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Incidence of post-operative pulmonary complications after emergency abdominal surgery

Taneem Bin Haider[1], Md. Tanvir Hasan[2], Rozina Akter Lata[3], Arman Hossain[4], Chaudary Nur-E-Tanzim[5], Nur Fatema[6]

[1]*Resident Surgeon, Department of Surgery, US-Bangla Medical College and Hospital, Narayanganj, Bangladesh*
[2]*Associate Professor, Department of Surgery, US-Bangla Medical College and Hospital, Narayanganj, Bangladesh*
[3]*Assistant Professor, Department of Surgery, US-Bangla Medical College and Hospital, Narayanganj, Bangladesh*
[4]*Associate Professor (CC), Pediatric Surgery, US-Bangla Medical College and Hospital, Narayanganj, Bangladesh*
[5]*Registrar, Department of Surgery, US-Bangla Medical College and Hospital, Narayanganj, Bangladesh*
[6]*Anesthesiologist, Dhaka Medical College, Dhaka, Bangladesh*
Corresponding Author: *Dr. Taneem Bin Haider, Resident Surgeon, Department of Surgery, US-Bangla Medical College and Hospital, Narayanganj, Bangladesh*

Abstract
Background: *Postoperative pulmonary complications (PPCs) are common and clinically significant after emergency abdominal surgery, where limited preoperative preparation and high physiological stress heighten respiratory risk. Incidence varies widely worldwide, and evidence from resource-limited settings such as Bangladesh remains scarce. This study aimed to determine the incidence of PPCs following emergency abdominal surgery and to identify the most frequent types of these complications in this patient population.*
Methods: *Patients who presented with acute abdomen attending the Department of Surgery as well as Casualty, DMCH, within the time period of May, 2014 to November, 2014, and subsequently undergone different abdominal surgical interventions on emergency basis, were prospectively included in this cross-sectional observational study.*
Results: *The sample size was 100 cases, out of which 22 developed postoperative pulmonary complications (PPCs). Four major PPCs found were Pneumonia in 12 (55%), atelectasis 4 (18%), pleural effusion 4 (18%) and acute respiratory failure in 2 (9%) patients. All 22 patients of PPCs had early postoperative respiratory symptoms and almost all of them had positive neutrophilic leukocytosis in blood postoperatively. Fifteen (75%) patients with PPCs had a length of hospital stay more than 15 days, which is 5 (25%) in non-PPCs group.*
Conclusion: *The study has demonstrated the incidence of postoperative pulmonary complications in patients following emergency abdominal surgery that cost significant morbidity and increased length of hospital stay. Early identification and appropriate precaution can reduce these types of unwanted consequences.*
Keywords: *Postoperative pulmonary complications; Emergency abdominal surgery; Respiratory morbidity; Surgical outcomes*

I. INTRODUCTION

More than 230 million major surgical procedures are undertaken each year worldwide, and postoperative complications impose a substantial clinical and economic burden on both patients and healthcare systems [1]. Postoperative pulmonary complications (PPCs) are significant; they are common and are associated with increased morbidity, mortality, and prolonged hospital stay [2–4]. Reported incidences vary widely, ranging from 9% to 40%, mainly due to methodological differences among studies and variations in patient populations [5–7]. Multiple perioperative factors such as surgical site, emergency operation, pre-existing respiratory illness, and inadequate analgesia further amplify the risk of PPCs [8,9]. Emergency abdominal surgery carries significantly higher morbidity and mortality than elective procedures [10,11]. The emergency nature of these operations allows for limited time for adequate preoperative evaluation, optimization, and implementation of preventive strategies; this effect has been consistently associated with increased postoperative complications, including pulmonary adverse events [9]. A lack of resources and limited expertise in many low- and middle-income countries may also contribute to prolonged operative times, increased physiological stress, and delayed mobilization, all of which elevate pulmonary risk. Emergency abdominal procedures encompass a broad range of non-traumatic and

traumatic causes. Non-traumatic conditions typically involve controlling intra-abdominal sepsis, restoring gastrointestinal continuity, and stabilizing hemodynamics, sometimes through staged or damage-control operations. Traumatic causes include blunt abdominal trauma and penetrating injuries, most commonly resulting from road traffic accidents, falls, and interpersonal violence [12]. Such injuries may rapidly become life-threatening if surgical intervention is delayed, further influencing postoperative respiratory outcomes. PPCs constitute a diverse group of respiratory disorders occurring after surgery [13]. They include pneumonia, atelectasis, pleural effusion, pneumothorax, bronchospasm, respiratory failure, and aspiration pneumonitis. Pneumonia, one of the most common PPCs, is characterized by the development of new pulmonary infiltrates associated with fever, purulent secretions, or leukocytosis in the postoperative period. Hospital-acquired pathogens such as Gram-negative organisms, Staphylococcus aureus, and anaerobes are frequently implicated. Atelectasis, often driven by general anesthesia, upper abdominal incisions, poor analgesia, or pre-existing lung disease, results in alveolar collapse and impaired oxygenation. Pleural effusion after abdominal surgery is generally related to fluid overload, pneumonia, hypoalbuminemia, cardiac failure, or underlying lung pathology. Respiratory failure, whether hypoxemic or hypercapnic, arises from inadequate ventilation resulting from anesthetic effects, pneumonia, obstructive lung disease, or insufficient postoperative pain control. Bangladesh, one of the most populous developing countries, has limited published data regarding the incidence and characteristics of PPCs. Given differences in population characteristics, disease patterns, healthcare resources, and postoperative care practices compared with Western countries, local data are essential. Therefore, the present study was undertaken to determine the incidence of postoperative pulmonary complications following emergency abdominal surgery and to identify the most common types of complications in this surgical cohort.

II. METHODS

This prospective, observational, cross-sectional study was conducted in the Department of Surgery at Dhaka Medical College Hospital, Dhaka, from May 11, 2014, to November 10, 2014. Dhaka Medical College Hospital serves as a major tertiary referral centre, catering to a catchment population exceeding 10,000. The required sample size was initially calculated as 384 using the Fisher formula; however, given the six-month study window and feasibility considerations, a sample size of 100 patients was deemed acceptable. A purposive sampling strategy was applied. Adult patients admitted through the emergency department with indications for emergency abdominal surgery were included. Eligible cases comprised non-traumatic acute abdomen, traumatic injuries, blunt abdominal trauma, and penetrating abdominal injuries. Both male and female patients were enrolled in the study. Individuals with any pre-existing acute respiratory illness or previously diagnosed neuromuscular disorders were excluded.

Patients presenting with an acute abdomen and meeting the inclusion criteria were recruited after providing verbal and written informed consent. The baseline assessment included a brief history, focused physical examination, and relevant investigations as outlined in a structured questionnaire. Following adequate resuscitation, surgical intervention was performed under general anesthesia or subarachnoid block based on clinical indications. Standardized anesthetic regimens were maintained for all participants. Postoperative analgesia consisted of similar classes of pain medications, prescribed according to clinical need, ensuring comparable pain control across the cohort. Patients were closely monitored for signs and symptoms suggestive of postoperative pulmonary complications (PPCs), including fever, dyspnea, cough, or chest pain. Blood samples were obtained at variable postoperative intervals when such symptoms developed and were compared with preoperative values; clinically significant rises in counts were recorded. Chest radiographs were performed when respiratory symptoms appeared, most commonly between the first and third postoperative days.

All collected data were routinely checked, verified for completeness and accuracy, coded, and subsequently analyzed using SPSS version 22.0. Ethical approval was aligned with institutional norms, and no elements of the study were deemed to pose additional ethical concerns beyond those inherent in routine clinical care.

III. RESULTS

The table shows that postoperative pulmonary complications (PPCs) were most common among patients with jejunal or ileal perforations, with 9 out of 25 cases (36% of that subgroup) developing PPCs. Antral perforations and multiple-organ injuries also demonstrated notable PPC rates, each contributing 4 cases. Duodenal perforations had a relatively low occurrence of PPC, with only 2 of 22 patients affected. No PPCs occurred in cases of significant gut obstruction or volvulus. Overall, PPCs accounted for 22% of the study population, while 77% experienced an uncomplicated postoperative course.

Table 1. Indications of emergency abdominal surgeries and number of PPCs

Indications	Total n (%)	Non-PPCs n (%)	PPCs n (%)
Jejunal / ileal perforations	25 (25.0)	16 (16.0)	9 (9.0)
Duodenal perforations	22 (22.0)	20 (20.0)	2 (2.0)
Acute appendicitis / appendicular abscess	15 (15.0)	12 (12.0)	3 (3.0)
Large gut obstructions / volvulus	8 (8.0)	8 (8.0)	0 (0.0)
Antral perforations	10 (10.0)	6 (6.0)	4 (4.0)
Others / multiple organ injury	20 (20.0)	16 (16.0)	4 (4.0)
Total	**100 (100.0)**	**77 (77.0)**	**22 (22.0)**

Pneumonia was the most frequent postoperative pulmonary complication, accounting for more than half of all cases (55%), indicating it was the predominant respiratory issue in the cohort. Atelectasis and pleural effusion occurred with equal frequency, each accounting for 18% of the complications. Acute respiratory failure was the least common, observed in only 9% of affected patients. Overall, the distribution suggests that infectious and ventilation-related complications were the major contributors to PPCs in this population.

Table 2. Types of pulmonary complications and their incidence

Pulmonary complications	Frequency (n)	Percentage (%)
Pneumonia	12	55.00
Atelectasis	4	18.00
Pleural effusion	4	18.00
Acute respiratory failure	2	9.00

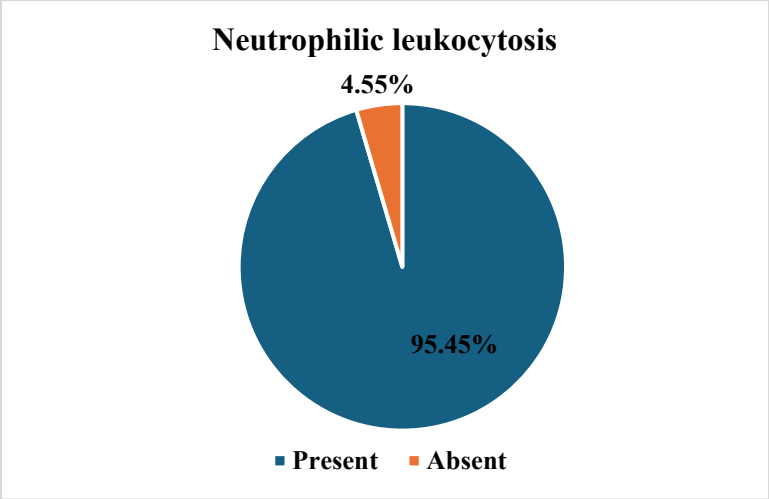

Figure 1: Presence of neutrophilic leukocytosis

Figure 1 shows that among 22 patients of PPCs, 21 patients had positive neutrophilic leukocytosis in blood which is about 95%. Here blood samples were collected from the patients on the appearance of symptoms suggesting PPCs in variable times postoperatively and compared them to the previous reports, if found raised counts thought to be significant but proper demarcation from other causes of leukocytosis remained controversial.

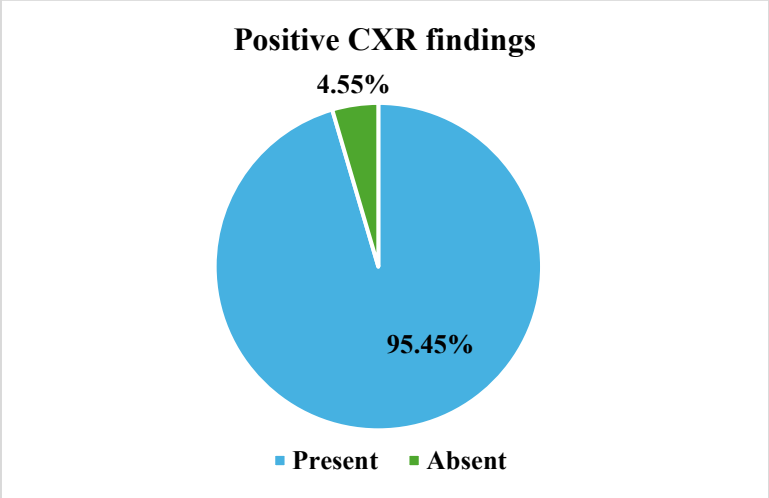

Figure 2. Distribution of positive CXR findings

Figure 2 showed us there were different positive chest X-ray findings in 21 patients among the total 22 patients with PPCs, which is about 95%. Chest radiographs advised postoperatively based on clinical features suggesting PPCs, most of them had been done in between 1st to 3rd postoperative days.

Figure 3. This radiograph showing bilateral pleural effusion was taken on the 3rd postoperative day in a patient operated for spontaneous perforation at the gastric antrum.

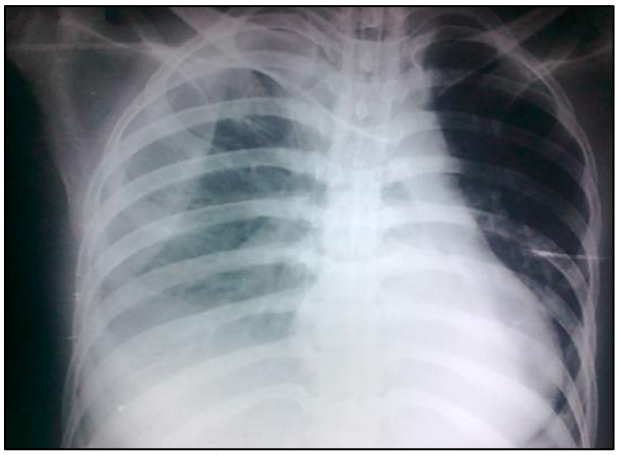

Figure 4. This radiograph was taken at the 5th postoperative day with progressive respiratory symptoms in a patient, starting from 2days after abdominal surgery. It shows pulmonary infiltration on the right side.

The length-of-stay profile shows a clear association between prolonged hospitalization and the development of postoperative pulmonary complications (PPCs). Most patients without PPCs were discharged within 10 days, with 58 out of 77 uncomplicated cases (75% of non-PPCs) completing treatment in this period. In contrast, the majority of PPC cases required more extended hospitalizations; 13 of 22 patients with complications (59%) stayed 16–20 days, and additional cases extended beyond 20 days. Only a small fraction of PPC patients were discharged before day 10. Overall, PPCs were strongly associated with extended hospital stays, reflecting the increased clinical burden associated with these complications.

Table 3. Length of hospital stay

Duration (days)	Total n (%)	Non-PPCs n (%)	PPCs n (%)
<10	61 (61.0)	58 (58.0)	3 (3.0)
11–15	18 (18.0)	14 (14.0)	4 (4.0)
16–20	15 (15.0)	2 (2.0)	13 (13.0)
>20	5 (5.0)	3 (3.0)	2 (2.0)
Expired	1 (1.0)	0 (0.0)	0 (0.0)
Total	**100 (100.0)**	**77 (77.0)**	**22 (22.0)**

IV. DISCUSSION

The primary objective of this study was to determine the frequency of postoperative pulmonary complications following emergency abdominal surgical procedures. The overall incidence of PPCs in this study was 22%, with pneumonia (55%), atelectasis (18%), pleural effusion (18%), and acute respiratory failure (9%) comprising the major complications. Similar distributions have been reported previously in abdominal surgical cohorts, where impaired ventilation, diaphragmatic dysfunction, and upper abdominal incisions play central roles [14–16]. In this study, upper abdominal procedures demonstrated the highest predisposition to PPCs, accounting for 26.3% of all upper abdominal operations and 85% of total PPCs. This pattern aligns with earlier evidence showing that upper gastrointestinal surgery significantly increases pulmonary risk due to pronounced postoperative diaphragmatic inhibition, pain, and impaired cough reflex [8,17]. Smith et al. reported a PPC incidence of 24.4% in upper abdominal operations, closely reflecting the findings of the present study [14]. Additional studies have confirmed that diaphragmatic dysfunction following upper abdominal surgery is a significant predictor of postoperative respiratory complications [18,19]. The emergency nature of surgery further contributed to PPC risk, consistent with findings from Smith et al. and Gallart et al. [14,15]. Emergency surgery limits the time available for preoperative optimisation, pulmonary assessment, and correction of modifiable risk factors, as supported in major reviews and risk prediction models [20,21]. Arozullah et al. and Qaseem et al. emphasized that emergency surgery is an independent predictor of PPCs, reinforcing the interpretation of our results [20,21]. The 28.2% incidence of PPCs following emergency laparotomy observed by Smith et al. [14] is comparable with the 22% reported in our study, with minor variations likely attributable to differences in population characteristics, disease burden, and sample size. Regarding the length of hospital stay, the majority of patients (61%) were discharged within 10 days, which was partly influenced by the limited bed capacity and high patient turnover in tertiary hospitals. However, 20 patients required hospitalization for more than 15 days; among them, 75% developed PPCs. This pattern illustrates the substantial impact of PPCs on prolonged hospital stays, socioeconomic burden, and delayed recovery. Smith et al. also reported substantially prolonged LOS associated with PPCs, with postoperative stay extending by an average of 15 days, and similar trends were observed by Serejo et al. [[14,16]. Extensive regional studies, including the prospective multicenter work by Canet et al., further validate the strong correlation between PPCs and resource utilization, ventilatory support, and extended hospitalization [22]. Overall, the findings of this study are consistent with previous literature: PPCs remain a significant determinant of postoperative morbidity, particularly in emergency and upper abdominal operations. The observed incidence and clinical patterns align well with recognised international ranges and underscore the ongoing need for enhanced perioperative assessment, risk stratification, and postoperative pulmonary care.

Limitation of the study: The study was limited by its relatively small sample size and single-centre design, which may restrict the generalizability of the findings. The use of purposive sampling may have introduced selection bias, and the short study period limited the ability to capture seasonal or practice-related variations in postoperative outcomes. Detailed preoperative pulmonary assessments and long-term follow-up were not feasible in the emergency setting, which may have led to under- or overestimation of specific pulmonary complications.

V. CONCLUSION

This study demonstrates that postoperative pulmonary complications are a significant concern following emergency abdominal surgery, with pneumonia, atelectasis, and pleural effusion being the most frequent events. Patients undergoing upper abdominal procedures and those with prolonged hospitalization showed a markedly

higher risk of PPCs. These findings highlight the need for early risk identification, optimized perioperative care, and focused postoperative monitoring to reduce pulmonary morbidity in emergency surgical populations.

VI. RECOMMENDATION

Strengthening preoperative stabilization, improving pain control, and encouraging early mobilization should be prioritized to reduce PPCs after emergency abdominal surgery. Routine postoperative respiratory assessment, timely chest imaging for symptomatic patients, and standardized pulmonary care protocols may further lower complication rates. Training and resource enhancement in emergency surgical units are also recommended to improve patient outcomes and minimize preventable respiratory morbidity.

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