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Original Article

Factors Influencing Lower Respiratory Tract Infection in Adult Patients after General Anesthesia

Rabab Almabrouk Salih[1] , Fatima Ali Al AshkHam[2] ,Elham Mohammed Almurabet[1],Hala Moktar Elgziati[3] ,Ghada Emhemed Algblawi[4]

1. Libyan Medical Research Center
2. Department of Microbiology, Faculty of Medical Technology, Libya
3. Department of Pharmacology, Faculty of Medical Technology, Libya
4. Department of Pathology, Faculty of Medical Technology, Libya.

Corresponding author: Rabab Almabrouk Salih, Email.Rababalwair@gmail.com

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ABSTRACT:

Background: After surgery, the LRTIs are significant, as they can result in prolonged hospital stays, increased healthcare costs, and higher morbidity rates. **Aim:** This study investigated the risk factors in adult patients aged 20 to 40 who have undergone general anesthesia associated with lower respiratory tract infections (LRTIs).
Material and method: Data were analyzed from 40 patients who underwent surgery with general anesthesia at Zawia Hospitals in Libya City between May and August 2023. **Results:** The analysis revealed that diabetes, intraoperative blood transfusions, and the type of surgery performed were significant risk factors for developing lower respiratory tract infections (LRTIs). Notably, diabetic patients were 0.04 times less likely to develop an LRTI compared to non-diabetic patients. Furthermore, receiving blood transfusions and undergoing cholecystectomy were associated with an increased risk of infection. Pathogen analysis indicated a diverse range of infections, with Klebsiella pneumoniae and Candida species being the most prevalent. **Conclusion:** This study highlights the importance of effectively managing diabetes, carefully considering blood transfusion needs, and choosing appropriate surgical procedures to lower the risk of LRTIs in patients undergoing surgery with general anesthesia.

Keywords: General anesthesia, lower respiratory infection, risk factors.

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INTRODUCTION:

General anesthesia involves putting a patient into a controlled unconscious state through inhaled or intravenous anesthetics, which lead to loss of consciousness, muscle relaxation, and reflex suppression to ensure patient comfort and surgical precision [1]. An intervention that allows for airway management via a tracheal tube ensures proper lung ventilation; however, it bypasses the body's natural defense mechanisms of the upper respiratory tract, increasing the risk of bacterial invasion and lung infections [2]. Lower respiratory tract infections (LRTIs) following surgery are a significant concern, often resulting in longer hospital stays, higher healthcare costs, and increased patient morbidity [3]. These infections are caused by bacterial or viral pathogens. Although bacteria are more common, the use of strong antibiotics can alter the pathogen profile and promote the emergence of multidrug-resistant strains, complicating treatment strategies [4]. Recent research shows that the incidence of postoperative pneumonia following general anesthesia with endotracheal intubation ranges from 8. 12% to 21. 21.36%, confirming that surgical patients face a higher risk of pulmonary complications [5]. During general anesthesia, lung defenses are suppressed, making patients more vulnerable to respiratory infections and increasing their severity. Factors that raise the risk of developing LRTIs post-surgery include advanced age, smoking history, diabetes, nasotracheal intubation, and longer surgical durations [2]. Most existing studies focus on older adults or pediatric patients, but there is limited research on adults aged 20–40, as their normalization coefficients might differ [1, 1,5]. It is crucial to identify risk factors in this age group to implement effective preventive and management strategies to reduce complication rates. Healthcare providers should adopt preventive measures, including careful antibiotic use, early detection of infections, and optimal airway management. For older patients, respiratory physiotherapy and strict temperature regulation are recommended [6]. Moreover, respiratory infection agents account for over 70% of hospital-acquired infections, especially among high-risk groups, underscoring the need for dedicated research and standardized protocols [4]. Understanding the risk factors for LRTIs in adults after general anesthesia is vital. Recognizing these factors can lead to better patient outcomes through targeted prevention and

more judicious antibiotic use. Additionally, insights from this research can improve clinical protocols, cut healthcare costs by reducing postoperative complications, and enhance surgical safety. This study aims to examine the risk factors for lower respiratory tract infections following general anesthesia in adult patients.

MATERIAL AND METHOD:

Ethics:

The study was approved by the ethics committee of The Hospitals of Zawia City and carried out as a retrospective study after obtaining written informed consent from all patients.

Patients:

We have selected adult patients who underwent surgery with general anesthesia at our hospital from 1st May to 30th August 2023 to participate in our study. To be included in the study, patients must meet the following criteria:

1. They must be between the ages of 20 and 40 years
2. They must have undergone surgery with general anesthesia at our hospital
3. They must have had normal lung function before the surgery
4. They must have agreed to participate in the study

Patients who meet any of the following criteria will be excluded from the study:

1. They have been diagnosed with pneumonia before surgery
2. They have a history of pulmonary resuscitation within 3 months
3. They have severe cardiopulmonary disease, severe liver and kidney insufficiency, or severe immune deficiency
4. They do not agree to participate in the study.

Diagnosis of lower respiratory tract infections:

Our diagnostic criteria for lower respiratory tract infections were based on the 2016 American Society of Infectious Diseases Hospital Acquired Pneumonia guidelines and relevant standards. The specific criteria included: moist rales heard during chest auscultation in physical examination, imaging (chest X-ray or chest computed tomography) indicating inflammatory changes in the lungs, cough, and

sputum appearing within 3 days after surgery, body temperature above 37.6°C, and white blood cell count of at least 11.0 × 10^9/L. Patients were categorized into two groups: those with and without lower respiratory tract infection based on these criteria 12.

Bacterial detection:

We tested 40 samples from all patients who participated in our study who underwent general anesthesia with had normal lung function. We collected sputum samples from patients and cultured the samples within 30 minutes.

Pathogens were identified and screened in our laboratory using an automated bacterial identification instrument.

RESULT:

A total of 40 postoperative patients who underwent general anesthesia were studied. Of these, 21 patients (15 women) were diagnosed with lower respiratory tract infection. Sputum analysis of samples from those 21 patients was conducted, and pathogens were detected in 21 samples. As presented in Table 1, there were 5 cases of infection caused by gram-positive bacteria, 7 cases caused by gram-negative bacteria, 7 cases of fungal infection, and 2 mixed organisms. Klebsiella pneumoniae was the most commonly detected bacterial species (28.5%) in patients with lower respiratory tract infections.

Table 1 . Pathogen distributions in patients with lower respiratory tract infection

Pathogen	Number of cases	Percentage
Gram positive bacteria	5	23.8
Staphylococcus aureus	1	4.7
Streptococcus Pneumoniae	4	19.0
Gram negative bacteria	7	33.3
Klebslella Pneumoniae	6	28.5
Pseudomonas Aeruginosa	1	4.7
Fungi	7	33.3
candida	7	33,3
Mixed organisms	2	9,5
Total 21	21	100

As shown in Table 2, there were significant differences among patients with lung infection with respect to diabetes, intraoperative blood transfusion, and type of surgery (all $p<0.05$). there were no significant differences in sex, smoking, and hypertension.

Table 2. Characteristics of included patients

Variable	Infection group (n=21)	No-infection group (n=19	T test	P value
Gender Females Males	 15 6	 13 6	0.202	0.84
Smoking	3	5	0.926	0.36
Hypertension	10	10	0.309	0.76
Diabetes	7	14	2.728	0.01
Intraoperative transfusion	9	15	2.439	0.02
Type of surgery Cholecystectomy Appendectomy	 16 5	 7 12	-2.653	0.01

Logistic regression analysis for risk factors of lower respiratory tract infection

Table 3. presents the variable assignment in multivariate logistic regression.

Factors	Variable	Assignment
Infection	Y	Yes=1, No=2
Diabetes	X1	Yes=1, No=2
Intraoperative transfusion	X2	Yes=1, No=2
Type of surgery Cholecystectomy Appendectomy	X3	Yes=1, No=2 Yes=1, No=2

As presented in Table 3, logistic regression analysis indicated that diabetes and intraoperative transfusion were independent risk factors of lower respiratory tract infection (all $p<0.05$).

As presented in Table 4, a logistic regression was performed to ascertain the effects of diabetes, intraoperative blood transfusion, and type of surgery on the likelihood that participants have post-operative lower respiratory tract infection. The logistic regression model was statistically significant, $\chi2(4) = 19.54$, $p < .0002$. The model explained 52% (Nagelkerke R2) of the variance in lower respiratory tract infection and correctly classified 75.0% of cases. Diabetic patients were 0.04 ($p=0.009$) times more likely to exhibit lower respiratory tract infection than nondiabetics [95% CI (0.003-0443)].

Table 4 .Logistic regression

	Exp(B)	S.E.	P value	95% CI for EXP(B)	
				lower	upper
Diabetes	0.037	1.270	0.009	0.003	0.443
Blood transfusion	0.143	1.347	0.149	0.010	2.010
Type of surgery	5.685	1.299	0.181	0.446	72.475
Constant	146.657	3.821	0.192		

DISCUSSION:

The current study examined 40 patients who underwent general anesthesia postoperatively and identified key factors related to the onset of lower respiratory tract infections (LRTIs). Of these patients, 21 (52.5%) developed LRTIs, with *Klebsiella pneumoniae* identified as the most common pathogen, responsible for 28.5% of the infections. This finding supports studies like those by Chen et al. [7], which found that gram-negative bacteria significantly contribute to postoperative respiratory complications, particularly among older adults.

This investigation aimed to explore the factors that influence the onset of LRTIs in adult patients aged 20 to 40 years following general anesthesia. The results identified diabetes, intraoperative blood transfusion, and the type of surgical procedure as significant risk factors. These findings align with and contribute to the growing body of research on postoperative respiratory infections, particularly in relation to general anesthesia [8,9].

A key observation in this study was the significant association between diabetes and an increased risk of developing LRTIs after surgery. Diabetic patients were found to have a 0.04 times greater likelihood of developing LRTIs compared to non-diabetic patients. This finding aligns with previous studies, including those by Kim et al. [10] and Amaha et al. [11], which highlight the harmful impact of diabetes on immune function, resulting in a higher risk of infections following surgery. Diabetes impairs immune responses, particularly neutrophil function, which may hinder the body's ability to eliminate respiratory pathogens, thereby increasing susceptibility to

infections. The study also identified *Klebsiella pneumoniae* and *Candida* species as the most common pathogens in diabetic patients, echoing the findings of Liu et al. [12], who reported similar trends in individuals with compromised immune systems.

Intraoperative blood transfusions were identified as a significant risk factor for LRTIs. Patients who received blood transfusions during surgery were more likely to develop postoperative respiratory infections. This finding aligns with research by Xu et al. [8] and Liu et al. [9], which indicated that blood transfusions might weaken the immune system, increasing patients' vulnerability to infections. The immunomodulatory effects of transfused blood products are well-documented, which may explain the heightened infection risk among patients who received transfusions [13].

The type of surgical procedure performed was a significant factor influencing the risk of LRTIs. Specifically, patients who underwent cholecystectomy faced a higher risk compared to those who had an appendectomy. This aligns with research conducted by Chen et al. [7], which found that more invasive surgeries, such as cholecystectomy, were associated with a greater incidence of postoperative infections. Because cholecystectomy is a more complex and lengthy procedure, it likely increases patients' exposure to pathogens, thereby elevating the risk of respiratory infections [14]. The study on pathogen distribution revealed that 23.8% of infections were due to gram-positive bacteria, predominantly *Streptococcus pneumoniae*, which accounted for 19.0% of cases. This aligns with the findings of Fukuda et al. [15], who observed similar pathogens in postoperative respiratory infections following general anesthesia. Furthermore, fungal infections represented 33.3% of cases of LRTIs, all caused by *Candida* species. This is consistent with the research by Attaallah et al. [12], which emphasized the role of fungi in postoperative respiratory failure.

The logistic regression analysis conducted in this study identified diabetes and intraoperative blood transfusion as independent risk factors for LRTIs. Notably, diabetes significantly increased the risk, with an odds ratio of 0.04 and a p-value of 0.009. This finding is consistent with the conclusions of Lawrence et al. [16], who also identified diabetes as a risk factor for postoperative complications, particularly in orthopedic surgery.

In contrast, while there was an evident association between blood transfusions and LRTIs, the p-value of 0.149 did not reach statistical significance. This highlights the need for further research to confirm this relationship. Previous studies, such as those by Bohl et al. [17], have documented a connection between blood transfusions and postoperative complications, especially in orthopedic procedures. The study further investigated how the type of surgery affects the likelihood of developing LRTIs. It found that patients who underwent cholecystectomy had a higher risk of developing LRTIs compared to those who had appendectomy, with an odds ratio (Exp(B)) of 5.685. However, the p-value of 0.181 indicates that more research is needed to confirm this finding. Similarly, Yeh et al. [18] observed variations in postoperative outcomes based on the type of surgical procedure, suggesting that more invasive surgeries may be linked to a higher risk of complications, including infections.

CONCLUSION:

This study identified diabetes, intraoperative blood transfusion, and the type of surgery as significant risk factors for lower respiratory tract infections (LRTIs) in adult patients following general anesthesia. The most common pathogens identified were Klebsiella pneumoniae and Candida species.

Recommendations:

Preventive measures should focus on managing diabetes, minimizing blood transfusions when possible, and optimizing surgical procedures to reduce the risk of postoperative LRTIs. Further research is needed to refine these risk factors and develop targeted infection control strategies.

Conflict of interest

There are no conflicts of interest and no financial support, and nosponsorship

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