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Analiza czynników ryzyka ciężkiego przebiegu choroby i śmiertelności wewnątrzszpitalnej w grupie pacjentów z COVID-19

Analysis of risk factors for severe disease and in-hospital mortality in a group of patients with COVID-19

Rozprawa doktorska na stopień doktora
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STRESZCZENIE W JĘZYKU ANGIELSKIM

Introduction

The progressive process of international exchanges and the widespread movement of populations in recent decades has resulted, in addition to many positive effects, in a significant increase in the global risk of certain types of hazards, including - at the forefront - sanitary-epidemic hazards associated with the increasingly easy spread of pathogens between countries and continents. An example of this phenomenon is the emergence of the SARS-CoV-2 virus and the outbreak of the global COVID-19 pandemic, which affected all aspects of life, created fear and social isolation and forced many changes in health systems. The global public health threat posed by COVID-19 has led to an important place among scientific studies on the characteristics of patients infected with the new pathogen, the risk factors for the disease, as well as its progression and prognosis.

Objective

The aim of the study was to identify risk factors for a severe course of COVID-19, resulting in the need for intensive care unit treatment, and factors associated with the risk of in-hospital death, and to analyse the predictive value of selected early warning scales used to predict severe course and mortality in a group of patients admitted to a hospital emergency department with confirmed SARS-CoV-2 infection.

Material and methods

This dissertation is based on a series of four thematically consistent and original scientific publications with a total score of 390 points from the Ministry of Education and Science and a total Impact Factor score of 5.9.

The research in the series of publications constituting the basis of the scientific achievement was carried out by means of a retrospective analysis of the medical records of patients infected with SARS-CoV-2 virus. The analysed cases were patients who were admitted to the ED of the MSWiA Medical Centre, now the MSWiA National Medical Institute, in Warsaw (Publication 2, Publication 3, Publication 4) and patients hospitalised at the Temporary National Hospital in Warsaw (Publication 1). In Publications 1, 2 and 3, the study covered the period from March 2020 to April 2021, while in Publication 4, the analysis covered the period from March 2020 to April 2022. In the process of analysing medical records, data were

extracted on patient characteristics, hospitalisations, baseline vital signs, laboratory results, medical procedures used, clinical symptoms, comorbidities and outcome of hospitalisation.

Results

Publication 1: From the analysis of our study, advanced age of patients was associated with higher mortality from COVID-19. The regression analysis performed showed that laboratory results of RBC, HTC, LY on admission were significant factors influencing the survival of patients with COVID-19. The presence of comorbidities such as diabetes mellitus, stroke, renal failure and COPD had an impact on the higher mortality of patients hospitalised at the Provisional National Hospital. In addition, the presence of shallow breathing and shortness of breath in patients were associated with increased mortality, while noted fever and myalgia were associated with a higher chance of survival in the study subjects. It was also shown that higher values of systolic blood pressure, diastolic blood pressure and saturation had a significant effect on positive hospital discharge. In contrast, higher values of mean arterial pressure, heart rate and higher respiratory rate indicated a higher risk of death for hospitalised patients.

Publication 2: Our study shows that the majority of patients admitted to the ED and hospitalised due to COVID-19 were men aged 45 years or older. The in-hospital mortality rate due to COVID-19 during the study period was 12.76%. Factors influencing the risk of in-hospital death associated with COVID-19 were age, gender, the presence of symptoms such as fever, shallow breathing and dyspnoea, and the presence of comorbidities such as diabetes, renal failure, heart failure, COPD and a history of stroke and active cancer. More than 5% of all patients hospitalised with COVID-19 were admitted to the ICU. Factors influencing the risk of patient transfer to the ICU were gender, presence of dyspnoea, number of reported symptoms of infection, presence of diabetes, COPD and nicotinism.

Publication 3: The analysis of our study shows that the subjects were predominantly male and the median age of the patients was 53 years. The median length of hospitalisation was 4 days, and 56 patients required the implementation of mechanical ventilation. The most common comorbidity was hypertension, and all comorbidities were significantly associated with higher mortality. The analysis showed that the NEWS scale on admission to the ED had the highest discriminatory power value (AUC 0.76) compared to the other scales, indicating that it may be useful for health care professionals in the assessment of patients with COVID-19. In addition, it showed that all other scales used were acceptable for screening patients with COVID-19.

Publication 4: Our results showed that the median age of patients was 59 years and more than half were male. ICU admissions were reported in more than 6% of patients. Among the analysed cases of patients who did not survive, the majority were male and elderly. The patient mortality rate was almost 22%. The analysis showed that patients who did not survive scored significantly higher on the early warning scales and were more likely to require specialised medical procedures and ICU admission. Of all the analysed early warning scores performed after patients were admitted to the ED, the REMS had the best overall prognostic performance, with the highest discriminatory power (AUC 0.84) and the highest negative predictive value (97.4%) compared to other scoring systems. The analysis also showed that for the subgroup of patients younger than 65 years, the NEWS and REMS criteria tests performed after admission to the ED had the highest discriminatory power values (AUC 0.81), and for the subgroup of patients aged 65 years and older, the NEWS and SEWS methods had the highest discriminatory power values (AUC 0.72).

Summary

On the basis of the analysis of the material carried out in **Publication 1**, it should be noted that a key measure, aimed at reducing the burden on inpatient hospitals during the peak phases of the pandemic, is the establishment of temporary hospitals. At the same time, the study presented here was the first retrospective case study of SARS-CoV-2-infected patients who were hospitalised in a temporary hospital set up at the National Stadium in Warsaw as part of a pandemic control strategy. SARS-CoV-2 virus infection is mostly asymptomatic or the symptoms manifested are non-specific. It should therefore be emphasised, as was done in this publication, that analyses, allowing the isolation of factors influencing the prognosis and mortality of patients with COVID-19, play a very important role in raising awareness and allowing the optimal therapeutic process to be planned and situations in which the patient's condition rapidly deteriorates to be eliminated.

The data presented in **Publication 2** on the risk factors for the transfer of a SARS-CoV-2-infected patient to the ICU, as well as the risk factors for in-hospital death in COVID-19, can be used by decision-makers responsible for organising health care systems in preparation for the increasing number of COVID-19 cases. The presented research results may consequently have an impact on improving the quality of medical service delivery to COVID-19 patients and, moreover, allow the rapid identification of high-risk patients and the selection of appropriate medical management for COVID-19 patients.

The ED is a place where things are done quickly and efficiently and where treatment procedures are carried out simultaneously. Especially during the COVID-19 pandemic, when

the increase in new cases was sudden, the ED was often the first point of contact between the patient and medical care. This is why it is so important to make efficient use of medical resources and solutions that enable the rapid identification of critically ill patients. One such solution is the use of early warning scales that allow rapid and effective formulation of a prognosis of the course of treatment. The study presented in **Publication 3** shows that the NEWS obtained the highest discriminatory power value, which means that it can be used as a tool to predict in-hospital mortality among patients with COVID-19.

REMS was the most accurate scoring system with the highest discriminatory power and negative predictive value compared to the other scoring systems analysed, as presented in **Publication 4**. In patients under 65 years of age, NEWS and REMS were the most effective in predicting mortality in patients with COVID-19, while in patients 65 years of age and older, NEWS and SEWS had the highest predictive value. Although MEWS was used during the pandemic in many hospitals in Poland, it was shown to be unsuitable for COVID-19 patients, as its effectiveness and predictive value in predicting mortality were lower compared to other early warning scales. Incorporating the above-mentioned prognostic tools into clinical practice in the hospital emergency department could provide a more effective assessment of mortality risk and thus increase the chances of effective medical care.

The scientific publications that form the basis of this dissertation emphasise the importance of correctly identifying factors affecting the prognosis and mortality of patients with COVID-19, as well as the use of adequate scoring tools to assess and monitor the patient's condition using early warning scales. All of this allows for the rapid identification of high-risk patients and the selection of appropriate management of patients with COVID-19. The results obtained can support the development of potential recommendations for healthcare providers in the event of another pathogen capable of causing a public health threat at a global scale.