal blood investigations findings. Thirteen (37.1%) patients did not undergo ABG testing, 9 (25.7%) patients had normal ABG findings, 1 (2.9%) patient's ABG showed high carbon-dioxide and 12 (34.28%) patient's ABG showed low oxygen. Eighteen (51.4%) patients did not require any oxygen and 17 (48.6%) patients required oxygen support. About 31 (88.5%) patients did not require any ventilation support and 4 (11.5%) patients required ventilation. Of the 4 patients who required ventilation, 2 were on invasive ventilation and 2 on non-invasive support.

The comparison of the proportion of complications between the patients of low and middle socio-economic status was also found to be statistically significant (p=0.012) [Table/Fig-2]. Ileal perforation was common finding [Table/Fig-3]. Out of 18 patients developing complication two were expired other recovered. One patient died within three days of operation due to acute respiratory failure and other on fifth day of surgery due to pneumonia -sepsis-shock [Table/Fig-4]. Duration of hospital stay was prolonged in patients developing complications [Table/Fig-5].

Variables	Patients	Number (n=35)	Complications (%)	Z-test for two sample proportion	p-value
Socioeconomic status	Lower class	23	15 (65.2%)	2.52	0.012
	Middle class	12	3 (25.0%)		
Smoking	Yes	22	15 (68.18%)	2.94	0.003
	No	13	3 (23.07%)		
Patient with underlying lung disease	Yes	16	12 (75.0%)	2.86	0.004
	No	19	6 (31.6%)		
Duration of surgery	<3 hours	12	4 (33%)	2.05	0.02
	>3 hours	23	14 (67%)		

[Table/Fig-2]: Risk factors for PPCs.
(Z test for two population proportion test used)

Variables	Number (n=35)	Percentage (%)
Gastric perforation	7	20.0
Duodenal perforation	5	14.3
Ileal perforation	10	28.6
Appendicular perforation	5	14.3
Rectal perforation	2	5.7
Intestinal obstruction	2	5.7
Ileocaecal lump	1	2.9
Large ventral hernia	1	2.9
Rupture liver abscess	1	2.9
Stab injury abdomen	1	2.9

[Table/Fig-3]: Surgical illness.

Variables	Number	Percentage (%)
Discharge from hospital	33	94.3
Death	2	5.7
Duration of hospital stay		
2-7 days	10	28.6
8-14 days	20	57.1
>14 days	5	14.3

[Table/Fig-4]: Outcome and duration of stay in study group.

Patients	Duration of stay (mean±SD)	't' value	p-value
Complications	12.78±5.58	-3.062, df=33	0.004*
Not developing complication	7.94±3.45		

[Table/Fig-5]: Mean duration of hospital stay in study group.

DISCUSSION

Pulmonary complications after emergency abdominal surgery are one of the common complications. Present study results reveal that advanced age, history of smoking, underlying lung disease, and lower socioeconomic status, are associated with increased risk for PPC in patients undergoing emergency abdominal surgery. In present study 51% of patients following emergency abdominal surgery developed PPC. It is comparable to the study by Kumar L et al., which reports 44.4% of patients developed PPC after emergency surgery [13]. This rate is higher than the reported rates by Serejo LGG et al., which was 28.2% [12]. Hemmes SN et al., and Futier E et al., observed the incidence of PPC between 20 and 40%. The incidence estimated in present study was high which may be explained by differences in patients' risk factors (e.g., smoking status, co-morbid illness) and only emergency cases were included not elective cases [14,15]. Increasing age was one factor that has been observed in the study to account for the increased incidence of PPC in older patients. A study have found age>60 or 65 year to be a risk factor [4]. More detailed age stratification shows an increased risk of a PPC as age increases. Older patients are already weak and are shown to be associated with PPCs as per Robinson TN et al., [16]. Lower socioeconomic status was associated with a higher PPC in present study. Malnutrition, which is common among lower socioeconomic populations is associated with respiratory impairment, being in itself a predictor of postoperative pneumonia [17]. Patients having an underlying lung disease had more incidence of PPC. About 75% of underlying lung disease developed PPC. Patients with chronic diseases like COPD, congestive heart failure, or chronic liver disease and ASA score II have more risk for PPCs [18]. Patients with Obstructive Sleep Apnoea (OSA) have more than twice risk to develop PPCs after non-cardiac surgery [19]. Another risk factor contributing to the development of PPC is a previous history of smoking. In the present study, 62.8% of the patients developing PPC were chronic smokers. Myles PS et al., in their study showed respiratory complications and wound healing delays in chronic smokers [20]. Current smokers were more likely to have a PPC compared with ex-smokers, who were in turn more likely than those who had never smoked [21]. In elective major surgical cases patients should be encouraged to stop smoking for postoperative optimal results. Previous respiratory infections in last six month also associated with more chance of developing PPCs. Postoperative pneumonia is the serious complication occurred in 9% to 40% of patients after surgery and it ranks as the third most common postoperative infection, besides urinary tract and wound infection in hospitals [22]. In present study postoperative pneumonia was the most common PPC (50%). This was consistent with the study conducted by Brooks-Brunn JA and Kanat F et al., where pneumonia was the leading PPC in their study [22,23]. In present study, fatality rate of 5.71% was observed. Pulmonary complications observed in cases with surgery duration increased for more than three hours. Brooks-Brunn JA et al., found that duration >4 hours was a significant risk factor [22]. Prolong surgery leads to more anaesthesia time and increase postoperative recovery and morbidity. In abdominal surgeries postoperative pain and visceral stimulation causes decreased phrenic nerve motor output. This leads to partial activation of diaphragm and respiratory muscles increases risk of lung atelctasis [24].

PPCs are often life-threatening, as shown by PPC-associated mortality rates that can be as high as 6%. PPCs increases morbidity and duration of hospital stay. Nearly one fourth death within six days of postoperative period is related to PPCs [1]. Managing these pulmonary complications requires many resources in terms of human resources and material and therefore risk identification is by far cost-effective.

Limitation(s)

The small sample size was a limitation. Only chronic lung diseases history was considered no other co-morbidity was studied. Further research is needed to study the risk factors for PPC to establish their causality.

CONCLUSION(S)

The burden of PPC after emergency abdominal surgery was high and the commonest complication was postoperative pneumonia. It leads to increased morbidity and length of hospital stay. Early identification of high-risk cases helps to manage patients optimally in achieving quality health care and clinical outcomes.

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