Journal of Vessels and Circulation
Qom University of Medical Sciences
Winter 2024. Volume 5. Number 1

Research Paper

Investigating Factors Related to Intubation of COVID-19 Patients Hospitalized in Cardiac Intensive Care Units

Javad Khodadadi[1], Hosein Heydari[2], Mostafa Vahedian[3], Reyhane Company[4], Mohammad Hossein Atarod[5], Amir Safari[4*], Maryam Nasiri[6]

1. Department of Infectious Disease, School of Medicine, Kamkar-Arabnia Hospital, Qom University of Medical Sciences, Qom, Iran.
2. Department of Pediatrics, School of Medicine, Hazrat-e Fateme Masoume Hospital, Qom University of Medical Sciences, Qom, Iran.
3. Department of Family and Community Medicine, School of Medicine, Spiritual Health Research Center, Qom University of Medical Sciences, Qom, Iran.
4. Department of Infectious Disease, School of Medicine, Kamkar-Arabnia Hospital, Qom University of Medical Sciences, Qom, Iran.
5. Medical Research Committee, Qom University of Medical Sciences, Qom, Iran.
6. Department of Infectious Disease and Tropical Medicine, School of Medicine, Firouzabadi Hospital, Iran University of Medical Sciences, Tehran, Iran.

Use your device to scan and read the article online

Please cite this article as Khodadadi J, Heydari H, Vahedian M, Company R, Atarod MH, Safari A, et al. Investigating Factors Related to Intubation of COVID-19 Patients Hospitalized in Cardiac Intensive Care Units. J Vessel Circ. 2024; 5(1):15-20. http://dx.doi.org/10.32598/JVC.5.1.31.45

http://dx.doi.org/10.32598/JVC.5.1.31.45

Article info:
Received: 27 Oct 2024
Accepted: 24 Dec 2024
Publish: 01 Jan 2024

Keywords:
COVID-19, Intubation, Intensive care unit, Cardiac patients, Coronavirus

ABSTRACT

Background and Aim: With the global outbreak of COVID-19, the need for medical interventions, especially intubation in severely affected patients, has dramatically increased. This study aimed to determine the factors associated with the need for intubation in patients with COVID-19 hospitalized in the intensive care unit (ICU).

Materials and Methods: This was a cross-sectional analytical study. The study population included patients hospitalized for COVID-19 in the ICU. Sixty-one patients were evaluated in two groups: those who underwent intubation and those who did not. A checklist was completed for each patient, and information was collected based on clinical and paraclinical manifestations. Subsequently, the outcomes of patients hospitalized in the ICU were compared based on the clinical decision of the specialist physician, and the obtained data were assessed to determine the factors related to intubation in COVID-19 patients hospitalized in the ICU. Data were analyzed using SPSS software version 22, and the relevant indices were calculated according to the study objectives. An independent t-test was used to analyze the quantitative data, while the chi-square test was used to measure the qualitative variables. A significance level of less than 0.05 was considered in this study.

Results: The results showed no statistically significant difference in the mean age, blood pressure, pulse rate, sex distribution, and history of addiction between the two groups ($P>0.05$). However, a statistically significant difference was observed in the prevalence of underlying diseases, as well as in the mean respiratory rate, arterial blood oxygen saturation, lymphocyte count, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), lactate dehydrogenase (LDH), urea, and creatinine levels between the two groups ($P<0.05$).

Conclusion: This study demonstrated that in patients with COVID-19 hospitalized in the ICU, factors associated with the need for intubation include the prevalence of underlying diseases and specific clinical and laboratory parameters, such as mean respiratory rate, lymphocyte count, arterial blood oxygen saturation, and CRP, LDH, urea, and creatinine levels. These results emphasize that accurate identification of these factors can be effective for optimal management and clinical decision-making when treating COVID-19 patients.

*** Corresponding Author:**
Amir Safari, MD.
Address: *Department of Infectious Disease, School of Medicine, Kamkar-Arabnia Hospital, Qom University of Medical Sciences, Qom, Iran.*
Phone: *+98 (912) 3514593*
E-mail: *safariamir1992@gmail.com*

Journal of Vessels and Circulation
Qom University of Medical Sciences

Introduction

With the outbreak of COVID-19 in late 2019, health systems worldwide faced unprecedented challenges [1]. This virus not only spreads rapidly in communities but also causes many serious complications and respiratory defects. Under acute conditions, several patients with COVID-19 require special care and intubation [2]. Intubation is vital to maintain and manage breathing in patients with respiratory failure [3]. Investigating the factors related to intubation in hospitalized COVID-19 patients reveals a complex interaction of clinical, demographic, and laboratory variables [4]. Timely intervention and specific clinical markers significantly affect the need for intubation and the associated mortality [5].

Several factors influence the need for intubation in COVID-19 patients. These factors include demographic variables, such as age and sex, one study showed that an average age of 66 years and male sex were significant risk factors [6]. In addition, this study showed that underlying conditions, such as kidney disease and chronic respiratory problems, increase the possibility of requiring mechanical ventilation [6]. Patients with higher simplified acute physiology score III (SAPS-3) scores and lower arterial oxygen partial pressure/fractional inspired oxygen (Pao_2/Fio_2) ratios are at a higher risk for intubation [7]. High levels of C-reactive protein (CRP), interleukin-6, and D-dimer are also associated with the need for intubation [8].

Moreover, lymphocyte counts and inflammatory cytokines are predictive markers of intubation and mortality [8, 9]. Early intubation is associated with a lower mortality rate than late intubation, emphasizing the importance of timely decision-making based on severity assessment [8]. Conversely, some studies have shown that a non-invasive ventilation strategy may delay intubation without significantly affecting outcomes, indicating the need for balanced clinical judgment [10]. Investigating the factors related to intubation in COVID-19 patients hospitalized in cardiac intensive care units (ICU) is particularly crucial due to the complexity and high risks associated with the combination of respiratory disorders and heart diseases. Critically ill patients with COVID-19 experience higher intubation rates due to poor clinical status; therefore, accurate identification of factors influencing this, including disease severity, clinical characteristics, and response to treatment, is essential. This research can aid in optimal decision-making and better management of these patients, and identifying key prognostic factors can improve treatment results and reduce the complications in this high-risk group. Consequently, a deeper understanding of the factors related to intubation in affected patients enables us to enhance our approach to their optimal management and improve clinical outcomes. This study investigated the factors related to the need for intubation in COVID-19 patients in the ICU.

Materials and Methods

This was a cross-sectional analytical study. The study population included patients hospitalized in the ICU of Kamkar Hospital for COVID-19 from 2021 to 2022. Convenience sampling was performed. According to the sample size formula for logistic regression and considering the probability of type I error equal to 5% and a power of 0.9, the effect size (odds ratio) of intubation in patients with tachypnea was 2.17. Based on similar studies [4], the required number of samples was calculated as 121 participants, of whom 61 were included in the study in two groups of patients with and without intubation.

After the design was approved, coordination with the hospital was established, and the agreement of the medical staff was secured. Subsequently, the files of all patients hospitalized with a diagnosis of COVID-19 were examined.

The inclusion criteria included all hospitalized patients with COVID-19 whose polymerase chain reaction (PCR) test was positive, while the exclusion criteria included patients whose tests for COVID-19 were negative or whose files were incomplete.

Patient information regarding detailed history, clinical examination, laboratory findings, and vital signs were recorded in a checklist. A relevant checklist was completed for each patient, and information was collected based on the patient's clinical and paraclinical manifestations. Then, for patients hospitalized in the ICU based on the clinical decision of the specialist doctor, the outcomes of these patients were compared and the information obtained from these patients was evaluated to determine the factors related to the intubation of the COVID-19 patients hospitalized in the ICU. All patient visits were performed by an experienced infectious disease specialist, and all checklists were completed by a researcher.

In the data analysis, descriptive indices, including Mean±SD, percentage, and frequency, were used. The data were analyzed using SPSS software, version 22, and the desired indices were calculated according to the study objectives. The t-test was used to analyze quantita-

tive data, and the chi-square test was used for qualitative variables. In this study, a significance level of less than 0.05 was considered.

Results

A total of 122 patients were included in our study, with an average age of 54.20±16.06 years. Of all the patients in the study, 58(47.5%) were male and 64(52.5%) were female. No statistically significant differences were found between the two groups of intubated and non-intubated patients regarding age, sex, and smoking status (P>0.05). However, the frequency of underlying diseases was significantly higher in the intubated group than in the non-intubated group (P<0.05).

Among the vital signs of the patients, such as blood pressure and pulse rate, no significant difference was observed between the two groups (P>0.05). However, the average respiratory rate in intubated patients was considerably higher, and SPO_2 levels were significantly lower than in non-intubated patients (P<0.05).

Regarding the laboratory parameters, the average counts of white blood cells and neutrophils were not significantly different between the two groups (P>0.05). However, in intubated patients, the average counts of lymphocytes and platelets were significantly lower. The average inflammatory indices of erythrocyte sedimentation rate (ESR), CRP, lactate dehydrogenase (LDH), mean urea, and creatinine were significantly higher in the intubated group than in the non-intubated group (P<0.05) (Table 1).

Discussion

The COVID-19 pandemic has created serious challenges for healthcare systems worldwide. Intubation is a vital measure for the management of patients with COVID-19. This process is essential for providing oxygen and respiratory support to critically ill patients, particularly when respiratory complications become increasingly destabilized [11, 12]. The results of our study showed that a high respiratory rate and decreased arterial blood oxygen are risk factors observed in the group of intubated patients.

On the other hand, one of the crucial criteria in deciding on intubation is the blood oxygen level. Maintaining oxygen levels (SaO_2) above 90% is an essential therapeutic goal, and a reduction in this level can indicate the need for interventions such as intubation [13]. Another result of this study was the difference in the frequency of underlying diseases observed in the intubated group. Based on the results of similar studies, underlying conditions such as diabetes, heart disease, and lung problems can reflect a high risk of complications from COVID-19. These patients are likely to experience acute respiratory conditions, which increase the need for intubation [14, 15]. According to the results, demographic variables, such as age and sex, were not significantly different between intubated and non-intubated patients. Consistent with our results, Luo et al. showed that the two variables of age and sex were not significant risk factors for intubation in individuals [16]. Meanwhile, other studies have demonstrated that patient age is also crucial in deciding on intubation. Older patients and those with a history of respiratory problems, such as asthma or chronic obstructive pulmonary disease (COPD), are more prone to requiring intubation [17, 18].

Regarding vital signs, our results showed that blood pressure and pulse were not significantly different between the two groups. This result may be attributed to the relatively stable clinical status of some non-intubated patients. In contrast, the average respiratory rate and SPO2 level in intubated patients were higher and lower, respectively, than those in non-intubated patients. These results indicate the need for respiratory support in more severely ill patients, consistent with previous research, such as the study by Liu et al. which determined that more severely ill patients usually face greater respiratory problems [19]. From the perspective of laboratory parameters, our results showed that the number of neutrophils was not significantly different in intubated patients. At the same time, lymphocyte and platelet counts were substantially lower, while inflammatory indices, such as ESR, CRP, and LDH, were higher. These findings indicate the development of an inflammatory response and the severity of the infection with COVID-19. Wang et al. also concluded that increasing values of these indicators can help predict the complications and severity of the disease [20]. Individuals with heart disease are at higher risk of ICU admission and intubation.

The results of this study emphasize the importance of accurately identifying the clinical status and laboratory parameters of patients, particularly those with heart disease. These findings can serve as a basis for future studies on the factors affecting the clinical outcomes of these patients. However, examining all these risk factors allows for a more accurate assessment, especially in such patients. The state of hospital infrastructure, including bed occupancy in the cardiac ICU and access to medical equipment, also plays a role in doctors' intubation decisions. Therefore, these factors can influence the selection of treatment methods and the level of care provided.

Journal of Vessels and Circulation
Qom University of Medical Sciences

Table 1. Examining the study variables between two groups of COVID-19 patients with and without intubation

Variables		No. (%)/ Mean±SD		P
		Connecting to the Ventilator		
		No	Yes	
Sex	Male	27(22.1)	31(25.4)	0.468
	Female	34(27.9)	30(24.6)	
Underling disease	Yes	11(9)	26(21.3)	0.003
	No	50(41)	35(28.7)	
Smoking	Yes	10(8.2)	13(10.7)	0.487
	No	51(41.8)	48(39.3)	
Age (y)		67.13±8.7	41.27±10.2	0.001
Systolic blood pressure (mmHg)		130.03±25.7	126.2±14.7	0.331
Diastolic blood pressure (mmHg)		75.7±9.46	77.06±9.96	0.451
Pulse rate (bpm)		73.1±13.9	76.5±9.4	0.121
Respiratory rate (bpm)		34.1±5.3	20.06±5.8	0.001
Arterial oxygen saturation (%)		78.8±5.8	94.1±2.8	0.001
White blood cells (cells/µL)		9.3±1.2	9.1±1.6	0.354
Neutrophil (cells/µL)		79.9±4.4	79.3±4.3	0.452
Lymphocyte (cells/µL)		10.2±2.2	12.1±1.9	0.001
Platelet (cells/µL)		209.6±90.2	298.2±77.7	0.001
Lactate dehydrogenase (U/L)		835.9±142.0	777.1±118.0	0.012
C-reactive protein (mg/L)		127.0±29.5	99.7±49.5	0.001
Erythrocyte sedimentation rate (mm/hr)		65.03±8.9	45.2±18.5	0.001
Urea (mg/dL)		47.7±5.7	42.9±3.9	0.001
Creatinine (mg/dL)		1.5±0.4	1.2±0.2	0.001

Journal of Vessels and Circulation
Qom University of Medical Sciences

Conclusion

Our study showed significant differences in the characteristics and clinical parameters of COVID-19 patients between the intubated and non-intubated groups. Despite the absence of differences in demographic variables, such as age, sex, and smoking status, the frequency of underlying diseases was significantly higher in the intubated group, indicating a greater severity of the disease in this group. In addition, the respiratory rate and arterial blood SPO2 levels were substantially higher and lower, respectively, in intubated patients, confirming a worse respiratory condition. Furthermore, laboratory parameters showed that inflammatory indices, such as ESR, CRP, and LDH, were significantly higher in intubated patients than in non-intubated patients. Therefore, the results of this study emphasize the importance of carefully examining the clinical status and laboratory parameters of patients to manage and continuously monitor them optimally. This study can also serve as a basis for future studies regarding the factors affecting the clinical outcomes of these patients.

One of the limitations of this study is that the treatment protocols can differ across different hospitals and regions. This diversity can lead to inhomogeneity in the data and difficulties in comparing results between studies. In addition, the results of this research pertain to a specific population, region, and time, and therefore cannot be generalized to broader populations or different conditions.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Qom University of Medical Sciences (Code: IR.MUQ.REC.1401.072).

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Authors' contributions

All authors contributed equally to the conception and design of the study, data collection and analysis, interception of the results, and manuscript drafting. Each author approved the submission of the final version of the manuscript.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

The authors thank the Vice-Chancellor for Research and Technology of Qom University of Medical Sciences, the Vice-Chancellor for Research at the School of Medicine and the Clinical Research Development Unit of Kamkar Hospital in Qom City.

References

[1] Kumar A, Singh R, Kaur J, Pandey S, Sharma V, Thakur L, et al. Wuhan to world: The COVID-19 pandemic. Front Cell Infect Microbiol. 2021; 11:596201. [DOI:10.3389/fcimb.2021.596201] [PMID]

[2] Dar M, Swamy L, Gavin D, Theodore A. Mechanical-ventilation supply and options for the COVID-19 pandemic. Leveraging all available resources for a limited resource in a crisis. Ann Am Thorac Soc. 2021; 18(3):408-16. [DOI:10.1513/AnnalsATS.202004-317CME] [PMID]

[3] Prasanna D, Bhat S. Nasotracheal intubation: An overview. J Maxillofac Oral Surg. 2014; 13(4):366-72. [DOI:10.1007/s12663-013-0516-5] [PMID]

[4] Grasselli G, Zangrillo A, Zanella A, Antonelli M, Cabrini L, Castelli A, et al. Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy region, Italy. JAMA. 2020; 323(16):1574-81. [DOI:10.1001/jama.2020.5394] [PMID]

[5] Wibowo, Frischa, Harjanto, Realino BR. Mechanical ventilation management in Covid-19 patients. Cermin Dunia Kedokteran. 2022; 49(4):229-34. [DOI:10.55175/cdk.v49i4.226]

[6] Vahedi L, Sheikhalipour Z, Molaei Tavani F, Behshid M, Zadi Akhuleh O, Hasanzadeh V, et al. Investigating the correlation between demographic data, laboratory results, intubation, and mortality rate in hospitalized COVID-19 patients: A retrospective study. Research Square. 2024. [DOI:10.21203/rs.3.rs-3945518/v1]

[7] Hohmann F, Midega T, Treml R, Galindo V, Veiga G, Machado I, et al. Factors associated with the intubation of patients with acute respiratory failure and their impact on mortality: A retrospective Cohort study. Research Square. 2024. [DOI:10.21203/rs.3.rs-4768432/v1]

[8] Xu Z, Jin G, Zhang D. Predictive value of inflammatory factors and lymphocyte counts in tracheal intubation and death after infection with COVID-19. BMC Pulm Med. 2024; 24(1):365. [DOI:10.1186/s12890-024-03176-6] [PMID]

[9] Noori E, Vahedian M, Rezvan S, Minaei N, Tabaraii R. The proposed scoring system for hospitalization or discharge of patients with COVID-19. J Emerg Pract Trauma. 2022; 8(1):60-3. [DOI:10.34172/jept.2021.08]

Journal of Vessels and Circulation
Qom University of Medical Sciences

[10] Riera J, Barbeta E, Tormos A, Mellado-Artigas R, Ceccato A, Motos A, et al. Effects of intubation timing in patients with COVID-19 throughout the four waves of the pandemic: A matched analysis. Eur Respir J. 2023; 61(3):2201426. [doi:10.1183/13993003.01426-2022]

[11] Anesi GL. COVID-19: Management of the intubated adult [Internet]. 2024. Available from: [Link]

[12] Meng L, Qiu H, Wan L, Ai Y, Xue Z, Guo Q, et al. Intubation and ventilation amid the COVID-19 outbreak: Wuhan's experience. Anesthesiology. 2020; 132(6):1317-32. [DOI:10.1097/ALN.0000000000003296] [PMID]

[13] Pisano A, Yavorovskiy A, Verniero L, Landoni G. Indications for tracheal intubation in patients with coronavirus disease 2019 (COVID-19). J Cardiothorac Vasc Anesth. 2021; 35(5):1276-80. [DOI:10.1053/j.jvca.2020.11.062] [PMID]

[14] Mohammadi M, Khafaee Pour Khamseh A, Varpaei HA. Invasive airway "intubation" in Covid-19 patients; statistics, causes, and recommendations: A review article. Anesth Pain Med. 2021; 11(3):e115868. [DOI:10.5812/aapm.115868] [PMID]

[15] Hur K, Price CPE, Gray EL, Gulati RK, Maksimoski M, Racette SD, et al. Factors associated with intubation and prolonged intubation in hospitalized patients with COVID-19. Otolaryngol Head Neck Surg. 2020; 163(1):170-8. [DOI:10.1177/0194599820929640] [PMID]

[16] Luo M, Cao S, Wei L, Zhao X, Gao F, Li S, et al. Intubation, mortality, and risk factors in critically ill Covid-19 patients: A pilot study. J Clin Anesth. 2020; 67:110039. [DOI:10.1016/j.jclinane.2020.110039] [PMID]

[17] McKay B, Meyers M, Rivard L, Stankewicz H, Stoltzfus JC, Rammohan G. Comparison of early and late intubation in COVID-19 and its effect on mortality. Int J Environ Res Public Health. 2022; 19(5):3075. [DOI:10.3390/ijerph19053075] [PMID]

[18] De Vita N, Scotti L, Cammarota G, Racca F, Pissaia C, Maestrone C, et al. Predictors of intubation in COVID-19 patients treated with out-of-ICU continuous positive airway pressure. Pulmonology. 2022; 28(3):173-80. [DOI:10.1016/j.pulmoe.2020.12.010] [PMID]

[19] Liu W, Tao ZW, Wang L, Yuan ML, Liu K, Zhou L, et al. Analysis of factors associated with disease outcomes in hospitalized patients with 2019 novel coronavirus disease. Chin Med J. 2020; 133(9):1032-8. [DOI:10.1097/CM9.0000000000000775] [PMID]

[20] Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. JAMA. 2020; 323(11):1061-9. [DOI:10.1001/jama.2020.1585] [PMID]