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# Relationship of Right and Left Bundle Branch Blocks to Mortality in COVID-19 Patients Hospitalized in the Intensive Care Unit: a Descriptive-Analytical Retrospective Study

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## ABSTRACT

***Background:*** *COVID-19, in addition to affecting the respiratory system, exerts an impact on various extrapulmonary organs, including the cardiovascular system. This influence may lead to hospitalization in the intensive care unit (ICU) and even mortality. This study aimed to investigate the relationship of right and left bundle branch blocks (RBBB and LBBB) to mortality in COVID-19 patients admitted to the ICU.*

***Methods:*** *This descriptive-analytical retrospective study examined 650 COVID-19 patients hospitalized in the ICU of Sina Hospital in Hamadan, Iran, during the fifth peak of the pandemic. Patients were initially categorized into two groups. Data were collected using a researcher-designed checklist that included demographic and clinical information, such as age, gender, smoking history, underlying medical conditions, initial electrocardiogram findings on admission (specifically the presence of RBBB or LBBB) and final outcomes (survival or mortality). Data analysis was conducted using SPSS software, at a significance level of 0.05.*

***Results:*** *Among the 650 COVID-19 patients with a mean age of 60.55 ± 17.22 years, 24 subjects had RBBB and 20, LBBB. Among the 161 subjects who did not survive, 11 (6.8%) had RBBB and six (3.7%) LBBB. A significant association between RBBB and mortality in COVID-19 patients was found (P=0.049). Right bundle branch blocks were also significantly associated with underlying medical conditions (P=0.034) and smoking history (P=0.031).*

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***Conclusion:*** *Electrocardiography (ECG) is a valuable tool in predicting the severity of COVID-19 and patient mortality. The presence of RBBB is associated with higher mortality rates in COVID-19 patients. Therefore, ECG can serve as a valuable diagnostic tool both upon admission and during hospitalization.*

**Keywords**: COVID-19, right bundle branch blocks, left bundle branch blocks.

## INTRODUCTION

COVID-19 is a respiratory syndrome associated with severe illness, intensive care unit (ICU) hospitalization and mortality. Studies demonstrate that the rapid surge of cytokines and interleukins, in addition to affecting the respiratory system, also has profound implications for various other bodily systems, including the cardiovascular system (1). Long-term cardiac involvement in COVID-19, resulting in ICU admission, manifests as cardiac conduction abnormalities, left ventricular mechanical asynchrony, breathlessness, palpitations and orthostatic tachycardia syndrome. These manifestations are indicative of direct viral myocardial damage or inflammation due to immune responses (2).

Furthermore, it has been shown that cardiac involvement, particularly ventricular conduction disturbances following COVID-19 infection, exacerbates the prognosis. An electrocardiogram (ECG) is a simple diagnostic test that can be highly informative (3).

Ventricular conduction disturbances on the ECG are characterized by a widening of the QRS complex. Two common forms of these disturbances, known as left bundle branch block (LBBB) and right bundle branch block (RBBB), can be observed in both healthy asymptomatic individuals and COVID-19 patients. While the presence of RBBB alone does not inflict harm on the heart, long-term LBBB can lead to a decline in left ventricular pumping capacity (4, 5). Right bundle branch block is often associated with respiratory diseases (4). A meta-analysis has revealed a higher risk of mortality among COVID-19 patients with RBBB (6).

Generally, ventricular conduction disturbances often occur due to micro emboli in the lungs of COVID-19 patients, and right ventricular dysfunction, which is more commonly observed in COVID-19 patients, is associated with a poor prognosis (6).

Studies have shown that the prevalence of LBBB in the general population is typically low, but it significantly increases in patients with chronic heart failure. Additionally, in many COVID-19 patients the occurrence of LBBB leads to acute heart failure and places them at higher risk of mortality (7). Left bundle branch block can lead to ventricular asynchrony and a disrupted sequence of left ventricular contraction.

In this context, a study by Mark *et al* demonstrated that conduction disturbances, arrhythmias, and electrocardiographic abnormalities in COVID-19 patients are common and deaths resulting from arrhythmias are associated with age, coronary artery disease, prolonged QT interval, LBBB and the use of vasopressor medications (8).

Moreover, many COVID-19 patients who simultaneously suffer from cardiac diseases, particularly ventricular conduction disorders, must be admitted to the ICU due to severe lung infection, its associated complications and presence of ventricular conduction abnormalities. Therefore, healthcare providers require a suitable indicator to predict mortality. In cases where patients have a weaker prognosis, they should be prioritized for care. Previous studies have highlighted the role of RBBB and LBBB in predicting mortality in COVID-19 patients. However, it remains unclear which bundle branch block plays a more significant role in predicting mortality in COVID-19 patients with ventricular conduction disorders admitted to the ICU. The current study aimed to establish the association between left and right bundle branch blocks, and mortality, in COVID-19 patients admitted to the intensive care unit. ❑

## METHODS

### Study design and setting

We conducted a descriptive-analytical retrospective study encompassing groups of survived and deceased patients afflicted with COVID-19

who had been admitted to the ICU. Our research was undertaken between June and July 2021, coinciding with the onset of the fifth wave of the COVID-19 pandemic, within the premises of the Sina Farshchian Educational and Medical Hospital, an institution affiliated with Hamadan University of Medical Sciences, Iran.

### Ethical considerations

The present study was approved by the Ethics Committee of Hamadan University of Medical Sciences, Iran (Ethics Code: IR.UMSHA.REC.1400.507).

### Data collection

In this study, a group comprising 650 individuals diagnosed with COVID-19 was assembled during the latter half of 2021 based on a census sampling technique and the following predefined inclusion criteria: 1) a documented history of hospitalization due to COVID-19 with corresponding medical records; and 2) confirmation of COVID-19 diagnosis leading to either patient recovery or mortality as per medical records and diagnostic assessments.

Exclusion criteria encompassed patients meeting any of the following conditions: 1) causes of death unrelated to COVID-19; 2) instances of incomplete data within the patient's medical records; and 3) hospitalization or demise unrelated to COVID-19 infection.

Initially, all eligible COVID-19 patients admitted to the ICU during the latter half of 2021 were included using the census sampling technique, followed by their categorization into two distinct groups based on clinical outcomes: those who survived and those who deceased. The deceased group consisted of 161 individuals who died during the latter half of 2021 due to COVID-19, while the survived group comprised 489 individuals who either survived the COVID-19 infection or, if deceased, had causes of death unrelated to COVID-19.

### Data collection

Initially, the researcher liaised with the hospital's information technology unit to procure a comprehensive roster of COVID-19 patients admitted to the ICU, subsequently identifying eligible subjects. Data collection entailed accessing and scrutinizing patients' medical records, facilitated through employment of a researcher-developed checklist. Said checklist encompassed demographic and clinical characteristics of patients, including but not limited to age, gender, COVID-19 disease outcome (survival or mortality), presence and type of bundle branch blocks (right or left), underlying medical conditions and smoking history. Due to unavailability of complete medical records, the most recent electrocardiogram (ECG) within the patient's file served as the primary review criterion.

Notably, the checklist underwent face validity assessment by ten faculty members affiliated with the Faculty of Medicine. Interpretation of ECG findings was initially conducted by a final-year general medical student, subsequently validated by an anesthesiologist stationed within the ICU. Cases presenting diagnostic uncertainty were further reviewed, with conclusive diagnoses conferred following consultation with two cardiologists based at the hospital's cardiology clinic.

### Statistical analysis

For data analysis, we employed descriptive statistics, encompassing measures such as mean, standard deviation, relative frequency and percentage, which were presented in the format of frequency tables. Given the qualitative nature of the data, examination of interrelationships pertinent to the study's objectives necessitated utilization of the chi-square test to compare variables across the two groups. Data analysis was conducted using SPSS version 26 software, with statistical significance defined as $p < 0.05$. ❑

## RESULTS

COVID-19 patients admitted to the ICU had a mean age of 60.55 ± 17.22 years and the majority of them were males [331 individuals (50.9%)]. Among all 650 patients, 24 subjects (3.7%) exhibited RBBB and 20 patients (3.1%) LBBB. Among the 161 patients who did not sur-

**TABLE 1.** Mortality rate in COVID-19 patients with bundle branch blocks

| | Total (n=650) N (%) | Deceased (n=161) N (%) |
|---|---|---|
| **RBBB** | 24 (3.7) | 11 (6.8) |
| **LBBB** | 20 (3.1) | 6 (3.7) |
| **No block** | 606 (93.2) | 145 (23.9) |
| **General mortality** | 650 (100) | 161 (24.8) |

LBBB: left bundle branch block;
RBBB: right bundle branch block

| Type of bundle branch block | | | Total (n=650) N (%) | Groups | | P-value* |
|---|---|---|---|---|---|---|
| | | | | Deceased (n=489) N (%) | Survived (n=161) N (%) | |
| RBBB | Age | <40 | 2 (8.3) | 1 (9.1) | 1 (9.1) | 0.089 |
| | | 40 – 59 | 7 (29.2) | 1 (9.1) | 6 (46.2) | |
| | | >60 | 15 (45.8) | 9 (45.5) | 6 (46.2) | |
| | Gender | Male | 10 (41.7) | 7 (63.6) | 3 (23.1) | 0.095 |
| | | Female | 14 (58.3) | 4 (36.4) | 10 (76.9) | |
| | Underlying diseases | yes | 14 (4.2) | 6 (0) | 8 (7.7) | 0.034 |
| | | No | 10 (41.7) | 5 (45.5) | 5 (45.5) | |
| | Smoking | Yes | 4 (16.7) | 4 (36.4) | 0 (0) | 0.031 |
| | | No | 20 (83.3) | 13 (100) | 0 (0) | |
| LBBB | Age | <40 | 1 (5) | 0 (0) | 1 (7.1) | 1.000 |
| | | 40 – 59 | 5 (25) | 1 (16.7) | 4 (28.6) | |
| | | >60 | 12 (35) | 5 (33.3) | 9 (35.7) | |
| | Gender | Male | 8 (40) | 3 (50) | 5 (35.7) | 0.642 |
| | | Female | 12 (60) | 3 (50) | 9 (64.3) | |
| | Underlying diseases | yes | 20 (5) | 6 (0) | 14 (7.1) | - |
| | | No | 0 | 0 | 0 | |
| | Smoking | Yes | 3 (15) | 1 (16.7) | 2 (14.3) | 1.000 |
| | | No | 17 (85) | 5 (83.3) | 12 (85.7) | |

LBBB: left bundle branch block; RBBB: right bundle branch block;
*: P-value conducted from Fisher's exact test

**TABLE 2.** Association of COVID-19 outcome with clinical and demographic characteristics by type of bundle branch block

**TABLE 3.** Association between COVID-19 outcome and type of bundle branch block

| Type of bundle branch block | Deceased (n=161) N (%) | Survived (n=489) N (%) | P-value* |
|---|---|---|---|
| **RBBB** | 11 (6.8) | 13 (2.6) | **0.049** |
| **LBBB** | 6 (3.7) | 14 (2.9) | |
| **No block** | 144 (89.5) | 462 (94.5) | |

LBBB: left bundle branch block; RBBB: right bundle branch block;
*: P-value conducted from Fisher's exact test

vive, 11 subjects (6.8%) had RBBB and six (3.7%) LBBB (Table 1).

Data analysis revealed that mortality was significantly associated with underlying comorbidities (P=0.034) and smoking history (P=0.031) in patients with RBBB, while it did not exhibit a statistically significant association with any of the variables in those with LBBB (Table 2).

Based on the results, there was a statistically significant association between bundle branch blocks and disease outcomes (P=0.049; Table 3).

## DISCUSSION

The present study has provided insightful findings regarding the association between cardiac bundle branch blocks (BBBs) and mortality in COVID-19 patients admitted to the ICU. The study established a significant correlation between bundle branch blocks, particularly RBBB, and mortality. Moreover, it identified that RBBB was linked to underlying comorbidities and cigarette smoking.

Our results are consistent with those reported by previous studies that have suggested a higher risk of mortality in COVID-19 patients with conduction disorders, emphasizing the clinical importance of assessing ECG findings as part of patient evaluation (3). For example, Kaeley and colleagues reported that new-onset atrial fibrillation, RBBB and sinus tachycardia were associated with increased mortality in COVID-19 patients with pneumonia (9). Likewise, Zuin *et al* highlighted that right ventricular dysfunction, typically attributed to micro thrombotic events in the pulmonary circulation and may lead to poor outcomes, potentially accompanied by conduction disturbances (6).

However, our findings do not align with those of De Carvalho's study, which suggested that both abnormal axes and LBBB were associated with increased COVID-19-related mortality (2). In our study, COVID-19 patients with RBBB showed evidence of higher involvement of the upper respiratory tract in computed tomography (CT) scans, requiring admission to ICUs and supplemental oxygen. It could be argued that these patients with pre-existing RBBB, comorbid conditions and a history of smoking may experience aggravated right ventricular stress and, as a result,

exacerbated bundle branch block and a higher risk of mortality (6, 11). When the right bundle branch is blocked, electrical impulses from the atrioventricular node travel to the His bundle and the left bundle branch. The depolarization wave reaches the left ventricle later than the right ventricle, creating the characteristic ECG pattern of right bundle branch block (12).

Therefore, our study underscores the clinical significance of evaluating ECG results, with a particular focus on the presence of RBBB as a simple and cost-effective means to assess and prioritize COVID-19 patients for admission to intensive care units. It should be noted that, although not investigated in this study, additional ECG findings and complementary diagnostic tools, such as echocardiography, could provide more detailed information, enhancing the precision of patient assessments. Moreover, a more comprehensive record of underlying comorbidities could further refine the results.

The present study has some limitations. In addition to heart blocks, other disorders such as arrhythmias, etc should have been examined. In addition to ECG, a tool like echocardiography was used to examine cardiac disorders.

The strengths of our study were the large number of cases (sample size) and patients' examination by a cardiologist. The weaknesses of the present study were the facts that the criteria for intraventricular conduction disorder were not included and it would have been better to use echocardiography, Holter and exercise testing in addition to electrocardiography. ❑

## CONCLUSION

In conclusion, the results of the present study emphasize the utility of electrocardiography in predicting disease severity and mortality in COVID-19 patients. Notably, the presence of right bundle branch block was associated with higher mortality rates among these patients. Consequently, ECG serves as a valuable tool for the early evaluation of patients upon admission and during hospitalization. ❑

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