

Summary

Coronaviruses are well-known pathogens that cause upper respiratory tract infections in adults and children. The viruses are transmitted by the airborne route, amid close contact with an infected person. COVID-19, caused by the new SARS-CoV-2 coronavirus, is a disease with a varied course. This is determined by the individual characteristics of the patient, such as the reactivity of the immune system and the incidence of comorbidities. In about 20% of infected people, the course is asymptomatic, in the majority it is mild or moderate, with a varied clinical course and a diverse array of symptoms. In the first stage, the disease mainly affects the upper respiratory tract, where it can spread to the lower respiratory tract and beyond the respiratory system. The presence of the virus has been found in the cardiovascular system, heart muscle, blood vessels, intestines, kidneys, pancreas, liver, central nervous system, genitalia and placenta.

Severe illness, requiring hospitalization, occurs in about 15% of those infected. Progression to critical condition affects about 5% of patients. Mortality based on infection and death statistics is about 2%.

The most common type of severe SARS-CoV-2 infection is interstitial pneumonia with respiratory failure. Patients requiring hospitalization in intensive care units experience severe tissue and organ damage due to:

- excessive immune system response,
- hypoxemia,
- vascular complications,
- complications secondary to medical treatment.

Despite an increasing understanding of the disease mechanisms and numerous studies, no drug with satisfactory efficacy has been identified to date, especially one which would protect against a severe course of infection. What is apparent, however, is the dependence of target treatment efficacy on the timing of the implementation of therapeutic interventions.

One of the breakthroughs in understanding the pathomechanism of COVID-19 has been the association of symptoms occurring in patients with cytokine storm. A cytokine storm is a pathological immune system response triggered by infectious or non-infectious diseases.

In addition to currently available vaccinations, early identification of factors that predict the course of infection, respiratory distress and the need for mechanical ventilation, is a key issue in preventing severe complications of SARS-CoV-2 infection. Identifying predictors of an

unfavorable course of the disease by evaluating individual laboratory tests and indicators of inflammation, will allow timely treatment of vulnerable patients. The aim of this study was to clinically analyze patients hospitalized for respiratory failure due to SARS-CoV-2 infection in the Intensive Care Unit of the University Hospital in Cracow over a 12-month period (03.2020-03.2021), with focus on population characteristics and prognostic factors.

Analysis of factors and parameters affecting patient mortality.

Our study compared the course of hospitalization in patients admitted directly to the ICU from other departments to those admitted directly from home.

We evaluated the length of hospitalization of patients, the level of inflammatory parameters and their mutual correlations, the influence of obesity on the course of the disease and mortality. We also analyzed the quality of life of patients who received extracorporeal circulatory, and respiratory support.

The retrospective analysis included 414 patients (129 women and 285 men) aged between 20 and 93 (mean age 63.9 years). The effects of age, BMI, presence of comorbidities, baseline severity of the patient's condition, time of hospitalization before ICU admission on the course, and outcome of hospitalization were examined, along with laboratory test results upon admission and during hospitalization (CRP, IL-6, procalcitonin, white blood cell count, leukocyte count, neutrophil count, NLR index, ferritin, hemoglobin, platelets, triglycerides, vitamin D3 level). The correlations of laboratory test results with the patient's baseline severity, time of hospitalization and its outcome, the course of disease, time and type of mechanical ventilation, time of tracheostomy access, use of continuous renal replacement therapy (CRRT) and extracorporeal membrane oxygenation (ECMO) were all analyzed.

During the analyzed period of twelve months 125,042 SARS-CoV-2 PCR tests were performed, 3,091 patients were hospitalized, and 414 patients required hospitalization in the Intensive Care Unit.

The overall hospital mortality rate was 18%, and 60.3% for patients hospitalized in the ICU.

In the group in question in both univariate and multivariate analysis, age was a predictor of death, where each additional year of life increased the risk of death by 3.5% and 3.4%, respectively. In the analyzed group, renal failure increased the risk of death by 2.142 times. Renal failure was also statistically significant according to the mode of patient admission,

occurring in 18.52% of patients admitted to the ICU from other departments and in 9% of patients admitted directly from home.

Similarly, to renal failure, higher APACHE scores and SAPS II scores were also strong predictors of death. For the APACHE scale, 1 point increased the risk of death by 10.1% and for the SAPS II scale by 4.9%. In the analyzed group, the average APACHE II score on admission to the intensive care unit was 19.47, and the mortality rate was 60.3%.

It is exceptionally important to assess the impact of treatment on quality of life, considering the patient's point of view. Patients hospitalized in critical care units are at risk of developing Post-Intensive Care Syndrome (PICS), which negatively affects the quality of life.

It is characterized by impairment of cognitive, physiological, and physical functions. Known risk factors for PICS are Adult Respiratory Distress Syndrome (ARDS), sepsis, delirium, or the need for invasive mechanical ventilation. The consequences of prolonged mechanical ventilation, immobilization, sedative and neuromuscular-blocking drugs include polyneuropathy, decreased exercise tolerance, malnutrition, and hypercatabolism. Tracheostomy, which is performed due to the need for prolonged mechanical ventilation and to facilitate weaning from ventilator therapy, is often associated with periodic problems with swallowing and speaking.

Patients with COVID-19, experienced social isolation throughout their hospitalization. Due to present regulations, no relatives or visitors were allowed access to covid wards. Restrictive personal protection equipment used by staff resulted in dehumanization and hindered patient communication. The COVID-19 pandemic caused a population-wide high level of anxiety. Previous studies on assessing patient quality of life after COVID-19 have not included critically ill patients. Extracorporeal membrane oxygenation (ECMO) is a highly invasive method of supporting respiratory and circulatory failure with a high risk of complications and involving significant human resources. It is implemented in the face of exhaustion of other treatment methods. ECMO is not per se a therapeutic method but rather a bridging method to gain time for damaged organs to recover. The first reports from Wuhan on COVID-19 patients requiring ECMO indicated an 83% mortality rate. The primary criterion determining eligibility for ECMO therapy is the potential reversibility of the process that led to lung failure. Among all patients hospitalized in the University Hospital in Cracow due to severe respiratory failure caused by COVID-19, 36 were qualified for ECMO therapy. 10 patients survived, including 2 who received lung transplants, 26 patients died (mortality rate of 72.2%). The leading causes of death in this group of patients were hematological disorders resulting in CNS bleeding and

septic shock caused by bacterial superinfection. 20 patients (56%) required continuous renal replacement therapy (CRRT). The average duration of ECMO therapy was 19.1 days. In 25% of patients, oxygenator dysfunction necessitated its replacement. This added to the cost of treatment and increased the staff's workload.

ECMO therapy was associated with a high mortality rate, yet post-ECMO survivor's quality of life show that the therapy can be valuable in young, non-morbid patients.