

Predictors of Post-operative Pulmonary Complications Following Emergency Laparotomy

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Abstract

Background: Post-operative respiratory complications are a major threat following emergency abdominal surgeries. It significantly increases post-operative morbidity and mortality. The aim of this study was to determine the incidence and factors affecting post-operative pulmonary complications (PPCs).

Materials and Methods: This is a prospective observational study conducted in 270 patients who got admitted through SOPD, casualty or transferred from other department, and undergoing emergency laparotomy over a period of 1 year (June 1, 2018–May 31, 2019). Patients were included in the study irrespective of age, sex, and occupation. Pre- and post-operative data were collected through interview and postoperatively patients were monitored clinically and various investigations were done to record post-operative respiratory complications. Then, their association was analyzed.

Results: Two hundred seventy patients were included in the present study and 55 (20.4%) developed PPCs. Pneumonia (20) was the most common PPC followed by atelectasis (15). Elderly patients had more risk. PPCs were more in current smokers (30.98%), patients with pre-existing respiratory diseases (47.1%), duration of surgery more than 3 h. PPCs significantly increase the duration of hospital stay and mortality.

Conclusion: Pulmonary complications are significant among patients undergoing emergency laparotomy that leads to increased morbidity and mortality. Predictors of PPCs are smoking, pre-existing respiratory diseases, prolonged duration of surgery, and prolonged intubation.

Key words: Emergency laparotomy, Post-operative pulmonary complications, Predictors

INTRODUCTION

Post-operative respiratory complication is a major concern following emergency abdominal surgeries. There is a wide disparity in the incidence of post-operative pulmonary complication (PPC) following abdominal surgery had reported from 5 to 60% by Stein *et al.* (1962), Latmeir *et al.* (1971), Bartlett *et al.* (1973), and Lord (1983). PPC is associated with a 30-day mortality

of 18% compared with 2.5% for those without PPCs (Khuri *et al.*, 2005).

PPCs include post-operative hypoxia, atelectasis, bronchospasm, pulmonary infection, pulmonary infiltrate, aspiration pneumonitis, acute respiratory distress syndrome (ARDS), pleural effusions, and pulmonary edema (Arozullah *et al.*, 2000). Depending on the severity, these can be self-limiting, require ward-based interventions, for example, antibiotics or physiotherapy or readmission to critical care, reintubation, and even death.

A number of risk factors for PPCs following elective nonthoracic surgery, derived from clinical history, physical examination, lung function tests, chest x-ray (CXR), and pre- or intra-operative elements, have been described.

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Pre-operative risk factors are a major determinant of post-operative morbidity. Several risk factors, both preoperatively and intraoperatively, have been identified with respiratory impairment after abdominal surgery. Conventionally, factors associated with PPCs are chronic airway disease, advanced age, upper abdominal surgery, intraperitoneal sepsis, and obesity. Other factors affecting PPCs are patient pulmo-operative mobility status, cardiac, respiratory conditions, and malignancies.

Patient-related risk factors that could influence PPCs include age, chronic lung diseases, cigarette use, congestive heart failure, obesity, asthma, obstructive sleep apnea, site and type of surgical incision, duration of surgery, anesthetic technique, and emergency surgery.

The main objectives of our study were clarification of the frequency of PPCs after emergency laparotomy and identify the independent predictors of risk factors for their occurrence.

MATERIALS AND METHODS

The present study was carried out in 270 patients who underwent emergency laparotomy in Sanjay Gandhi Memorial Hospital associated with S.S. Medical College, Rewa (M.P.) during the period of June 1, 2018–May 30, 2019. Patients admitted in surgical wards (irrespective of the age and sex) through SOPD, casualty, or transferred from other departments undergoing emergency laparotomy during the period of study were included in the study. On admission, detailed history and clinical examination were conducted. The data were noted on a predesigned pro forma. Baseline investigations such as complete blood count, urinalysis, serum urea/creatinine, serum electrolytes, CXR, electrocardiograph, HIV, hepatitis B and C profile, blood grouping, and blood sugar (random) were noted. Abdominal radiographs and ultrasonography of abdomen in selected cases were also done to confirm diagnosis where required. After initial conservative management including intravenous fluid resuscitation with Ringer’s lactate solution/Foley’s catheterization/nasogastric tube insertion, pre-anesthetic assessment was made. After assessment emergency laparotomy was performed.

Patients were observed for any post-operative respiratory complications; morbidity and mortality, predisposing factors, day of appearance of respiratory complication, and post-operative hospital stay were recorded.

Patients having cough, post-operative fever, and chest pain were evaluated further by X-ray chest posteroanterior view, ultrasound chest and high-resolution computed tomography

chest (in selected cases), and blood investigations (hemoglobin, T&D, erythrocyte sedimentation rate, and serum electrolytes).

RESULTS

Of 270 patients studied, 55 developed a pulmonary complication. Hence, overall incidence of PPC was 20.4% [Figure 1].

Pneumonia accounted for 36.4% (20 patients) followed by atelectasis in 27.3% (15 patients) of all PPCs. Others were pleural effusion 18.2% (10), ARDS 7.3% (4), acute bronchitis 5.4% (3), and acute exacerbation of respiratory diseases 5.4% (3) [Figure 2].

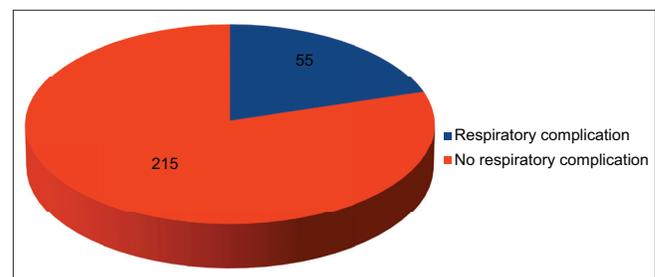


Figure 1: Distribution of cases and respiratory complication

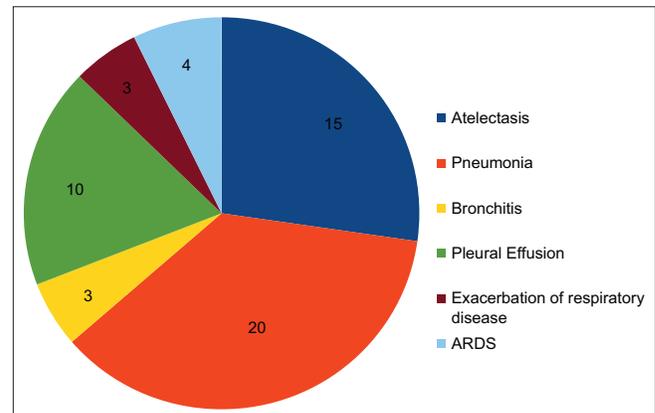


Figure 2: Distribution of various respiratory complications

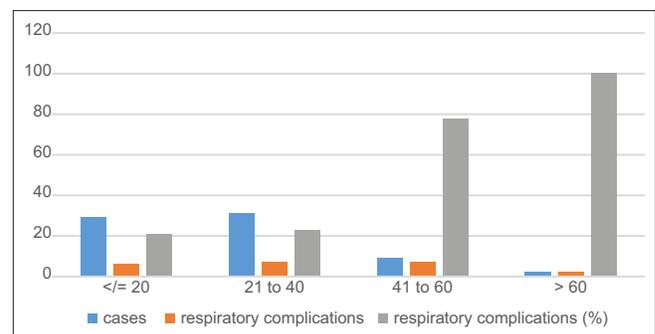


Figure 3: Relationship between smoking in pack years and respiratory complication

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. The incidence of respiratory complication among smokers was 30.98%, while 16.58% among non-smokers. There is a positive correlation ($P < 0.01$) between smokers and respiratory complication [Table 1]. In active smokers, PPCs incidence increase incrementally with the number of pack-year smoked that is 22.8% (8 of 35 patients). Among patients who smoked <20 pack year, the incidence of PPCs was 70% (7 of 9 patients) among patients who smoked 41–60 pack year, and incidence of PPCs was 100% (2 of 2 patients) among patient who smoked >60 pack year [Figure 3].

In the present study, 17 patients had pre-existing respiratory comorbidities, of which 8 (47.1%) developed respiratory complications [Table 2]. There is a positive correlation between pre-existing respiratory comorbidities and post-operative respiratory complications ($P < 0.01$).

The incidence of respiratory complications among the patients who underwent exploratory laparotomy for more than 3 h was 36.78%.

There is a strong positive correlation between the duration of surgery and post-operative respiratory complication ($P < 0.001$) [Table 3].

DISCUSSION

This is a prospective observational study conducted in 270 patients who underwent emergency abdominal surgeries.

The main objectives of our study were clarification of the frequency of PPCs after emergency laparotomy and

identify the independent predictors of risk factors for their occurrence.

There is a wide disparity in the incidence of PPC following abdominal surgery had reported from 5 to 60% by Stein *et al.* (1962), Latmeir *et al.* (1971), Bartlett *et al.* (1973), and Lord (1983).

Authors	Years	Incidence of post-operative pulmonary complications (%)	Types of surgeries
Deodhar <i>et al.</i>	1991	54.2	Upper abdominal
Jawai <i>et al.</i>	2006	7.0%	Elective and emergency abdominal surgeries
Goreth	2006	28.2	Emergency abdominal
Smith <i>et al.</i>	2009	7.0	Laparotomies
Kim <i>et al.</i>	2016	16.3	Laparoscopic, emergency and elective laparotomies
Patel and Hadian	2016	11.9	Elective abdominal surgeries
Gangwal and Singh	2016	30.2	Emergency laparotomies
Kumar <i>et al.</i>	2018	44.4	Emergency abdominal
		16.0	Elective abdominal
Verma <i>et al.</i>	2018	2.9	Emergency abdominal

In our study, the incidence of pulmonary complications was 20.4%, PPCs developed in 55 patients of 270 patients who underwent emergency laparotomy.

Pneumonia is most common PPCs 36.4% (20 patients) followed by atelectasis in 27.3% (15 patients). Others are pleural effusion 18.2% (10), ARDS 7.3% (4), acute bronchitis 5.4% (3), and acute exacerbation of respiratory diseases 5.4% (3).

In various studies (Goreth *et al.*, 2006; Smith *et al.*, 2009; Kim *et al.*, 2016; and Verma *et al.*, 2018), pneumonia is found to be a most common complication.

Smoking is a risk factor for PPC. Morton (1944), Wightman (1968), and Blumen *et al.* in Chest (1998) found that smokers had a significantly higher incidence of PPC, as compared to non-smokers. The incidence of respiratory complications among smokers was 30.98% while 16.58% among non-smokers. There is a positive correlation ($P < 0.01$) between smokers and respiratory complications. In active smokers, PPCs incidence increase incrementally with the number of

Table 1: Relationship between smoking and respiratory complication

Patients	No respiratory complication	Respiratory complication	Percentage
Smokers (n=71)	49	22	30.98
Non-smokers (n=199)	166	33	16.58
Total (n=270)	215	55	

Table 2: Relationship between pre-operative respiratory comorbid diseases with post-operative respiratory complication

Patients	Respiratory complication	Percentage	No. respiratory complication	Percentage
Respiratory comorbid diseases (n=17)	8	47.1	9	52.9
No respiratory comorbid diseases (n=253)	47	18.6	206	81.4

Table 3: Relationship between duration of surgery and respiratory complication

Duration of surgery	No. respiratory complication	Respiratory complication	Percentage
>3 h (n=87)	55	32	36.78
<3 h (n=183)	160	23	12.56

pack-year smoked that is 22.8% (8 of 35 patients). Among patients who smoked <20 pack year, the incidence of PPCs was 70% (7 of 9 patients) among patients who smoked 41–60 pack year, and incidence of PPCs was 100% (2 of 2 patients) among patient who smoked >60 pack year.

The pre-existing respiratory disease such as emphysema and bronchiectasis is important factors influencing the PPCs and has been stressed by many authors Mortan (1944), Dripps and Deming (1946), Stein *et al.* (1962), Wightman (1968), Tisi (1979), and Lord (1983). Wightman (1968) has reported that post-operative chest complications occurred 3 times more frequently with pre-existing infections of the respiratory tract. In the study of Deodhar *et al.* (1991), of 67 patients who developed pulmonary complications, 24 cases had pre-existing pulmonary disease and 16 of these had chronic bronchitis due to smoking. Kim *et al.* (2016) have reported that there were no significant differences in PPCs ($P = 0.657$) or requirement for intensive care, including intensive care unit (ICU) care ($P = 0.590$) and mechanical ventilator support ($P = 0.506$), between patients with mild-to-moderate COPD and control subjects. Kumar *et al.* (2018) reported that 67 patients undergoing surgery were identified to have cardiac comorbidity, and 16 (23.9%) among them developed PPCs. Four patients (57.1%) with combined cardiac comorbidity and respiratory comorbidity had significantly increased the risk for the development of PPCs. Patel and Hadian (2016) said that PPCs were more common in patients with a history of chronic obstructive pulmonary disease compared to those with no history (26.7 vs. 10.2%, $P < 0.001$).

In the present study, of 270 patients who underwent exploratory laparotomy, 17 patients had pre-existing respiratory comorbidities, of which 8 (47.1%) developed respiratory complications ($P < 0.01$). We observed that post-operative respiratory complication was much more when patient had a history of respiratory comorbid disease such as COPD, asthma, pulmonary tuberculosis, and interstitial lung disease.

Wong *et al.* (1995) reported that of 105 patients who underwent non-cardiothoracic surgery; 38 of 39 patients (97%) with PPCs had an anesthetic duration >2 h. Brooks-Brunn chest 1997 reported that duration of surgery >4 h was a significant risk factor ($P = 0.0062$) for PPCs.

McAlister *et al.* (2005) reported that PPC was affected by the duration of anesthesia (odds ratio 3.3 for operations lasting at least 2.5 h, $P = 0.008$); Kelkar (2015) found that incidence of respiratory complications was decreased in patients, operated for <3 h. Verma *et al.* (2018) reported that surgeries lasting >3 h chances of PPCs increased.

In the present study, of 270 patients who underwent emergency laparotomy, 55 patients were operated for more than 3 h; 32 (36.78%) patients developed PPCs ($P < 0.001$). While of 160 patients who underwent surgery for <3 h, 23 (14.37%) patients developed PPC.

CONCLUSION

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.

It is concluded from our study that 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.

REFERENCES

1. McAlister FA, Bertsch K, Man J, Bradley J, Jacka M. Incidence of and risk factors for pulmonary complications after nonthoracic surgery. *Am J Respir Crit Care Med* 2005;171:514-7.
2. Arozullah AM, Daley J, Henderson WG, Khuri SF. Multifactorial risk index for predicting postoperative respiratory failure in men after major noncardiac surgery. The national veterans administration surgical quality improvement program. *Ann Surg* 2000;232:242-53.
3. Strandberg A, Tokics L, Brismar B, Lundquist H, Hedenstierna G. Constitutional factors promoting development of atelectasis during anaesthesia. *Acta Anaesthesiol Scand* 1987;31:21-24.
4. Brooks-Brunn JA. Predictors of postoperative pulmonary complications following abdominal surgery. *Chest* 1997;111:564-71.
5. Bluman LG, Mosca L, Newman N, Simon DG. Postoperative smoking habits and postoperative pulmonary complications. *Chest* 1998;113:883-9.
6. Kumar L, Satheesan KN, Rajan S, Vasu BK, Paul J. Predictors and outcomes of postoperative pulmonary complications following abdominal surgery in a South Indian population. *Anesth Essays Res* 2018;12:199-205.
7. Siddhartha V, Ankur B. Study of post-operative pulmonary complications in patients of emergency abdominal surgeries. *Int Surg J* 2018;5:3057-65.
8. Herbstreit F, Peters J, Eikermann M. Impaired upper airway integrity by residual neuromuscular blockade: Increased airway collapsibility and blunted genioglossus muscle activity in response to negative pharyngeal pressure. *Anaesthesiol* 2009;110:1253-60.
9. Hawn MT, Houston TK, Campagna EJ, Graham LA, Singh J, Bishop M, *et al.* The attributable risk of smoking on surgical complications. *Ann Surg* 2011;254:914-20.
10. Serejo LG, da Silva-Júnior FP, Bastos JP, de Bruin GS, Mota RM, de Bruin PF. Risk factors for pulmonary complications after emergency abdominal surgery. *Respir Med* 2007;101:808-13.
11. Wong DH. Factors associated with postoperative pulmonary complications in patients with severe chronic obstructive pulmonary disease. *Anesthe*

- Analg 1995;80:276-84.
12. Kelkar KV. Post-operative pulmonary complications after non-cardiothoracic surgery. *Indian J Anaesth* 2015;59:599-605.
 13. Kim TH, Lee JS, Lee SW, Oh MY. Pulmonary complications after abdominal surgery in patients with mild-to-moderate chronic obstructive pulmonary disease. *Int J Chron Obstr Pulm Dis* 2016;11:2785-96.
 14. Stein M, Koota GM, Simon M, Ha F. Pulmonary evaluation of surgical patients. *J Am Med Assoc* 1962;181:766-70.
 15. Lord B. Postoperative chest complications in abdominal operations. In: Maingot R, editor. *Abdominal Operations*. 7th ed., Vol. 1. New York: Applaton-Contura-Croft Co. Ltd.; 1983. p. 491-6.
 16. Deodhar SD, Mohit CJ, Shirhatti RG, Joshi S. Pulmonary complications of upper abdominal surgery. *J Postgrad Med* 1991;37:88-92.
 17. Jawaid M, Masood Z, Iqbal SA. Post operative complications in a general surgical ward of a teaching hospital. *Pak J Med Sci* 2006;22:2171-5.
 18. Smith PR, Baig MA, Brito V, Bader F, Bergman MI, Alfonso A. Postoperative pulmonary complication after laparotomy *Respiration* 2010;80:269-74.
 19. Dripps RD, Deming MV. Postoperative atelectasis and pneumonia. Diagnosis, etiology, management based on 1240 cases of upper abdominal surgery. *Ann Surg* 1946;124:94-110.
 20. Tisi GM. Postoperative evaluation of pulmonary function. Validity, indications and benefits. *Am Rev Respire Dis* 1979;119:293-310.
 21. Morton HJ. Tobacco smoking and pulmonary complications after operation. *Lancet* 1944;1:368-70.
 22. Wightman JA. A prospective survey of the incidence of post-operative pulmonary complications. *Brit J Surg* 1968;55:85-91.
 23. Gangwal M, Singh B. Incidence of postoperative pulmonary complications following emergency laparotomy in tertiary care centre in Vindhya region of Madhya Pradesh, India. *Int Surg J* 2018;5:979-82.
 24. Patel K, Hadian F. Postoperative pulmonary complications following major elective abdominal surgery: A cohort study. *Perioper Med* 2016;5:10.

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