MAK HILL Publications
Research Journal of Medical Sciences

Research Article
doi: 10.59218/makrjms.2023.12.214.218

Determinants of Lower Respiratory Infections in Adults Following General Anaesthesia: A Cross-Sectional Study

[1]Sarfraj Ahmad, [2]Pragati Saxena, [3]Poorva Parihar and [4]Nikita Baser

[1]*Department of Anesthesiology, Rohilkhand Medical College, Bareilly, Uttar Pradesh, India*

[2]*Department of Anesthesiology, Motilal Nehru Medical College, Prayagraj, Uttar Pradesh, India*

[3]*Department of Medicine, N.S.C. Government Medical College, Khandwa, Madhya Pradesh, India*

[4]*Department of Anesthesiology, Pacific Medical College and Hospital, Udaipur Rajasthan, India*

OPEN ACCESS

Key Words
Respiratory tract infections, general anesthesia, pneumonia, diabetes mellitus

Corresponding Author
Nikita Baser
Department of Anaesthesiology, Pacific Medical College and Hospital, Udaipur Rajasthan, India
dr.nikitabaser@gmail.com

Author Designation
[1,4]Associate Professor
[2,3]Assistant professor

Received: 16 November 2023
Accepted: 27 November 2023
Published: 30 November 2023

Citation: Sarfraj Ahmad, Pragati Saxena, Poorva Parihar and Nikita Baser, 2023. Determinants of Lower Respiratory Infections in Adults Following General Anaesthesia: A Cross-Sectional Study. Res. J. Med. Sci., 17: 214-218, doi: 10.59218/makrjms.2023.12.214.218

ABSTRACT

The occurrence of pulmonary complications following surgery is prevalent among adult individuals. Our investigation delved into identifying the risk factors associated with lower respiratory tract infections subsequent to general anaesthesia in older patients. In this retrospective study, we enrolled adult patients who had undergone surgery with general anaesthesia. Employing logistic regression analyses, we aimed to discern the risk factors contributing to lower respiratory tract infections. The study encompassed a total of 456 postoperative patients who underwent general anesthesia, revealing an incidence of lower respiratory tract infection at 9.33%. Gram-positive bacteria accounted for ten cases, gram-negative bacteria for 26 cases and fungus for two cases. Significantly divergent variables included age, smoking habits, diabetes status the mode of tracheal intubation (oral/nasal) and the duration of surgery. Logistic regression analysis underscored that age above 70 years, diabetes, nasotracheal intubation and a surgical duration exceeding 3 hrs were identified as independent risk factors for lower respiratory tract infections. Older patients undergoing general anesthesia with tracheal intubation face an elevated risk of lower respiratory tract infections. It is imperative to implement clinical interventions aimed at preventing pulmonary infections in individuals exhibiting these pertinent risk factors. Respiratory tract infections, general anesthesia, pneumonia, diabetes Mellitus.

INTRODUCTION

General anaesthesia induces a transient suppression of the central nervous system following the administration of anaesthetics through inhalation, intramuscular injection or intravenous injection. This results in the loss of consciousness, skeletal muscle relaxation and reflex inhibition, mitigating patient pain and ensuring the seamless progression of surgical procedures. A common approach to airway management post-general anaesthesia is tracheal intubation. However this method disrupts the inherent defence mechanism of the upper respiratory tract, rendering the patient's nose and throat susceptible to bacterial infiltration and escalating the likelihood of lung infection. Lower respiratory tract infections typically stem from bacterial and viral sources[1-5].

The widespread use of antibacterial agents has altered the landscape of pathogenic bacteria capable of invading the lower respiratory tract. The surge in drug-resistant strains, alongside an elevation in drug resistance levels, including the emergence of multidrug-resistant strains, poses substantial challenges to clinical treatment[6].

In recent years the escalating global aging population has led to a corresponding rise in the number of adult patients undergoing surgical interventions. General anaesthesia coupled with tracheal intubation stands out for its safe and effective airway management. Despite its widespread clinical application the use of general anaesthesia predisposes patients to an increased susceptibility to respiratory infections post-surgery[9]. Reports indicate that patients undergoing tracheal intubation under general anaesthesia face an estimated 8.12-21.36% probability of developing pulmonary infections. The weakened immune function in older patients due to aging makes them more prone to infections from various pathogens[7-13].

Currently the reasons behind the heightened risk of lower respiratory tract infections in adult patients after tracheal intubation under general anaesthesia remain incompletely understood. Therefore a comprehensive analysis of clinical treatment in this population is crucial to unravel the etiological characteristics and risk factors associated with lower respiratory tract infections. The outcomes of such investigations can furnish valuable evidence for the judicious selection of clinically effective antibiotics and contribute to the formulation of preventive measures addressing relevant risk factors, thereby reducing the incidence of lower respiratory tract infections in this patient demographic.

MATERIAL AND METHODS

The study employed a retrospective design, focusing on adult patients who underwent surgery with general anaesthesia at our hospital. Inclusion criteria encompassed adult individuals, those who had surgery with general anaesthesia at our hospital, exhibited normal lung function pre-surgery and consented to participate in the study. Exclusion criteria comprised patients diagnosed with pre-surgical pneumonia a history of pulmonary resuscitation within the last 3 months, severe cardiopulmonary disease, severe liver and kidney insufficiency, severe immune deficiency or those unwilling to participate.

The diagnosis of lower respiratory tract infections adhered to the 2016 American Society of Infectious Diseases Hospital-Acquired Pneumonia guidelines and relevant standards[14-16]. Diagnostic criteria included physical examination findings such as moist rales on chest auscultation, imaging indicating inflammatory changes in the lungs (chest X-ray, chest computed tomography) symptoms like cough and sputum within 3 days post-surgery, body temperature exceeding 37.6°C and white blood cell count surpassing 11.0×10^9 L^{-1}. Based on this diagnosis, patients were categorized into groups with and without infection.

Bacterial detection involved testing samples from all patients with lung infections for pathogenic bacteria. Sputum samples were collected and cultured, with pathogens identified and screened using an automated bacterial identification instrument.

Statistical analysis focused on the incidence of lung infection post-general anaesthesia. Distribution of pathogenic bacteria in patients with lung infections was calculated. Basic characteristics (age, sex, body mass index (BMI) alcohol consumption, smoking history) underlying diseases, duration of surgery, intraoperative blood infusion and length of hospital stay were compared between the two groups. IBM SPSS 19.0 software facilitated data analysis. Enumeration data were expressed as number and percentage, analysed using the χ^2 test in univariate analysis. Variable data were presented as Mean±Standard deviation and between-group comparisons employed the t-test. Multivariate logistic regression analysis identified independent risk factors, with $p<0.05$ indicating statistical significance.

RESULTS

As indicated in Table 1, notable variances were observed among individuals with pulmonary infection concerning age, smoking habits, diabetes, oral/nasal tracheal intubation and the duration of surgical procedures (all $p<0.05$). However, no statistically significant differences were identified in terms of gender, body mass index (BMI) alcohol consumption, hypertension, hyperlipidaemia, type of surgery, intraoperative blood infusion and the length of hospital stay.

As outlined in Table 2, there were 11 instances of infection attributed to gram-positive bacteria, 28 cases linked to gram-negative bacteria and 2 instances of

Table 1: Clinico-demographic characteristics of study population

Variable	Infection group (n = 43)	No-infection group (n = 413)	p-value
Males	29	289	0.08
Females	14	124	
Age (in years)	72.15±7.21	65.78±8.42	<0.05
BMI (kg m²)	23.89±1.31	24.45±1.65	0.09
Smoking	33	110	<0.05
Alcohol consumption	21	161	0.07
History of diabetes	21	96	<0.05
History of hypertension	22	188	0.07
History of hyperlipidemia	9	77	0.09
Oral/nasal tracheal intubation	20-23	25-388	<0.05
Intraoperative blood infusion	23	194	0.08
Duration of surgery (min)	215.47±36.28	168.57±25.63	<0.05
Length of hospital stay (days)	6.14±1.43	4.92±1.18	0.11

Table 2: Logistic regression examination of factors contributing to the risk of LRTI

Variables	OR	95% CI	p-value
Smoking	2.017	0.965-3.701	0.048
Duration of surgery ≥180 min	1.495	1.086-1.842	0.036
Age ≥70 years	1.852	0.984-3.352	0.032
Diabetes	2.263	1.215-4.584	0.026
Nasotracheal intubation	3.145	1.234-4.768	0.019

Table 3: Distribution of pathogens among individuals with LRTI

Pathogens	Cases	Percentage
Gram-negative bacteria	28	65.12
Pseudomonas aeruginosa	15	34.88
Acinetobacter baumannii	5	11.63
Klebsiella pneumoniae	8	18.60
Gram-positive bacteria	11	25.58
Staphylococcus aureus	6	13.95
Streptococcus	2	4.65
Enterococcus	3	6.98
Fungus	2	4.65
Candida albicans	2	4.65
Total	43	100

fungal infection. Notably, Pseudomonas aeruginosa emerged as the predominant bacterial species, accounting for 34.88% of cases in individuals with lower respiratory tract infection.

As demonstrated in Table 3 the outcomes of logistic regression analysis revealed that factors such as age exceeding 70 years, smoking, diabetes, nasotracheal intubation and a surgical duration surpassing 180 min were identified as independent risk factors for lower respiratory tract infection.

DISCUSSIONS

Administration of general anaesthesia for tracheal intubation is widely practiced in clinical settings due to its favourable anaesthesia efficacy, minimal intraoperative response, low physical and mental impact on patients and high acceptance levels. Nevertheless the occurrence of postoperative lower respiratory tract infections represents a common complication following general anaesthesia[17-19].

Our findings indicate that advanced age constitutes an independent risk factor for lower respiratory tract infection post-general anaesthesia. Numerous studies corroborate this, emphasizing the independent association between older age and pulmonary infections[20,21]. This correlation may be attributed to the gradual decline in functional reserves across various organ systems in elderly patients, encompassing alterations in heart and lung function, along with changes in lung structure leading to decreased lung elastic recoil[22]. Age-related reductions in the cross-sectional area of the pulmonary capillary bed result in heightened pulmonary vascular resistance and pulmonary artery pressure. These changes elevate the susceptibility to perioperative lung complications. Concurrently, respiratory tract mucosal atrophy, weakened phagocytic cell function and diminished respiratory tract cilia motility in older individuals contribute to impaired mucous clearance, diminishing the respiratory tract's ability to eliminate pathogenic bacteria, fostering rapid bacterial proliferation[23-26].

Long-term heavy smoking diminishes bronchial mucosal cilia motor function, compromising airway self-purification capacity, stimulating increased mucus secretion and impeding alveolar phagocyte function. These factors collectively contribute to the elevated incidence of postoperative pulmonary infections in surgical patients who smoke. Notably, smoking is also a potential inducer of chronic obstructive pulmonary disease (COPD)[27-29]. Hence, it is imperative for smokers scheduled for surgery to cease smoking prior to the procedure.

Lower respiratory tract infections following general anaesthesia in patients have been linked to damage to the lower respiratory tract mucosa after tracheal intubation and interactions between the lower respiratory tract and the external environment. Common causative agents, such As P. Aeruginosa, Acinetobacter Baumannii, Klebsiella Pneumoniae, Staphylococcus Aureus and Streptococcus Pneumoniae, exhibit varying antibiotic resistance levels. In clinical practice, antibiotic use should be judicious, aligned with testing results and tailored to the characteristics of the causative pathogen. Additionally, diabetes-induced metabolic disorders heighten the risk of complex infections, potentially leading to cardiac insufficiency, respiratory and circulatory failur and impacting patient prognosi[30-32].

This study is subject to certain limitations. The inclusion of patients undergoing general anaesthesia at a single hospital within the past year resulted in a relatively small case dataset and a limited sample size. Lack of observed differences in infection risk and types of surgery could be attributed to insufficient statistical power to detect group distinctions. Further validation necessitates multicentre data. Moreover, being a retrospective study, some observational indicators may have been overlooked. Future research should encompass potential influencing factors, including blood gas analysis results and prognostic indicators.

CONCLUSION

The findings from our investigation revealed that, among older patients subjected to general anaesthesia, age exceeding 70 years, smoking, diabetes, nasotracheal intubation and surgical durations surpassing 180 min independently contributed to a heightened risk of lower respiratory tract infection. In the realm of clinical practice, healthcare providers should prioritize attention to factors associated with pulmonary complications post-general anaesthesia. Strategic plans should be devised based on these identified risk factors, guiding the implementation of targeted treatment strategies and nursing care. This approach aims to mitigate the risk of pulmonary complications following surgical procedures.

REFERENCES

1. Wang, J, L.u. Fan, M. Zhou, Q.I. Zhong. and Z. Chen, 2020. Tracheal intubation in patients with severe and critical COVID-19: Analysis of 18 cases. Nan. Fang. Yi. Ke. Da. Xue. Xue. Bao., 40: 337-341.
2. Chia, W.T., Y.C. Liu. and T.W. Wong, 2020. Optimize general anesthesia for a dystrophic epidermolysis bullosa patient that cannot be intubated. Asian. J. Anesth., 58: 111-114.
3. Cabrini, L., M.B. Redaelli, M. Filippini, E. Fominskiy and L. Pasin *et al*., 2019. Tracheal intubation in patients at risk for cervical spinal cord injury: A systematic review. Acta. Anaesthe. Scand., 64: 443-454.
4. Kolb, C.M., D. Tinley-Strong, R. Rangarajan, T. Uejima and U.K. Shah, 2020. General anesthesia risk across pediatric surgical specialties: Low in otolaryngology. Int. J. Pediatr. Otorhinolaryngol., Vol. 129 .10.1016/j.ijporl.2019.109780.
5. Smith, G., D.J.R. Cruz, B. Rondeau, *et al*., 2020. General anesthesia for surgeons. In: Stat pearls. edn.
6. Kiliç, Y., S.S. Bas, Ö. Aykaç and A.Ö. Özdemir, 2020. Nonoperating room anesthesia for interventional neuroangiographic procedures: Outcomes of 105 patients. J. Stroke. Cerebrovascular. Dis., Vol. 29. 10.1016/j.jstrokecerebrovasdis.2019.104495.
7. Kissel, M., A. Rambeau, S. Achkar, F. Lecuru. and P. Mathevet, 2020. Challenges and advances in cervix cancer treatment in elder women. Cancer. Treat. Rev., Vol. 84 .10.1016/j.ctrv.2020.101976.
8. Hammer, M., P. Santer, M.S. Schaefer, F.C. Althoff. and K. Wongtangman et al., 2021. Supraglottic airway device versus tracheal intubation and the risk of emergent postoperative intubation after general anaesthesia in adults: A retrospective cohort study. Br. J. Anaesth., 126: 738-745.
9. Tung, A., N.A. Fergusson, N. Ng, V. Hu, C. Dormuth and D.E.G. Griesdale, 2020. Medications to reduce emergence coughing after general anaesthesia with tracheal intubation: A systematic review and network meta-analysis. Br. J. Anaesth., 124: 480-495.
10. Estebsari, F., M. Dastoorpoor, Z.R. Khalifehkandi, A. Nouri and D. Mostafaei et al., 2020. The concept of successful aging: A review article. Curr. Aging Sci., 13: 4-10.
11. Touré, T., S.R. Williams, M. Kerouch. and M. Ruel, 2020. Patient factors associated with difficult flexible bronchoscopic intubation under general anesthesia: A prospective observational study. Can. J. Anesth. J. canadien d'anesthésie., 67: 706-714.
12. Mushambi, M.C., V. Athanassoglou and S.M. Kinsella, 2020. Anticipated difficult airway during obstetric general anaesthesia: Narrative literature review and management recommendations.. Anaesth., 75: 945-961.
13. Chen, T., Y. Yasen, J. Wu. and H. Cheng, 2021. Factors influencing lower respiratory tract infection in older patients after general anesthesia. J. Int. Med. Res., Vol. 49 .10.1177/03000605211043245.
14. Martin, L.I., A.H. Rodriguez. and A. Torres, 2018. New guidelines for hospital-acquired pneumonia/ventilator-associated pneumonia: Usa vs. Europe. Curr. Opin. Crit. Care, 24: 347-352.
15. Lu, M. and Y. Kang, 2017. Clinical practice guidelines of HAP/VAP in 2016: The updates. Zhonghua. Wei. Zhong. Bing. Ji. Jiu. Yi. Xue., 29: 769-773.

16. Kalil, A.C., M.L. Metersky, M. Klompas, J. Muscedere. and D.A. Sweeney et al., 2016. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by the infectious diseases society of America and the American thoracic society. Clin. Infect. Dis., 63: 61-111.
17. Zdravkovic, M., M. Podbregar. and M. Kamenik, 2019. Near-infrared spectroscopy for assessing microcirculation during laparoscopic gynaecological surgery under combined spinal-general anaesthesia or general anaesthesia alone: A randomised controlled trial. J. Clin. Monit. Comput., 34: 943-953.
18. Lv, L., L. Yan, X. Liu. and M. Chen, 2020. Effectiveness of lidocaine/prilocaine cream on cardiovascular reactions from endotracheal intubation and cough events during recovery period of older patients under general anesthesia: Prospective, randomized placebo-controlled study. BMC. Geriatrics, Vol. 20. 10.1186/s12877-020-01567-y
19. Nakamoto, H., S. Kayama, M. Harada, T. Honjo, K. Kubota and S. Sawamura, 2020. Airway emergency during general anesthesia in a child with plastic bronchitis following fontan surgery: A case report. JA Clin. Rep., Vol. 6. 10.1186/s40981-020-0311-5.
20. Zandkarimi, E., G. Moradi. and B. Mohsenpour, 2020. The prognostic factors affecting the survival of kurdistan province COVID-19 patients: A cross-sectional study from february to may 2020. Int. J. Health Policy Manage., 11: 453-458.
21. Sipka, S., A. Toth. and S. Sipka, 2020. Age-dependent possible role of contact-activated blood coagulation factor XII as a potential contributor to the “bradykinin storm” in COVID-19 patients. Sage Publications, Orv. Hetil., 161: 2099-2103.
22. Lee, C.H., J.Y. Wang, H.C. Lin, P.Y. Lin and J.H. Chang *et al*., 2017. Treatment delay and fatal outcomes of pulmonary tuberculosis in advanced age: A retrospective nationwide cohort study. BMC. Infect. Dis., Vol. 17. 10.1186/s12879-017-2554-y
23. Mannemuddhu, S.S., W. Clapp, R. Modica, M.E. Elder and K. Upadhyay, 2019. End-stage renal disease secondary to anti-glomerular basement membrane disease in a child with common variable immunodeficiency. Clin. Neph. Case. Stud., 7: 1-6.
24. Sapey, E., J.M. Patel, H.L. Greenwood, G.M. Walton. and J. Hazeldine *et al*., 2017. Pulmonary infections in the elderly lead to impaired neutrophil targeting, which is improved by simvastatin. Am. J. Respir. Crit. Care Med., 196: 1325-1336.
25. Machida, Y., N. Motono, T. Matsui, K. Usuda and H. Uramoto, 2017. Successful endovascular coil embolization in an elder and asymptomatic case of anomalous systemic arterial supply to the normal basal segment. Int. J. Surg. Case. Rep., 34: 103-105.
26. Qi, Z., W. Yang and Y.F. Wang, 2017. Epidemiological analysis of pulmonary tuberculosis in heilongjiang province China from 2008-2015. Int. J. Mycobacteriology, 6: 264-267.
27. Hamid, S., M.R.A. da Silva, K.W. Burak, T. Chen and J.P.H. Drenth et al., 2020. Wgo guidance for the care of patients with COVID-19 and liver disease. J. Clin. Gastroenterol., 55: 1-11.
28. Ji, X., W. Cui, B. Zhang and S. Shan, 2020. Effect of lung protective ventilation on perioperative pulmonary infection in elderly patients with mild to moderate copd under general anesthesia. J. Infec. Public. Health., 13: 281-286.
29. Tashkin, D.P. and M.D. Roth, 2019. Pulmonary effects of inhaled cannabis smoke. J. Drug. Alco. Abuse., 45: 596-609.
30. Otsuji, K., K. Fukuda, M. Ogawa, Y. Fujino, M. Kamochi and M. Saito, 2019. Dynamics of microbiota during mechanical ventilation in aspiration pneumonia. BMC Pulm. Med., Vol. 19. 10.1186/s12890-019-1021-5.
31. Bluhmki, T., A. Allignol, S. Ruckly, J. Timsit, M. Wolkewitz and J. Beyersmann, 2018. Estimation of adjusted expected excess length-of-stay associated with ventilation-acquired pneumonia in intensive care: A multistate approach accounting for time-dependent mechanical ventilation. Biome. J., 60: 1135-1150.
32. Sartorius, A., Q. Lu, S. Vieira, *et al*., 2007. Mechanical ventilation and lung infection in the genesis of air-space enlargement. Crit. Care., Vol. 11.