Treatment outcomes of COVID-19 patients in bi-disciplinary cardiology and cardiac surgery ward

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INTRODUCTION

SARS-CoV-2, a coronavirus causing severe acute respiratory syndrome, emerged at the end of 2019 and triggered a pandemic forcing rapid changes in the organization of public healthcare both at the national and in-hospital level [1]. Patients infected with COVID-19 underwent treatment in designated hospitals and other existing facilities with infectious diseases departments.

Patients with either exacerbation of chronic heart disease or patients recently affected by acute cardiac disorders are at high risk of death if infected with SARS-CoV-2 [2]. Unfortunately, in Poland, some COVID-19 designated hospitals do not have medical facilities to conduct highly specialized cardiological therapies. A transfer to COVID-19 dedicated cardiology or cardiac surgery units reduces an opportunity to achieve optimal medical outcomes [3]. Depending on available healthcare resources, urgent cardiac procedures with documented efficacy should be continued during consecutive waves of the COVID-19 pandemic [4]. To provide prompt treatment and diminish the risk of the virus spread, our hospital, which is a multi-specialist non-COVID-19 dedicated hospital, established a combined unit for COVID-19 patients. The ward functioned for 6 months (from October 23, 2020 to October 23, 2021) during the 2 waves of the highest intensity of the pandemic in Poland.

The study aims to present the clinical characteristics, the course of hospitalization, outcomes, and risk factors of death among our patients.

METHODS

The cases comprised 227 patients hospitalized in the newly created ward for exacerbation of chronic cardiovascular diseases or acute illnesses and requiring urgent cardiac surgery or cardiac invasive procedure. Patients were diagnosed with COVID-19 in accordance with the recommendations of the Polish Association of Epidemiologists and Infectiologists with the use of the real-time polymerase chain reaction method [5]. Others who tested negative on admission were hospitalized separately and tested regularly twice a week or in case of any infection symptoms.

Patients were hospitalized for acute heart failure (New York Heart Association [NYHA] class III or IV), acute coronary syndrome, pulmonary embolism, infective endocarditis, arrhythmia, hypertension crisis, myocarditis, pericarditis, a need for urgent cardiac surgery, post-sternotomy complication treated with vacuum-assisted closure (VAC) therapy, or pneumonia in patients with multiple cardiovascular comorbidities. There were no exclusion criteria.

Both risk factors and cardiovascular diseases were identified based on a medical history of prior diagnosis or treatment and defined according to the current European Society of Cardiology guidelines [6].

Blood samples were drawn on admission using a minimal stasis and atraumatic venipuncture from an antecubital vein.

Left ventricular ejection fraction was assessed using transthoracic echocardiography and the biplane Simpson method with Philips

Table 1. Demographic and clinical characteristics of the studied groups

Variable	All patients (n = 227)	Survivors (n = 179)	Non-survivors (n = 48)	P-value
Age, years	69.6 (13.4)	68.5 (13.7)	73.4 (11.8)	0.028
Male sex, n (%)	150 (66)	115 (64)	35 (73)	0.26
Body mass index, kg/m²	30.3 (6.2)	31.0 (6.5)	28.1 (4.4)	0.069
Length of hospital stay, days	14 (9–22)	14 (11–22)	13 (6–21)	0.12
Left ventricular ejection fraction, %	50 (35–56)	50 (40–60)	40 (20–48)	0.003
Main cause of hospitalization, n (%)				
Acute coronary syndrome[a]	64 (28)	46 (26)	18 (38)	0.11
Heart failure	58 (26)	45 (25)	13 (27)	0.78
Pulmonary embolism	13 (6)	10 (6)	3 (6)	0.74
Infective endocarditis	11 (5)	7 (4)	4 (8)	0.25
Arrhythmia[b]	26 (11)	23 (13)	3 (6)	0.2
Hypertension	6 (3)	6 (3)	0 (0)	0.35
Urgent cardiac surgery[c]	17 (7)	17 (9)	0 (0)	0.027
Pneumonia	30 (13)	23 (13)	7 (15)	0.75
Peri/Myocarditis	2 (1)	2 (1)	0 (0)	1.00
Risk factors and comorbidities, n (%)				
Diabetes mellitus	76 (33)	55 (30)	21 (44)	0.09
Arterial hypertension	158 (70)	127 (71)	31 (65)	0.39
Heart failure	109 (48)	84 (47)	25 (52)	0.53
Coronary artery disease	49 (22)	34 (19)	15 (31)	0.07
Atrial fibrillation	95 (42)	69 (39)	26 (54)	0.051
Cardiac pacing	16 (7)	13 (7)	3 (6)	1.00
Rheumatic disorder	12 (5)	10 (6)	2 (4)	1.00
Obesity	60(26)	48 (27)	12 (25)	0.80
Pulmonary disease	9 (4)	7 (4)	2 (4)	1.00
Laboratory parameters on admission				
Hemoglobin, g/dl	12.76 (2.25)	12.82 (2.22)	12.56 (2.39)	0.49
Platelets, 10⁹/l	198 (142–261)	204 (153–264)	169 (117–239)	0.015
White blood cells, 10⁹/l	7.1 (5–9.8)	6.8 (4.7–9.1)	8.8 (6–13.8)	0.002
Creatinine, µmol/l	86.2 (67.4–120.3)	82.2 (65.0–109.6)	109.6 (81.8–150.8)	<0.001
hsCRP, mg/l	39 (13–87)	29 (9–66)	86 (44–154)	<0.001
Maximum hsCRP, mg/l	67 (24–131)	49 (17–108)	128 (84–187)	<0.001
Procalcitonin, ng/ml	0.14 (0.07–0.42)	0.1 (0.06–0.24)	0.35 (0.15–1.38)	<0.001
NT-pro-BNP, pg/ml	4018 (985–13273)	2720 (701–6586)	12974 (4510–35000)	<0.001
hsTnI, ng/l	73 (19–754)	43 (14–463)	585 (116–7316)	<0.001
D-dimer, ng/ml	1165 (652–5303)	1008 (570–3652)	3381 (1160–19943)	<0.001
TSH, mIU/l	1.08 (0.48–1.88)	1.1 (0.54–1.9)	0.92 (0.28–1.51)	0.089
Therapy, n (%)				
Noninvasive oxygen therapy	125 (55)	101 (56)	24 (50)	0.51
Mechanical ventilation >24 hours	21 (9)	1 (1)	20 (42)	<0.001
Antiplatelet therapy	92 (41)	71 (40)	21 (44)	0.61
Anticoagulants	191 (84)	147 (82)	44 (92)	0.11
β-blockers	179 (79)	149 (83)	30 (63)	0.002
ACEIs/ARBs	125 (55)	109 (61)	16 (33)	<0.001
Statin	120 (53)	97 (54)	23 (47)	0.44
Antibiotics	140 (62)	97 (54)	43 (90)	<0.001
Steroids	122 (54)	92 (51)	30 (63)	0.17
Convalescent plasma	17 (7)	11 (6)	6 (12)	0.21
Remdesivir	64 (28)	50 (28)	14 (29)	0.87
Procedure during hospitalization, n (%)				
Coronary angiography	83 (37)	64 (36)	19 (40)	0.62
PCI	54 (24)	41 (23)	13 (27)	0.54
CIEDs implantation	11 (5)	11 (6)	0 (0)	0.13
Temporary cardiac pacing	3 (1)	1 (1)	2 (4)	0.11
CIEDs removal	3 (1)	2 (1)	1 (2)	0.51
Cardiac ablation	4 (2)	4 (2)	0 (0)	0.58
Cardiac surgery[c]	20 (9)	20 (11)	0 (0)	0.009

Values are given as mean (standard deviation [SD]), number (percentage), or median (interquartile range [IQR])

[a]Acute myocardial infarction or unstable angina according to the fourth universal definition of myocardial infarction; [b]Atrioventricular block at least the second degree, ventricular arrhythmias including electrical storm, symptomatic bradycardia, atrial fibrillation, atrial flutter or reentrant supraventricular tachycardias; [c]Coronary artery bypass graft, valve repair or replacement, ascending aortic replacement, thoracic endovascular aortic repair, transcatheter valve implantation or VAC therapy

Abbreviations: ACEIs, angiotensin-converting enzyme inhibitors, ARBs, angiotensin receptor blockers; CIEDs, cardiac implantable electronic devices; hsCRP, high-sensitivity C-reactive protein; hsTnI, high-sensitivity troponin I; NT-pro-BNP, N-terminal prohormone of brain natriuretic peptide; PCI, percutaneous coronary intervention; TSH, thyroid-stimulating hormone

Affiniti CVx (Philips Healthcare, Amsterdam, The Netherlands).

The analyzed endpoint in our study was in-hospital mortality from any cause. We have also analyzed the need for oxygen supplementation i.e. non-invasive oxygen therapy (including Optiflow® High Flow Nasal system), mechanical ventilation, duration of hospital stay, use of cardiovascular drugs grouped into drug classes (β-blockers, angiotensin-converting enzyme inhibitors/angiotensin receptor blockers [ACEIs/ARBs], statins, anticoagulation treatment, and antiplatelet therapy), and other recommended therapy (steroids, antibiotics, convalescent plasma, and remdesivir) [7]. The last part of Table 1 summarizes invasive procedures performed throughout the hospitalization.

Statistical analysis

Statistical analysis was performed using PQStat v.1.8.2. Software (Poznań, Poland). Continuous variables are presented as a mean and standard deviation if parametric (assessed using the Shapiro-Wilk test) or as a median and interquartile range (IQR) for continuous variables. Categorical variables are presented as numbers and percentages. The χ^2 test, Fisher's exact test, Student's t-test, and the Mann-Whitney U-test were used, as appropriate, for group comparison. The univariate logistic regression was applied to assess predictors of in-hospital death or mechanical ventilation. The results were presented as odds ratio (OR) with 95% confidence intervals (CI). A two-sided P-value of <0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Demographic and clinical characteristics of survivors and non-survivors are presented in Table 1. From October 23 to April 23 227 patients were admitted to the bi-disciplinary cardiology and cardiac surgery ward and completed their hospital course (i.e. discharge or death). Most of the cases were tested positive on the first day of hospitalization (median [IQR], 1 [1–4] day), hence they were defined as community-acquired infections. The median hospitalization duration was 14 (9–22) days. Overall, in-hospital mortality was 21% (48 of 227 patients). Seventy-nine percent of non-survivors were older than 65 years (38 of 48 patients). There was no difference between the survivor and non-survivor groups with respect to sex (17% in female vs 23% in male; P >0.05), the body mass index, and the duration of hospital stay (Table 1). Reduced left ventricular ejection fraction was observed in the non-survivor group.

There were no intergroup differences regarding the main cause of hospitalization. The most frequent reasons for hospitalization were acute coronary syndromes (28%), acute heart failure (26%), and pneumonia (13%) in patients with multiple cardiovascular comorbidities. The most prevalent cardiovascular risk factor or disease was arterial hypertension (70%), followed by heart failure (48%), atrial fibrillation (42%), diabetes mellitus (33%), obesity (26%),

and coronary artery disease (22%). Seven percent of patients had a cardiac pacemaker or implantable cardioverter defibrillator previously implanted.

Our data confirm that elderly patients with numerous comorbidities are at the highest risk of hospitalization [8].

Non-survivors had a higher level of troponin I, N-terminal prohormone of brain natriuretic peptide, white blood cells count, creatinine, D-dimer, C-reactive protein, and procalcitonin on admission than survivors. β-blockers and ACEIs/ARBs were used more frequently by survivors than by non-survivors. By contrast, antibiotics were used less frequently by survivors than by non-survivors. No difference amongst the groups was observed regarding using steroids, convalescent plasma, or remdesivir.

Oxygen supplementation was necessary for 64% of patients (n = 146). Mechanical ventilation (>24 hours to exclude resuscitation and perioperative period) was applied in 21 cases (9%). Nasal high-flow oxygen therapy (including prone position) was applied in the preceding stage of invasive ventilation and also in 26 patients (11%). The mortality rate was high in patients requiring mechanical ventilation (95%).

Age over 65 years (OR, 2.33; 95% CI, 1.09–4.97; P = 0.029) and ejection fraction <50% (OR, 3.94; 95% CI, 1.9–8.18; P <0.001) were independent predictors of in-hospital death, whereas treatment with ACEIs/ARBs (OR, 0.32; 95% CI, 0.16–0.62; P <0.001) or β-blockers (OR, 0.34; 95% CI, 0.17–0.68; P = 0.002) were associated with a lower risk of in-hospital death and mechanical ventilation (OR, 0.16; 95% CI, 0.05–0.5; P = 0.002 and OR, 0.31; 95% CI, 0.12–0.79; P = 0.014, respectively).

The most frequently performed procedures were coronary angiography in 83 patients (37%), percutaneous coronary intervention in 54 patients (24%), and cardiac surgery in 20 patients (9%), most of whom underwent coronary artery bypass grafting or valve replacement/repair procedure (75%). It is worth noting that there were no deaths among patients in the cardiac surgery group.

Our study presents data of the unique group of patients both with SARS-CoV-2 infection and acute cardiac disorders or exacerbation of chronic heart diseases treated in a bi-disciplinary unit of the multi-profile tertiary referral hospital that was not solely dedicated to COVID-19 patients. Establishing such a department made it possible to effectively separate infected patients from healthy ones and to maintain access to highly specialized procedures.

Article information

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