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A STUDY OF POST-OPERATIVE PULMONARY COMPLICATIONS IN PATIENTS UNDERGOING EMERGENCY EXPLORATORY LAPAROTOMY FOR ACUTE ABDOMINAL CONDITIONS: A PROSPECTIVE OBSERVATIONAL STUDY.

General Surgery

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ABSTRACT

Background: Emergency laparotomy is associated with high rates of mortality and postoperative complications, as well as prolonged hospital stay. It remains uncertain when death and complications occur. The present research is aimed to study the incidence of post-operative pulmonary complications after emergency exploratory laparotomy. **Methodology:** A cross-sectional observational study on 60 patients was carried out in department of General Surgery at tertiary care institute on patients who underwent emergency exploratory laparotomy for acute abdominal conditions under General Anaesthesia for a duration of 18 months. Post-operatively pulmonary complications were assessed. Appropriate statistical tests were applied for statistical analysis. $P \leq 0.05$ at 95% confidence interval was considered as statistically significant. **Results:** There were 70% in 51-60 years. Male patients were 40% and female patients were 60%. ASA 1, 2, 3, 4 and 5 constituted about 11.6%, 41.6%, 35%, 8.3% and 3.3% of the study population respectively. Duration of surgery lasted for 2 hours in 23.3%, 2-5 hours in 5% and 3 hours in 71.6% of the patients. There were 33% of smokers, 21.6% had diabetes mellitus, 23.3% hypertension, 20% had history of lung disease, 21.6% had history of cardiac disease and 13.3% had history of respiratory infection. Nasogastric tube was used after laparotomy in 51.6% of the subjects. Incentive spirometry was done in 90% of the subjects. Upper incisions were done in 28.3% of cases, upper/lower and lower were done in rest 33.3% and 38.3% of cases respectively. Post laparotomy complications were seen in 10% of the subjects. Pneumonia, atelectasis, bronchitis and pleural effusion were seen in 50%, 16.6%, 16.6% and 16.6% of cases respectively. 83.3% of patients stayed in hospital for >7 days. **Conclusion:** The PPCs are higher in smokers, in patients with comorbid respiratory diseases, and with longer duration of surgery. PPCs increase the hospital, and ICU stay and mortality. Pneumonia is most common respiratory complication observed. Outcomes of laparotomies are multifactorial with high morbidity and mortality, leading to an escalation in hospital costs and prolonged illness which can be avoided if the factors involved are properly addressed.

KEYWORDS

Acute Abdominal Conditions, Exploratory Laparotomy, Post-Operative Pulmonary Complications, American Society Of Anesthesiologists

INTRODUCTION

Emergency laparotomy is associated with high rates of mortality and postoperative complications, as well as prolonged hospital stay[1,2]. There is considerable heterogeneity in patient factors, underlying pathology and surgical procedures, but perforated viscus, intestinal obstruction, bowel ischemia and haemorrhage are common[3]. Compared with other acute surgical emergencies, patients undergoing emergency laparotomy have a disproportionately high mortality in younger, fitter patients as well as older, sicker patients[4].

Thirty-day mortality is approximately 45% and complication rates approximately 70% in octogenarians[5]. The number of elderly patients undergoing emergency surgery is increasing, and initiatives aimed at improving complication-free survival are urgently needed[6]. Despite the effectiveness of care bundles in improving outcomes after surgery, there is limited standardization of these after emergency laparotomy[7]. Intervention/ outcome studies are ongoing, but are focusing primarily on the immediate peri-operative period up to 72 h after surgery[8].

It remains uncertain when death and complications occur after emergency laparotomy, which makes effective targeting of appropriate interventions difficult. The present research is aimed to study the incidence of post-operative pulmonary complications after emergency exploratory laparotomy and various risk factors associated with development of these post-operative pulmonary complications

MATERIALS AND METHODS

A cross-sectional observational study on 60 patients was carried out in department of General Surgery at tertiary care institute on patients who underwent emergency exploratory laparotomy for acute abdominal conditions under General Anaesthesia for a duration of 18 months. Patients with age >18 years and <75 years, of both genders, undergoing emergency exploratory laparotomy for acute abdominal conditions were included. Patients undergoing exploratory laparotomy for acute abdominal conditional conditions under anesthesia other than general anesthesia and patients with non-operative cause of acute abdomen like for example acute pancreatitis, blunt trauma to spleen (less than grade 3) were excluded.

The informed consent was taken from all the enrolled patients and the study was started after taking institutional ethical committee approval. Pre-operative assessment of the patient was done. Details of the patients was taken like body mass index, smoking history, co-morbid illness, ASA (American Society of Anesthesiologists) grading, Signs and symptoms of respiratory system and X-Ray chest. Patients with respiratory symptoms and abnormal findings from physical examination of the chest (orthopnoea, tactile fremitus, dullness, crackles or rhonchus) were defined preoperatively as “symptomatic patients”.

Post-operatively pulmonary complications were assessed. The data was entered into Microsoft Excel Worksheet. Categorical data was expressed as proportions and continuous data was expressed as mean. The comparison of categorical data was performed using Chi-square test and Fisher's exact test and comparison of continuous data was done using independent sample t-test. $P \leq 0.05$ at 95% confidence interval was considered as significant.

RESULTS:

Table 1. Demographic Profile of the Patients

Demographic Parameters		Frequency	Percentage
Age groups (Years)	20-30	2	3.3%
	31-40	6	10%
	41-50	7	11.6%
	51-60	39	65%
	61-70	6	10%
Gender	Males	24	40%
	Females	36	60%

There were 3.3%, 10%, 11.6%, 65% and 10% of the subjects in the age range of 20-30, 31-40, 41-50, 51-60 and above 60 years respectively. Male patients were 40% and female patients were 60%.

Table 2. Co-morbidities Among the Patients

Co-morbidities	Frequency	Percentage
Smoking	20	33.3%

Diabetes mellitus	13	21.6%
Hypertension	14	23.3%
Lung Disease	12	20%
Cardiac Disease	13	21.6%
Respiratory infection	8	13.3%

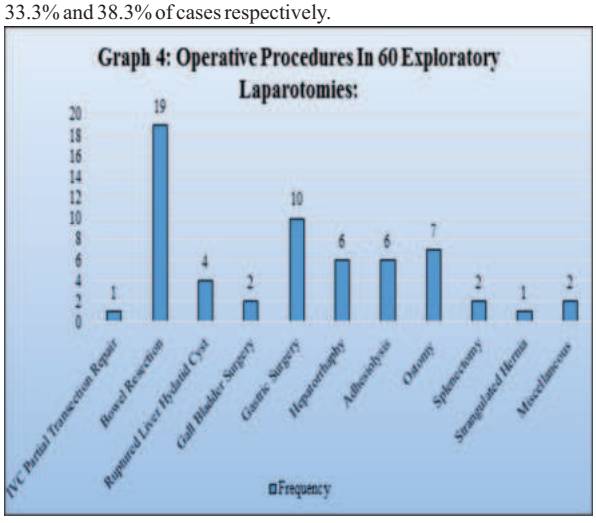
There were 33% of smokers. 21.6% of the subjects had diabetes mellitus, 23.3% of the subjects had hypertension. 20% of the subjects presented with history of lung disease and 21.6% of the subjects presented with history of cardiac disease. History of respiratory infection was seen in 13.3% of the subjects.

Table 3. Intra-operative Details of the Patients

Intra-operative details		Frequency	Percentage
ASA Grading	1	7	11.6%
	2	25	41.6%
	3	21	35%
	4	5	8.3%
	5	2	3.3%
Duration of surgery (hours)	2	14	23.3%
	2.5	3	5%
	3	43	71.6%
Nasogastric tube use	Yes	31	51.6%
	No	29	48.3%
Incentive spirometry	Yes	54	90%
	No	6	10%
Incisions	Upper	17	28.3%
	Upper/Lower	20	33.3%
	Lower	23	38.3%

ASA (American Society Of Anesthesiologists) 1, 2, 3, 4 and 5 constituted about 11.6%, 41.6%, 35%, 8.3% and 3.3% of the study population respectively. Duration of surgery lasted for 2 hours in 23.3%, 2-5 hours in 5% and 3 hours in 71.6% of the patients.

Nasogastric tube was used after laparotomy in 51.6% of the subjects. Incentive spirometry was done in 90% of the subjects. Upper incisions were done in 28.3% of cases, upper/lower and lower were done in rest 33.3% and 38.3% of cases respectively.

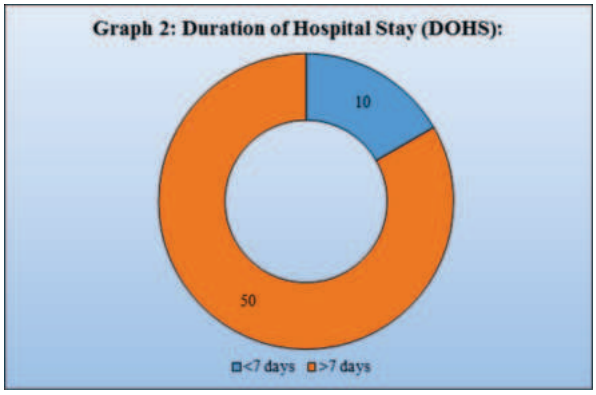


Inferior Vena Cava Partial Transection Repair, Bowel Resection, Ruptured Liver Hydatid Cyst, Gall Bladder Surgery, Gastric Surgery, Hepatorhhaphy, Adhesiolysis, Ostomy, Splenectomy, Strangulated Hernia and miscellaneous cases constituted to 1.6%, 31.6%, 6.6%, 3.3%, 16.6%, 10%, 10%, 11.6%, 3.3%, 1.6% and 3.3% respectively.

Table 4. Post-operative Complications Among Patients

Complications	Frequency	Percentage
Pneumonia	3	50%
Atelectasis	1	16.6%
Bronchitis	1	16.6%
Pleural effusion	1	16.6%
No Complications	54	90%

Post laparotomy complications were seen in 10% of the subjects. Pneumonia, atelectasis, bronchitis and pleural effusion were seen in 50%, 16.6%, 16.6% and 16.6% of cases respectively. 54 (90%) patients didn't develop complications.



16.6% of patients stayed in hospital for less than 7 days and 83.3% of patients stayed more than 7 days.

Univariate analysis of potential risk factors for PPCs are shown in table 24. Heart or lung disease were significant risks for PPCs, as were a higher American Society of Anesthesiology risk stratification, longer anesthesia time, emergency surgery, reoperation, the presence of nasogastric tubes postoperatively, and upper or upper/lower abdominal incisions (versus lower incisions). There was a trend toward older age in the PPC group (p = 0.064). Gender, smoking history, surgery for malignant disease and ordering incentive spirometry did not impact the occurrence of PPCs.

Table 5. Risk Variables Associated With PPCs in Exploratory Laparotomies

Variable	PPCs (n = 6)	No PPCs (n = 54)	P value
Mean age ±SE, years	63.7 ±2.25	58.4 ±3.12	0.064
Male gender	3 (60%)	33 (60%)	0.43
Smoking	2 (40%)	18 (32.7%)	0.11
History of lung disease	2 (40%)	10 (18.1%)	0.017
History of cardiac disease	2 (40%)	11 (20%)	0.034
Mean ASA ± SE	3.04±0.42	2.38 ±0.42	0.001
Mean anesthesia time (min)	252.2±5.5	177.8±26.	0.002
Lower abdominal incision	1 (20%)	12 (21.8%)	0.001
Nasogastric tube	4 (80%)	27 (49%)	0.001
Incentive spirometry	4 (80%)	50 (90.9%)	0.14
>1 operation during admission	1 (20%)	2 (3.6%)	0.042

SE = Standard error of the mean; ASA = American Society of Anesthesiology risk stratification.

Table 6. Independent Predictors of PPCs in Exploratory Laparotomies

Variable	OR	95% CI	P value
History of lung disease	2.45	0.95–6.30	0.063
Upper versus lower incision	15.30	1.42–165.18	0.025
Upper/lower versus lower incision	7.17	0.82–62.72	0.075
Nasogastric tube	5.44	1.57–18.84	0.008

Independent predictors of PPCs identified by logistic regression modeling are shown in table 25 Overall, the data fit the model well (p = 0.60). Upper abdominal incisions were over 15 times more likely than lower incisions to be associated with PPCs. Upper/lower abdominal incisions were associated with a more than 7-fold increase in risk compared with lower incisions, although the difference just missed statistical significance (p = 0.075). The use of nasogastric tubes postoperatively conveyed a more than 5-fold increase in risk. A history of lung disease was associated with increased risk but was just below the threshold for statistical significance (OR 2.45; p = 0.063)

DISCUSSION

Our research aimed to determine the incidence of postoperative pulmonary complications (PPCs) after laparotomy and identify the risk variables associated with their occurrence. After performing laparotomy, we discovered a 10.0% occurrence of postoperative pulmonary complications (PPCs). Upper abdominal incisions and nasogastric tubes were identified as separate factors that might predict the likelihood of postoperative pulmonary complications (PPCs).

Both upper and lower incisions, as well as chronic lung illness, showed

an elevated risk, but the statistical significance was not nearly reached. The previous publications have shown a broad range of occurrence of PPCs after laparotomy. In studies by Brooks-Brunn JA et al[9], McAlister FA et al[10], Orces CH et al[11] and Mitchell CK et al[12], specifically examined laparotomies, and the incidence of postoperative pulmonary complications (PPCs) varied from 0.9% to 69.5%. A prospective cohort study by Kanat F et al[13] involved 400 patients and found that the frequency of postoperative pulmonary complications (PPC) was 22.5%. A research investigation by Ford GT et al[14] including 1,055 individuals examined elective nonthoracic surgeries, of which 413 were laparotomies.

Overall, PPCs occurred in 2.7%. The National Hospital Discharge Survey of major abdominal operations in United States for 1989–2004 by Arozullah AM et al[15] showed a PPC rate of 6.5% in 12,897,800 procedures.

The wide variety in PPC frequencies seen in earlier reports after laparotomy may be attributed to many reasons. These include different definitions of PPCs, the postoperative time period, the precise surgical sites (limited to upper abdominal or including entire abdomen), specific exclusions (such as hernia repairs), diverse patient groups, and research methodology. There has been a significant amount of variation in how earlier research have defined PPCs. The aforementioned research identified pneumonia as the only factor defining postoperative pulmonary complications (PPCs) in study by Brooks-Brunn JA et al[9] and Orces CH et al[11], whereas pneumonia and atelectasis were identified as the factors in study by McAlister FA et al[10] and Kanat F et al[13].

In our study, only PPCs identified within the first postoperative week were included. Events after the first week are less likely, due specifically to the operation. Laparotomy reduces diaphragmatic function via reflex inhibition of phrenic nerve output, during the first postoperative week[16]. Atelectasis and pneumonia are promoted by rapid-shallow breathing due to the impairment of diaphragmatic function. The incidence of PPCs after laparotomy was lower in the present study than in many prior study by Hall JC et al[17] and Dilworth JP et al[18].

The primary factor contributing to this discovery in our research is our specific definition of PPCs, which deliberately eliminated temporary and small episodes, as well as problems resulting from non-pulmonary sources such as cardiogenic pulmonary edema. A potential contributing factor, while of lesser significance, that may have influenced the occurrence rate of PPCs in our research is the limited number of open abdominal aortic aneurysm repairs. This technique has the highest risk for postoperative pulmonary complications (PPCs) compared to any other specialized surgery[17]. The data we have collected demonstrate that, when it comes to postoperative pulmonary complications (PPCs), procedure-related variables provide a higher risk than patient-related ones, particularly the surgical location[19]. The highest risk was associated with higher abdominal incisions, followed by combination upper/lower incisions. The use of postoperative nasogastric tubes was identified as separate risk factors. The one autonomous risk factor associated with patients was a previous occurrence of lung illness, which narrowly fell short of reaching statistical significance[20].

The operating mechanism is assumed to be a deeper reflex inhibition of diaphragmatic function after upper abdominal operations[16]. Prior investigations, including a study of 560 gynecologic procedures, have indicated a reduced risk following lower abdominal incisions. Our results substantiate a heightened susceptibility to postoperative pulmonary complications (PPCs) associated with the use of nasogastric tubes. This information has been previously documented, notably in a recent extensive study by Ford GT et al[14]. Emerging data indicates that the usual use of nasogastric tubes during laparotomy is unnecessary[21,22]. The exact mechanism by which nasogastric tubes contribute to the increased risk of postoperative pulmonary complications (PPCs) remains uncertain. The postulated causes for interference with cough include pain, inadequate closure of the glottis, and the transfer of microorganisms from the oropharynx to the airways[23].

We did not see a decrease in postoperative pulmonary complications (PPCs) while using incentive spirometry. The data did not provide sufficient information to assess the actual frequency and appropriateness of usage of this modality. Research by Dureuil B et al[24] suggests that emergency surgery is associated with a higher likelihood of experiencing postoperative problems. However, it is important to note that most studies have mostly focused on elective operations. Research by Peter R. Smith et al[25] including 266 patients examined the occurrence of postoperative pulmonary complications (PPCs) and found that they occurred in 28.2% of the cases.

The occurrence of postoperative complications resulted in large rise in mortality rate inside the hospital, the need for intensive care unit (ICU) treatment, the length of hospital stay, and the length of time spent in recovery following surgery. In previous research, it was shown that 22% of patients with postoperative pulmonary complications (PPCs) who had elective laparotomy died while in the hospital. This was compared to a control group of 82 patients without PPCs, none of whom died during their hospital stay in a study by Pessaux P et al[26]. During prospective research by Filardo Fde A et al[27] including 283 patients who had upper abdominal surgery, 69 individuals (24.4%) suffered postoperative pulmonary complications (PPCs). Out of these 69 patients, 14 (20.3%) unfortunately passed away.

The analysis indicated that PPCs were the only variable that shown a noteworthy correlation with mortality. Our results further enhance the comprehension of the influence of PPCs. The past has not given sufficient attention to the repercussions of heightened usage of ICU beds and extended postoperative hospital stays. Our research is limited by factors such as a low volume of abdominal aortic aneurysm repairs, a single-center focus, and limited relevance to institutions that do not offer surgical training programs.

CONCLUSION

We concluded that the PPCs are higher in smokers, higher in patients with comorbid respiratory diseases, patients with longer duration of surgery, PPCs considerably increase the hospital, and ICU stay and mortality. Pneumonia is the most common respiratory complication observed. Outcomes of laparotomies are multifactorial with high morbidity and mortality, leading to an escalation in hospital costs and prolonged illness. These complications can be avoided if the factors involved are properly addressed.

Post-operative pulmonary complications increase morbidity post-surgery. Pre-operative assessment aids in identifying patients at risk of developing post-operative pulmonary complications. Proper pre-operative assessment by the pulmonologists and management of existing risk factors would reduce the incidence or possibly eliminate completely the occurrence of the post-operative pulmonary complications. The incidence of post-operative pulmonary complications in our study was relatively less.

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