Abnormal Electrocardiogram and Overweight is Predictor of Outcome in COVID-19

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Abstract

Objective: To evaluate the severe illness incidence of, predictors for, and effects on outcome by COVID-19. Methods and Results: 104 patients with COVID-19 in the Harbin Infectious Disease Hospital from Jan 15 to March 22, 2020 was retrospective include, 16.53 developed severe illness COVID-19. Patients who developed severe illness were significantly higher body-mass index (BMI), number of comorbidities, lymphocyte percentage and electrocardiogram abnormalities ($P < 0.0001$). Multivariate logistic regression was used to determine the predictors of developing severe illness. Independent predictors of severe illness COVID-19 were BMI and electrocardiogram abnormalities ($P < 0.05$). The electrocardiogram abnormalities was associated with poor outcomes (include mortality, sent to ICU or transfer to a superior hospital) (odds ratio, 7.374; 95% confidence interval, 1.365-39.846; $P < 0.05$). Similar results were observed in BMI. Conclusions: The higher BMI and electrocardiogram recording abnormalities on admission are the predictor of prognosis severe illness patients with the COVID-2019.

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Introduction

Coronavirus disease 2019 (COVID-19) started in December 2019 as a respiratory infection with epidemic potentials [1]. Since the appearance of several cases in Wuhan, the virus has extended rapidly to different parts of China as well as to other countries. Most of COVID-19 infections has occurred through human-to-human contact in family homes and hospitals [2]. The typical presentation of COVID-19 involves fever and cough, but some cases of COVID-19 may progress to acute respiratory failure, acute respiratory distress syndrome, metabolic acidosis, coagulopathy, and septic shock, which are associated with high mortality [3, 4]. Early diagnosis, treatment and prognostic stratification of patients with COVID-19 are crucial. Neutrophil-to-lymphocyte ratio or N terminal pro B type natriuretic peptide (NT-proBNP) has been suggested to be risk factors for severe illness Patients [5]. But this study ignore the many factors that influence patient outcome.

Despite the prevalence of COVID-19, few studies have evaluated the risk factors on outcome in patients. In fact, many factors are used in order to predict the severity and determine the prognosis of pneumonia[6]. Early identification of risk factors for severe illness facilitated appropriate supportive care and alleviate the shortage of medical resources.

METHODS

Data Source

Data were extracted from medical records of the Harbin Infectious Disease Hospital. Harbin Infectious Disease Hospital was assigned to treatment of confirmed COVID-2019 infection in Harbin, CHINA. The ethical approval was granted by Ethics Commission of Harbin Sixth Hospital and all participants enrolled from Jan 15 to March 22, 2020 were given with written informed consent. Epidemiological and clinical features, laboratory, treatment and outcomes were obtained from medical records. Items of data referred to WHO case record form with modifications. Outcomes were evaluated till March 22, 2020.

Inclusion and Exclusion Criteria

Patients were included if they had COVID-2019 according to the new coronavirus pneumonia diagnosis and treatment plan (trial version 4) developed by the National Health Committee of the People's Republic of China (http://www.nhc.gov.cn/). To specifically evaluate the impact of predictor on outcomes, only patients aged [?]18 years were included.

Patient Stratification

The clinical classifications were as follows: (1) non-severe ill patients: mild, with fever, respiratory tract symptoms, and imaging shows pneumonia, (2) severe ill patients: meet any of the following: a) respiratory distress, respiratory rate [?] 30 beats/min, b) in the resting state, means oxygen saturation [?] 93%, c) arterial blood oxygen partial pressure / oxygen concentration [?] 300mmHg (1mmHg = 0.133kPa), d) respiratory failure occurs and requires mechanical ventilation, e) shock occurs.

Predictor Variables

Patient age, sex, body-mass index, comorbidities, antiviral agent treatment and laboratory test results on admission were extracted. The total number of comorbidities were evaluated included hypertension, diabetes mellitus, cardiovascular disease, nervous system diseases, respiratory disease and others (arthrolithiasis, hepatitis B, renal failure, and rheumatoid). Electrocardiogram abnormalities included sinus tachycardia, ST elevation up or depression, Premature atrial contraction, T-wave inversion, and P pulmonale).Patient medical costs were also evaluated.

Outcomes

Outcomes evaluated included poor outcome and medical costs. The poor outcome included mortality, sent to ICU or transfer to a superior hospital. Medical costs was evaluated both as a continuous variable and as a categorical variable, evaluating the proportion of patients with a medical cost higher than the median the total study population.

Sensitivity Analysis

Sensitivity analyses were performed for to assess for congruity with the primary analysis distinguish with and without hypertension, diabetes mellitus, and cardiovascular disease.

Statistical Analysis

All statistical analyses were performed using SPSS version 13.0 (SPSS Inc., Chicago, IL). Continuous variables of baseline patient and hospital characteristics, treatment variables, and complications were compared using Student t test and discrete variables by the Fisher Exact Test. Predictors of developing severe COVID-2019 were determined by performing univariate logistic regression on each demographic variable using survey statistics; those with a p value of < 0.01 in univariate analyses were included in the multiple variable logistic regression model using forward prediction. Area under the receiver operating characteristic curves (AUC) assessed the discriminatory capacity of each logistic regression model. Thereafter, hierarchical multivariate logistic regression models were constructed with all defined predictor variables to evaluate outcomes. A P value of < 0.05 was considered statistically significant.

RESULTS

Demographics of Study Population

Of the 104 patients with the Coronavirus Disease 2019 included in the study population. The demographics of patients and clinical characteristics were compared by severity of COVID-2019 in Table 1. The median age was 50.0 (interquartile range [IQR], 38.0-61.75) years for the total population, and was 62.0 (IQR, 47.5-71.5) years for those who developed severe. The incidence of severe COVID-2019 was 16.35%, the percent of poor outcome was 10.58% (the mortality was 2.88%, and the percent of ICU admission or transfer to a superior hospital was 7.69%). Many predictors evaluated varied by COVID-2019, including patient age, weight, BMI and laboratory test results on admission.

Regression Modeling

Univariate logistic regression modeling compared each predictor variable with the development of severe COVID-2019 (Table 2). Variables that were significant in univariate models were then included in the final

multiple variable logistic regression model with the development of severe COVID-2019 (Table 3). The AUC of the development of severe COVID-2019 model was 0.98.

Outcomes

The outcomes evaluated were compared based on BMI and electrocardiogram results in Figure. Abnormal electrocardiogram was associated with increased odds of poor outcome (odds ratio [OR], 13.381; 95% confidence interval [CI], 2.881-62.158; P =0.001) and severe ill COVID-2019 (OR, 7.347; 95% CI, 1.365-39.846; P =0.020). Overweight was also associated with increased odds of poor outcome (OR, 1.257; 95% CI, 1.030-1.534; P =0.024) and severe ill COVID-2019 (OR, 1.555; 95% CI, 1.166-62.158; P =0.003). Both BMI and electrocardiogram results were not found to be associated with medical costs more than Y=11838.65.

Sensitivity Analysis

In the sensitivity analysis that instead number of comorbidities by the type of comorbidities, hypertension, diabetes mellitus, and cardiovascular disease were included. Multivariate logistic regression identified ECG abnormalities was also associated with severity of COVID-2019 (OR, 30.452; 95% CI, 1.060-874.985; P =0.046), with the exception that BMI was only of borderline significance (OR, 2.510; 95% CI, 0.998-6.313; P =0.51).

Discussion

Although COVID-2019 is one of the most emergency infections today, there are limited data on risk factors of outcome. In our study of patients with COVID-19 in Harbin we have shown that 16.35% have developed of severe COVID-2019 and the percent of poor outcome was 10.58% (the mortality was 2.88%, and the percent of ICU admission or transfer to a superior hospital was 7.69%). Both are lower than the previous research which showed that 26% of patients received ICU care, and mortality was 4.3% in Wuhan [7]. The lower mortality may be related to early isolation and early treatment in Harbin. ECG abnormalities and overweight are predictors of severe COVID-2019. On multivariate analysis, presence of abnormal ECG on admission and higher BMI are the two significant factors predicting outcome. The percent of poor outcomes increases with abnormal electrocardiogram.

Early identification of those "at risk" of poor outcome is an essential part of the assessment of any disease. In the study, the data of 104 patients with COVID-2019 are analyzed, the baseline characteristics of patients in the non-severe and severe groups are described and compared. The independent risk factors affecting incidence of severe illness are screened by univariate and multivariate Logistic Regression. We found that ECG abnormalities and overweight plays a key role in determining the course in severe patients with COVID-2019.

A recent study showed myocardial injury is significantly associated with fatal outcome of COVID-19, while myocardial injury is associated with cardiac dysfunction and arrhythmias [8]. It is similar with our study. In our study, creatine kinase and creatine kinase MB form and ECG record were compared and used to univariate logistic regression evaluating. Neither creatine kinase nor creatine kinase MB form is associated with developing severe COVID-19. However, ECG abnormalities is associated with the outcome. This is also similar to the observation in patients with sepsis, where the heart rate variability which calculated by electrocardiogram recording seemed to be the best indicator to predict the occurrence of septic shock[9] or mortality [10].

Another research showed is neutrophil-to-lymphocyte ratio is an independent risk factor for mortality in hospitalized patients with COVID-19 [11]. In that research focused on a series of predictors such as age, gender, symptoms and blood laboratory findings, except BMI and ECG results. However, in other publications evaluating the BMI was a predictor of microbiological persistence in patients with mycobacterium avium complex lung disease [12]. The virus persistence in respiratory might imply a lymphoid hypertrophy and a stimulatory effect for inflammation [13]. Virus persistence may have a pathogenetic potential for development of lymphoid hypertrophy and a chronic stimulatory effect for inflammation.

In this study, we first quantify the total direct economic burden of COVID-2019 related hospitalizations. Because of the high spread of the disease, all patents were hospitalized. The median cost per patient is Y=11805.98 and higher in severe patients. The medical costs per patient of COVID-2019 in Harbin is higher than influenza hospitalisation costs of Y=9832.00 in China [14], but lower than that of

The limitations of our study is a single center study and the small sample size. In addition, the laboratory test of cardiac function examination, including Troponin I and brain natriuretic peptide, cannot be acquired in the medical records. Third, the medical costs data has been obtained from a middle city, which may not be applicable to the other city or country.

Conclusion

The higher BMI and electrocardiogram recording abnormalities on admission are the predictor of prognosis severe illness patients with the COVID-2019. The electrocardiogram abnormalities and higher BMI are more likely to develop mortality, sent to ICU or transfer to a superior hospital.

Contributors

Benzhi Cai and Jinliang Li had the idea for and designed the study and had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Zhidan Sun and Yan Hou contributed to writing of the report and the statistical analysis. All authors contributed to data acquisition, data analysis, or data interpretation, and reviewed and approved the final version.

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Declaration of interests

All authors declare no competing interests.

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