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Original Research Article

Study of incidence and factors associated with postoperative pulmonary complications in patients undergoing abdominal surgery

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ABSTRACT

Background: Postoperative pulmonary complications are an important cause of increased morbidity and mortality in surgical patients. These complications affect the normal respiratory functions and there are limited studies regarding the contributing factors. The aim of this study was to identify incidence and factors associated with postoperative pulmonary complications in patients undergoing abdominal surgery.
Methods: A prospective cross-sectional study was conducted at SKIMS Hospital, Soura. Sample size of 290 patients using systematic random sampling was taken. Variables included sociodemographic, surgical, and anaesthetic factors. Postoperative follow up was done for 7 days. Any respiratory problems were recorded. Both bivariate and multivariate logistic regressions were used for analysis. A p value of <0.05 was considered statistically significant.
Results: About 32% of the participants that underwent abdominal surgery developed postoperative pulmonary complications. Age >65 years, duration of surgery >3 hours, preoperative oxygen saturation <94%, and postoperative serum albumin level <3.5 g/dl (p value <0.001) were associated with postoperative pulmonary complications significantly.
Conclusions: The incidence of postoperative pulmonary complications after abdominal surgeries was high. Age >65 years, duration of surgery >3 hours, preoperative SpO_2% <94%, cigarette smoking, and postoperative serum albumin level <3.5 g/dl were factors strongly associated with postoperative pulmonary complications.

Keywords: Postoperative, Pulmonary complications, Respiratory, Morbidity, Mortality

INTRODUCTION

Any negative alterations to the respiratory system that happen after surgery and have an impact on the patients' clinical course are referred to as postoperative pulmonary complications. The European Society of Intensive Care Medicine and the European Society of Anaesthesiology provide the definitions for postoperative pulmonary complications (PPCs).[1] Numerous scholarly research have demonstrated a broad range in the incidence of pulmonary problems following surgery. Various international investigations have determined the risk factors for pulmonary problems following surgery. American Society of Anesthesiologists (ASA) >III, age ≥65, use of general anaesthesia, history of upper respiratory tract infection, low socioeconomic status, smoking, alcoholism, oxygen saturation less than 94%, serum albumin less than 3.5 gm/dl, intraoperative bleeding, haemoglobin less than 10 g/dl, intraoperative blood transfusion, prolonged surgery, postoperative mechanical ventilation, long hospital stay, cardiac surgery, history of prior respiratory diseases, inadequate pain management following surgery, use of neuromuscular blocking medications, and early ambulation are the most frequently identified risks.[2-7]

Most developing nations lack enough knowledge regarding the causes of PPCs, how to recognize and manage postoperative pulmonary problems, and what factors lead to them. A study conducted in Nigeria revealed that the rate of postoperative pulmonary complications was 52% and another study conducted in Zimbabwe and Ethiopia showed that 42% and 21.7% of patients developed postoperative pulmonary complications.[4-8]

Aims and objectives

The aim of this study was to identify incidence and factors associated with postoperative pulmonary complications in patients undergoing abdominal surgery.

METHODS

A prospective cross-sectional study was conducted at SKIMS Hospital, Soura from February 2020 to February 2021 after obtaining approval from the ethical committee of the institute. Sample size of 290 patients using systematic random sampling was taken. Variables included sociodemographic, surgical, and anaesthetic factors. Post-operative follow-up was done for 7 days. Any respiratory problems were recorded. Both bivariate and multivariate logistic regressions were used for analysis. A p value of <0.05 was considered statistically significant.

Inclusion criteria

All patients older than 15 years, who underwent elective or emergency abdominal surgery were included.

Exclusion criteria

The following criteria were used for exclusion: pregnancy, procedures under regional anaesthesia, and ICU patients.

Study variables

Dependent variables included postoperative pulmonary complications.

Independent variables included sociodemographic variables: smoking status, age, sex, body mass index (BMI), and ASA status.

Preoperative variables included anaemia, cancer, renal failure, chronic obstructive pulmonary disease (COPD), asthma, congestive heart failure (CHF), hypertension (HTN), diabetes mellitus, and recent respiratory infection.

Anaesthetic and surgical factors included surgery type and duration, incision site, posture, anaesthesia type, muscle relaxants, blood loss, transfusion, and intraoperative complications. Postoperative parameters included analgesic type, discomfort, ambulation, postoperative serum albumin, and chest physical therapy.

Sampling method and sample size

Sample size

A total of 290 patients were taken for the study after fulfilling the inclusion and exclusion criteria.

Sampling method

A method of systematic random sampling was chosen.

Data collecting methods

After taking informed consent from the participants, data collection was done in the preoperative phase. Preoperative demographic information, comorbidities, intraoperative anaesthesia, surgical variables, and postoperative factors were all included in the data gathering proforma. The confidentiality of the information was upheld during the whole data collection process.

During the postoperative phase, data collectors monitored the patients for seven days and confirmed any new findings that suggested a respiratory disease after performing comprehensive exams.

Operational definitions

Postoperative pulmonary complications included the manifestation of two or more symptoms for a minimum of two days in a row, occurring no later than seven days following surgery: abnormal breath sounds, such as reduced breath sounds, rhonchi, or rales; verified infectious cause based on BAL and sputum culture; fever and sputum-producing cough (T >38ºC); the diagnosis of respiratory illness made by doctors and nurses; >25/min respiratory rate; saturation <90% in ambient air, <94% for more than two hours with 100% oxygen; and X-ray: new discoveries in consolidation, infiltration, and diffusion.[9-13]

Abdominal surgery included surgical operations that entail abdominal openings.[14-19]

Data processing, analysis and interpretation

After data were entered into statistical package for the social sciences (SPSS) version 26, they were examined for completeness codes. The results of the computation of descriptive statistics were shown as frequency and percentage. To identify the contributing components, bivariate and multivariate logistic analyses were employed.

A bivariable variable was deemed a suitable candidate for multivariate analysis if its p value was less than or equal to 0.2. The results were displayed using graphs and tables. A p value of less than 0.05 was designated as the statistical significance threshold.

RESULTS

Sociodemographic factors

290 people in all were enlisted and finished the research. Table 1 represents the results for the sociodemographic data collected. Most of the patients (57.5%) were in the age group of 15-47 years. Out of 290 patients 49.6% were females and 50.3% were males. The BMI of the most of the patients (76.2%) was in the range of 18.5-24.9 kg/m^2. ASA I patients constituted 53.8% as compared to ASA II which were 46.2%. Majority of the cases were done under general anesthesia (86.5%). 59% cases were emergency surgeries and 41% cases were elective surgeries. In our study 84% patients were non-alcoholic and 16% alcoholic.

Anaesthetic and surgical factors

Results of various intraoperative anaesthesia and surgical factors are given in Table 2. Most of the surgeries were upper abdominal surgeries (57.5%) with vertical incisions (50.6%). 74.8% of the muscle relaxant used were intermediate acting. 92.7% of the surgeries were done in supine position. Out of all the cases 12.4% required blood transfusion. In majority of the patients' blood loss was less than 500 ml and in 24.1% patients' blood loss was more than 500 ml.

Postoperative factors

Results of factors that contributed to postoperative pulmonary complications are given in Table 3. The postoperative albumin was <3.5 in 34.8% patients and in 65.1% patients it was >3.5. The NRS pain score was as shown in the above Table 3.

Bivariate analysis to identify the association of independent variables with outcome variables in surgical patients

Nine independent variables were included in the bivariate analysis and results are given in Table 4. 26% of the patients who developed postoperative pulmonary complications were in the age group of 15-47, 16% in the age group 48-63, and 55% in the age group >64. 52% of the patients who underwent upper abdominal surgery developed postoperative pulmonary complications. The incidence of postoperative pulmonary complications was 84% in patients who received general anesthesia. The incidence of postoperative pulmonary complications was 56% in emergency surgeries, 78% in patients having preoperative saturation less than 94%, 81% when postoperative serum albumin was <3.5 and 64% in patients who had pain score of moderate intensity.

Overall incidences of postoperative pulmonary complications

The overall incidence of postoperative pulmonary complications was 32% and is shown in Figure 1.

Table 1: The sociodemographic characteristics of patients who underwent abdominal surgery.

Variables	Frequency (N)	Percentage
Age (years)		
15-47	167	57.5
48-63	56	19.3
≥64	67	23.1
Gender		
Female	144	49.6
Male	146	50.3
BMI (kg/m^2)		
<18.5	37	12.7
18.5-24.9	221	76.2
25-34.9	31	10.7
>35	1	0.3
ASA status		
ASA I	156	53.8
ASA II	134	46.2
Type of anaesthesia		
General	251	86.5
Regional	39	13.4
Type of operation		
Elective	119	41
Emergency	171	59
Alcoholic		
Yes	49	16
No	241	84
Preoperative anaemia		
Yes	35	12
No	255	87.9
Preoperative saturation		
<94%	100	34.4
≥94%	190	64.8
Malignancy		
Yes	36	12.4
No	254	87.5
Hypertension		
Yes	30	10.3
No	260	89.6
Diabetes mellitus		
Yes	22	7.5
No	268	92.4

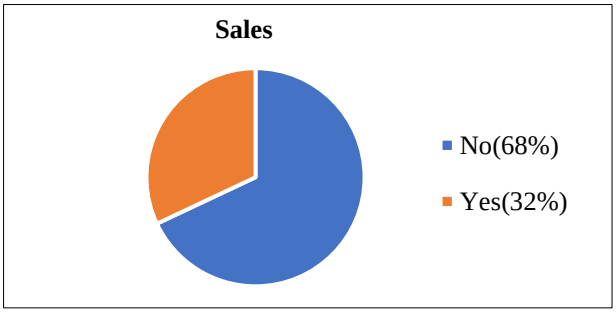

Figure 1: Incidence of postoperative pulmonary complications.

Among different types of PPCs, pneumonia (50%) and atelectasis (24) were the commonest ones.

The graph shows different types of disorders affecting the respiratory system, as shown in Figure 2.

Table 2: Intraoperative anaesthesia and surgical factors who underwent abdominal surgery.

Variables	Frequency (N)	Percentage
Surgical site		
Upper abdominal	167	57.5
Lower abdominal	56	19.3
Both	67	23.1
Incision type		
Vertical	147	50.6
Horizontal	31	10.6
Transverse	71	24.4
Subcostal	41	14.1
Muscle relaxant		
Short acting	18	6.2
Intermediate acting	217	74.8
Long acting	9	3.1
None	46	15.8
Surgical position		
Supine	269	92.7
Lateral	6	2.06
Lithotomy	15	5.1
Blood transfusion		
Yes	36	12.4
No	254	87.5
Intraoperative blood loss (ml)		
≤500	220	75.8
>500	70	24.1

Table 3: The postoperative factors in patients who underwent abdominal surgery.

Variables	Frequency (N)	Percentage
Postoperative albumin		
<3.5	101	34.8
≥3.5	189	65.1
NRS pain score		
None	25	8.6
Mild	139	47.9
Moderate	99	34.1
Severe	27	9.3
Postoperative mobility		
≤24	154	53.1
>24	136	46.8

Table 4: Bivariate analysis to assess the association of variables with postoperative pulmonary complications in surgical patients.

Variables	Yes (%)	No (%)	P value
Age (years)			
15-47	26	141 (73.1)	
48-63	16	40 (20.7)	0.710
≥64	55	12 (6.2)	0.011
Surgical procedure			
Upper abdominal	52	118 (61.1)	0.437

Continued.

Variables	Yes (%)	No (%)	P value
Lower abdominal	13	34 (17.6)	
Both	32	41 (21.2)	0.355
Type of anaesthesia			
General	84	166 (86)	0.340
Regional	13	27 (14)	
Duration of surgery (hours)			
<2	14	126 (65.3)	
2-3	13	51 (26.4)	0.485
>3	70	16 (8.3)	0.002
Type of surgery			
Elective	41	77 (39.9)	
Emergency	56	116 (60.1)	0.492
Smoking status			
Never smoker	43	167 (86.5)	
Former smoker	11	13 (6.7)	0.996
Current smoker	43	13 (6.7)	0.412
Preoperative saturation			
<94%	78	22 (11.4)	0.079
≥94%	19	171 (88.6)	
Postoperative serum albumin			
<3.5	81	21 (10.9)	0.068
≥3.5	16	172 (89.1)	
Pain score			
None	0	24 (12.4)	
Mild	5	134 (69.4)	
Moderate	64	35 (18.1)	
Severe	28	0	

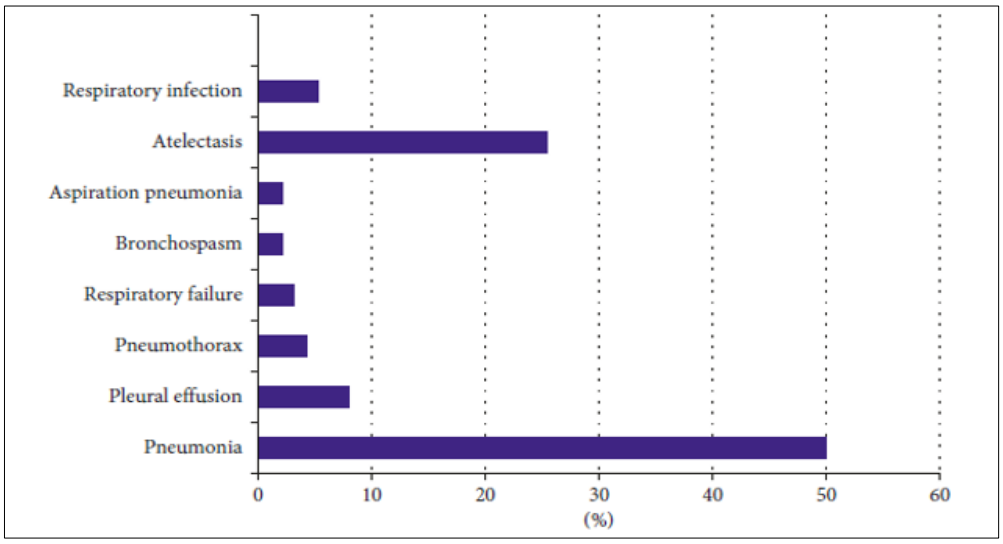

Figure 2: The distribution of postoperative pulmonary complications among patients who underwent abdominal surgery.

DISCUSSION

The incidence of postoperative pulmonary problems following abdominal procedures was found to be 32% in this study. This result is greater than that of the 2015 study report from Gondar University Hospital.[15] Inter-observer variability may have an impact on the results, and a larger sample size utilized in their study could be one explanation for this. This result, however, was consistent with the findings of Sinouvassan et al's observational analytical investigation, which was carried out in India and yielded an incidence of 34%.[20,21] The results of our investigation were similarly consistent with a retrospective study carried out in Turkey by Diken et al, which reported an incidence

of 32.6%.[22] This could be because of the similarity in criteria used to diagnose postoperative pulmonary complications or postoperative follow-up periods.

Meanwhile, the finding of this study was lower than that of the study conducted in Zimbabwe by Tadyanemhandu et al, which revealed that 42.4% of study subjects developed postoperative pulmonary complications.[3] Moreover, an observational cohort study conducted in an Australian tertiary hospital by Haines et al and Parry et al revealed incidences of 39% and 42%, respectively.[23,24] The differences in the study design may have contributed to this discrepancy in the incidences.

Post-operative pulmonary problems were 23 times more likely to occur in participants with postoperative blood albumin levels <3.5 g ($p \leq 0.001$). One probable explanation is that albumin is essential for muscle strength, indicates the patients' nutritional state, and aids in the healing of wounds. serum albumin levels reveal a patient's nutritional state as well as the weakness of their expiratory muscles, a reduction in chest wall expansion, and a higher risk of pulmonary problems.

Over 65 years of age increased the incidence of postoperative pulmonary problems by 12 times ($p<0.001$, AOR: 12.09, 95% CI: 3.31–44.1). The most plausible reason is that growing older has been linked to a rise in cardiorespiratory comorbidities, which can worsen under anaesthesia and after surgery.[13,24] An 11-fold increased risk of postoperative pulmonary problems would result from a surgical procedure lasting more than three hours ($p<0.001$). This result is consistent with several literature articles examined by various international scholars.[3,12,15] A plausible rationale could be that the extended duration of the surgical procedure was linked to a modified physiological reaction of metabolic processes.[13,24]

Preoperative oxygen saturation levels below 94% in study participants increased the probability of post-operative pulmonary complications ($p \leq 0.001$). Our result is in line with research done in China by Jin et al and in Spain by Canet et al.[7,13]

Limitations

According to the study, pulmonary problems can have a substantial impact on a considerable number of surgery patients in the aftermath. Additionally, it revealed important confounding variables that can have an impact on the development of pulmonary problems following surgery. The study's drawback was that interobserver heterogeneity in the diagnosis of postoperative pulmonary problems may be caused by another linked factor.

CONCLUSION

The postoperative complication was found to occur significantly in patients undergoing both upper and lower abdominal surgeries. The study revealed age >65 years, duration of surgery >3 hours, SpO_2% <94%, and the postoperative serum albumin level <3.5 g/dl were factors strongly associated with postoperative pulmonary complications.

Recommendations

We recommend the healthcare workers to give a deep insight into the identified factors and take necessary precautions while caring for the patients. A future study with a large sample size and large varieties of surgical specialties is recommended.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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