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Original Research Article

# A Retrospective Study to Establish the Incidence of PPCs in a Cohort of Patients Undergoing Emergency Laparotomy and the Consequences on Patient Outcomes

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**Abstract**

**Aim:** This study aimed to establish the incidence of PPCs in a cohort of patients undergoing emergency laparotomy and the consequences on patient outcomes.

**Methods:** A retrospective analysis was conducted of patient that underwent emergency laparotomy over a period of three years at the Department of General Surgery Nalanda Medical College and Hospital, Patna, Bihar, India. A total of 400 patients coming to the hospital were selected randomly for this study. Individual patient data was collected using proforma which included demographics, date of operation, risk stratification using ASA score, P-POSSUM, serum lactate and serum creatinine, operative details, critical care service utilization post-operatively and in-hospital outcomes.

**Results:** The table demonstrates high risk patients ended up having significantly worse outcomes than low risk patients. High-risk patients were older (67 years {IQR 51–77} vs. 48 {IQR 38–66}; $p < 0.001$) and had higher PPOSSUM predicted mortality scores ($p < 0.001$). The incidence of PPCs within the entire cohort was 37%. The burden of PPCs was almost entirely in the high-risk patients with an incidence of 35%, with only 5%of the low-risk patients developing a PPC. **Conclusion:** This study demonstrates that the sub-group of patients deemed 'high-risk' are at greatest risk of developing a PPC and consequently has an increased length of stay and an increased 90-, 180- and 360-day mortality. This allowed us to identify a group of patients at high risk of PPC who we can target with potential novel therapies such as high-flow nasal cannula oxygen in clinical trials to reduce mortality and morbidity.

**Keywords:** Emergency Laparotomy, Mortality, peritonitis

## Introduction

An emergency laparotomy is a commonly performed operation by general surgeons where the abdomen is opened and the abdominal organs examined for any injury or disease [1]. A few major indications for an emergency laparotomy are like perforation peritonitis, acute intestinal obstruction, burst appendix and blunt or penetrating abdominal injuries either due to road side accidents, fall from height or gun shot or stab injuries.[2]

Emergency laparotomy is a high-risk procedure in old patients due to underlying comorbidity, frailty, and reduced physiological reserves. [3]

Risk factors associated with poorer outcomes from emergency laparotomy have been identified by the National Emergency Laparotomy Audit (NELA) and include advancing age, with each decade above the age of 50 being associated with increasing risk. Additional risk factors include an American Society of Anesthesia (ASA) status of 3 or more and Portsmouth- Physiological and Operative Severity Score for the enumeration of Mortality and morbidity (P-POSSUM) risk of death of greater than 5% [4].

The development of post-operative pulmonary complications (PPCs) is a composite definition for a variety of respiratory complications that occur following surgery. They range from clinically significant bronchospasm and atelectasis, through to the development of pneumonia and the acute respiratory distress syndrome (ARDS) [5]. The incidence following elective major abdominal surgery has been estimated at 11.9% and is associated poorer outcomes with increased length of hospital stay, increased re-admissions and a higher mortality [6].

Thus, we aim to establish the incidence of PPCs in a cohort of patients undergoing emergency laparotomy and the consequences on patient outcomes.

## Materials and Methods:

A retrospective analysis was conducted of patient that underwent emergency laparotomy over a period of three years at the Department of General Surgery in Nalanda Medical college and Hospital, Patna, Bihar, India.

A total of 400 patients coming to the hospital were selected randomly for this study. Informed consent were obtained after explaining the purpose of the study to the study participants. Study was conducted after achieving the ethical clearance from the ethical committee of the institute.

## Data Collected:

Individual patient data was collected using proforma which included demographics, date of operation, risk stratification using ASA score, P-POSSUM, serum lactate and serum creatinine, operative details, critical care service utilization post-operatively and in-hospital outcomes.

## Definition of High-risk and Low-risk Patients:

As described previously patients presenting for emergency surgery are heterogeneous with different groups of patients having variable outcomes. Patients were therefore categorized as high or low-risk based upon either an ASA ≥3 or a P-POSSUM predicted mortality of ≥5%. This categorization was based on evidence from 30000 cases analyzed by the NELA group that suggested that adverse outcomes occur if a patient meets any one of these three variables [4].

## Diagnosis of PPCs:

PPCs were identified using the Melbourne Group Score. This is a validated daily screening tool for identifying patients with PPCs and has been used previously in

patients undergoing major abdominal and thoracic surgery [7]. Patients EPRs were screened daily from the day of operation till the seventh post-operative day for PPCs using the Melbourne Group Score. The daily score was recorded and where a patient met the diagnosis of a PPC the postoperative day of occurrence was recorded.

**Statistical Analysis:**

All data were analyzed using a Mann-Whitney U test. Categorical data are represented as numbers and proportions with any comparative tests performed using a Fisher's exact or Chi-squared test. Kaplan-Meier analysis and odd's ratio were performed to quantify the consequences of PPC development on survival and re-admissions. These were calculated using Chi-squared test. Additionally, to identify factors that may predict the development of PPCs Cox-logistical regression was carried out using SPSS. Significance was taken as a p-value of less than 0.05.

**Results:**

Demographics and risk stratification of our cohort are showing in this table. The table demonstrates high risk patients ended up having significantly worse outcomes than low risk patients.

The median age of the entire cohort was 60 years (IQR 45–74 years). The majority of patients (72.2% n = 289) had an ASA ≥3 with a median P-POSSUM score of 5% (2.0–19.8%). The median length of hospital stay was 13 days (IQR 6–25), with a 30-day mortality of 13.4%. (Table 1)

High-risk patients were older (67 years {IQR 51–77} vs. 48 {IQR 38–66}; $p < 0.001$) and had higher PPOSSUM predicted mortality scores ($p < 0.001$).

**Table 1: Comparison of demographics and risk stratification of low and high risk patients**

| | All Patients N = 400 | Low Risk Patients N = 147 | High-Risk Patients N = 253 | p-values |
|---|---|---|---|---|
| Age | 78 (45–74) | 61 (38–66) | 81 (51–77) | <0.001 |
| Sex, male: female (%) | 45:50 | 47:50 | 41:52 | |
| ASA | | | | |
| 1–2 | 33% (128) | 100% | 26.8% (68) | |
| ≥ 3 | 72.2% (289) | 0% | 68.7% (174) | |
| P-POSSUM (mortality) | 5% (2.1–17.1%) | 1% (1.1–3.6%) | 10.36 (6.3–34.1) | <0.001 |
| ICU admission: | 20% (80) | 0 | 66 (26.0%) | |
| P-POSSUM 5–10% (N = 72 | 38.7% (155) | 0 | 187 (73.9%) | |
| P-POSSUM > 10% (N = 156) | 48% (174) | Total (0) | Total (253) | |
| Length of stay | 23 (6–25) days | 12 (6–15) days | 21 (9–32) days | <0.001 |
| 30-day Mortality | 19.7% (79) | 3.4% (5) | 13.4% (34) | <0.001 |
| PPC | 30% | 6% | 37% | <0.001 |

The incidence of PPCs within the entire cohort was 37%. The burden of PPCs were almost entirely in the high-risk patients with an incidence of 35%, with only 5%of the low-risk patients developing a PPC. The demographics of patients who were diagnosed with and without a PPC are

shown in Table 2. There were no significant differences between these patients, although patients who did develop a PPCs showed a trend towards an increased pre-operative P-POSSUM predicted mortality scores and were more likely to be admitted directly to CCU (p = 0.02). Importantly, there were no differences between these two cohorts in baseline respiratory or cardiovascular disease asmeasured by the P-POSSUM risk score.

**Table 2: Demographics of patients with a PPC and without a PPC**

| High Risk Laparotomies | No PPC<br>N = 180 | PPC<br>N = 101 | p-value |
|---|---|---|---|
| Age, years | 89 (43–70) | 70.1 (47.1–60.3) | 0.98 |
| P-POSSUM %(mortality) | 15.2 (5.7–30.3) | 21.8 (8.0–45.7) | 0.08 |
| No dyspnea (n) | 67.2% (121) | 63.3% (64) | 0.50* |
| No failure (n) | 56.6% (102) | 68.3% (69) | 0.61* |
| Admission to ICU (n) | 48.3% (87) | 80.1% (81) | 0.01* |

**Discussion:**

Emergency laparotomy is a major test of the surgical skills to a surgeon. The general surgeon performing laparotomy in emergency must be aware of the diverse etiology of the acute abdomen, the unique characteristics of each case and their management. Patients undergoing emergency laparotomy have a disproportionately high morbidity and mortality compared to elective laparotomies [7].

Emergency abdominal surgery by its very nature is associated with increased morbidity and mortality.

This study demonstrates that the well validated ASA and P-POSSUM scoring tools in conjunction with age can be used to identify patients at high risk of developing PPCs. Importantly we demonstrate that the patients who develop a PPC overall have poorer outcomes and consume more resources. Although, in hospital or 30-day mortality was no different, patients who developed a PPC did stay in CCU for longer and have prolonged hospital stays compared to those who did not develop a PPC. Longer term outcomes, were also poorer, with unplanned hospital readmissions and mortality increased at all-time points.

The pathophysiology of PPCs following emergency surgery is multi-factorial and complex. Post-operative pain following surgery is implicated as this prevents patients from ventilating dependent portions of the lung [8].

The incidence of peptic perforation in younger age group is usually higher because of high rate of smoking and analgesic drug abuse as the same are easily available in medicine stores and sold as over the counter drug. This age group is also economically productive group and are involved in outdoor activities and are therefore more prone to road side accidents leading to head injury or abdominal injuries.[9]

Whilst the PROVILHO study investigated the use of high versus low PEEP and demonstrated no difference, but importantly did suggest that high PEEP strategies were associated with increased cardiovascular compromise [10]. Both these studies have potentially important implications in emergency abdominal

surgery, however they only recruited patients undergoing major abdominal surgery. The use of protective ventilation in emergency surgery would seem intuitive and supported by evidence in ventilated critically ill patients without ALI/ARDS. Indeed, a prospective observational study of ventilation practices did demonstrate that anesthetists adopted a more protective strategy in this cohort of patients [11].

Post-operative interventions have also been evaluated, with the recently completely OPERA trial, investigated the use of high-flow nasal oxygen in patients undergoing major abdominal surgery, but found no difference in oxygenation 4 hours post-operatively (primary outcome), nor in any of their clinical secondary outcomes, which included PPCs and LOS [12].

**Conclusion:**

This study demonstrates that the sub-group of patients deemed ‘high-risk’ are at greatest risk of developing a PPC and consequently have an increased length of stay and an increased 90, 180 and 360 day mortality. This allowed us to identify a group of patients at high risk of PPC who we can target with potential novel therapies such as high-flow nasal cannulae oxygen in clinical trials to reduce mortality and morbidity.

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