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Comparison of reorganized versus unaltered cardiology departments during the COVID-19 era: A subanalysis of the COV-HF-SIRIO 6 study

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Abstract

Background: *Since the beginning of the coronavirus disease 2019 (COVID-19) pandemic, numerous cardiology departments were reorganized to provide care for COVID-19 patients. We aimed to compare the impact of the COVID-19 pandemic on hospital admissions and in-hospital mortality in reorganized vs. unaltered cardiology departments.*

Methods: *The present research is a subanalysis of a multicenter retrospective COV-HF-SIRIO 6 study that includes all patients (n = 101,433) hospitalized in 24 cardiology departments in Poland between January 1, 2019 and December 31, 2020, with a focus on patients with acute heart failure (AHF).*

Results: *Reduction of all-cause hospitalizations was 50.6% vs. 21.3% for reorganized vs. unaltered cardiology departments in 2020 vs. 2019, respectively ($p < 0.0001$). Considering AHF alone respective reductions by 46.5% and 15.2% were registered ($p < 0.0001$). A higher percentage of patients was brought in by ambulance to reorganized vs. unaltered cardiology departments (51.7% vs. 34.6%; $p < 0.0001$) alongside with a lower rate of self-referrals (45.7% vs. 58.4%; $p < 0.0001$). The rate of all-cause in-hospital mortality in AHF patients was higher in reorganized than unaltered cardiology departments (10.9% vs. 6.4%; $p < 0.0001$). After the exclusion of patients with concomitant COVID-19, the mortality rates did not differ significantly (6.9% vs. 6.4%; $p = 0.55$).*

Conclusions: *A greater reduction in hospital admissions in 2020 vs. 2019, higher rates of patients brought by ambulance together with lower rates of self-referrals and higher all-cause in-hospital mortality for AHF due to COVID-19 related deaths were observed in cardiology departments reorganized to provide care for COVID-19 patients vs. unaltered ones.* (Cardiol J 2023; 30, 3: 344–352)

Key words: acute heart failure, COVID-19, hospital admission, in-hospital mortality

Introduction

On December 31, 2019 the World Health Organization (WHO) was informed of 44 pneumonia cases of unknown cause in the city of Wuhan, China. The first case of the coronavirus disease 2019 (COVID-19) in the United States of America was reported on January 20, 2020. Four days later the first patient in Europe was diagnosed with COVID-19. On March 11, 2020 due to the spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the WHO declared COVID-19 a pandemic.

Soon after healthcare systems across the globe became paralyzed. The usual medical care

pathways were replaced with new temporary solutions to provide treatment for patients infected with SARS-CoV-2. In the majority of Polish hospitals, additional beds dedicated to COVID-19 patients were made available either within pre-existing departments or emerging as new or transformed separate wards. Some hospitals were entirely transformed into multidisciplinary COVID-19 hospitals or new temporary hospitals were created. In Madrid, Spain, after reaching 100% hospital bed capacity, additional beds were provided in physical therapy gyms, corridors, libraries and tents located outside of the main hospital buildings [1]. In the Rizoli Institute, Italy, separate care pathways were created for COVID-19 patients who were hospitalized in newly established wards [2]. The enormous surge of COVID-19 patients at the very beginning of the pandemic in Italy provoked a 72% increase in the number of intensive care unit beds [3]. In Lombardy, Italy, entire hospitals were transformed to provide care for COVID-19 patients only. Many hospital wards, like stroke units, were closed or converted to treat COVID-19 patients, leaving as few as 11 out of 36 stroke units in the region of Lombardy to provide emergency care for stroke patients. According to the French "plan blanc", the number of intensive care unit beds was doubled with reallocation of all resources to fight the pandemic [3]. All routine consultations were cancelled or postponed. During the first few weeks, whole wards were converted to treat COVID-19 patients, then separate areas were created for COVID-19 patients. In Denmark, organizational changes included: upscaling intensive care unit capacity, deferral of all non-acute diagnostics and treatment, as well as intensive care medical training for healthcare professionals of other specialties [4]. All these revolutionary, large-scale reorganizations of healthcare systems have brought to light shortcomings in the treatment of other medical conditions. Reports from many countries showed a decrease in hospital admissions due to various cardiovascular causes, including life-threatening emergencies [5–11].

In the previously published impact of COVID-19 pandemic on acute Heart Failure admissions and mortality: multicenter (COV-HF-SIRIO 6) study, it was demonstrated that a reduction in hospital admissions for acute heart failure (AHF) during the COVID-19 pandemic compared with the pre-COVID era and a concurrent increase in in-hospital AHF mortality [12].

The aim of the subanalysis of the COV-HF--SIRIO 6 study was to identify differences in hospital admissions and mortality among AHF patients hospitalized in cardiology departments reorganized to provide care for COVID-19 patients vs. cardiology departments that remained unaltered.

Methods

Study design

The present retrospective study analyzed hospital records of consecutive patients hospitalized in 24 cardiology departments in Poland from January 1, 2019 to December 31, 2020. Out of all cardiology departments included in the study, those reorganized to provide care for COVID-19 patients were compared with cardiology departments that remained unaltered. Cardiology departments were considered reorganized if an official warrant from the local authorities was issued to allocate separate areas for hospitalization of COVID-19 patients. Reorganized cardiology departments provided additional beds to hospitalize COVID-19 patients in rooms separated from other patients. In unaltered cardiology departments patients with confirmed or suspected SARS-CoV-2 infection were not admitted, as no additional beds to hospitalize COVID-19 patients were created inside of these wards. The focus herein, was on hospital admissions and mortality in patients with AHF (International Statistical Classification of Diseases and Related Health Problems codes for heart failure I50.x). In order to diagnose AHF, criteria determined by the 2016 European Society of Cardiology guidelines for the diagnosis and treatment of acute and chronic heart failure were used [13]. The COV-HF-SIRIO 6 study was conducted in accordance with the Declaration of Helsinki and was approved by the Local Ethics Committee (study approval reference number KB 353/2021).

Statistical analysis

Statistical analysis was performed using the Statistica version 13.0 (TIBCO Software Inc, California, USA). Continuous variables were expressed as means with standard deviations. Due to the non-normal distribution of the investigated data as demonstrated by the Shapiro-Wilk test, non-parametric tests were chosen. Comparisons of continuous variables between the two groups were performed with the Mann-Whitney unpaired rank sum test. Comparisons between year 2019 and 2020 were performed with the Wilcoxon signed test. Categorical variables are presented as numbers and percentages and were compared using the χ^2 test. Results were considered significant at $p < 0.05$.

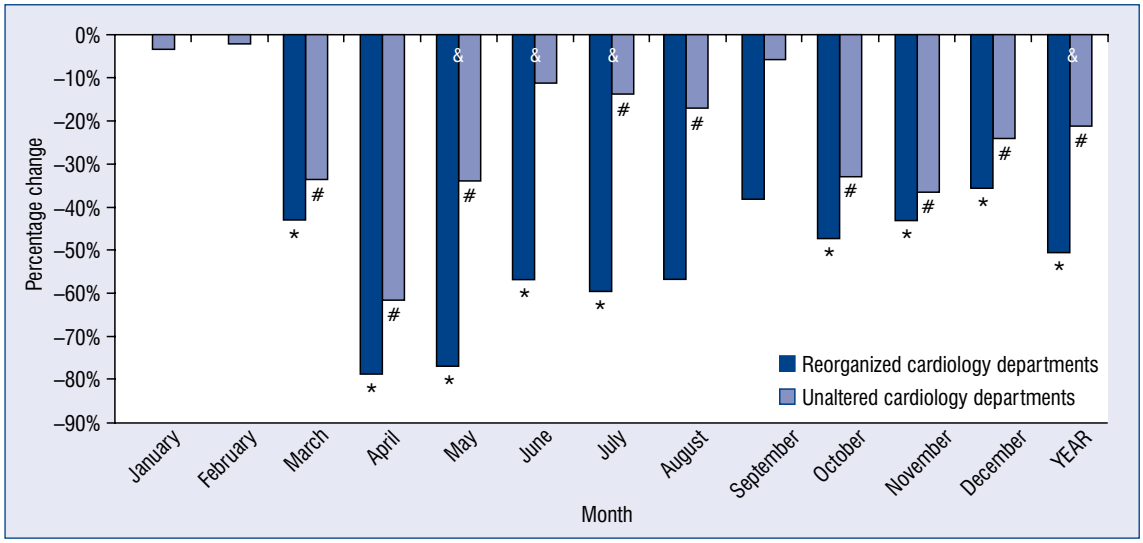

Figure 1. Reduction of all-cause hospitalizations during the COVID-19 pandemic in 2020 vs. 2019; *p < 0.05 for the comparison 2020 vs. 2019 in reorganized cardiology departments; #p < 0.05 for the comparison 2020 vs. 2019 in unaltered cardiology departments; &p < 0.05 for the comparison reorganized vs. unaltered cardiology departments in 2020.

Results

General findings

During the study period, a total of 101,433 patients were hospitalized in 24 cardiology departments in Poland. Initially, after the outbreak of the COVID-19 pandemic in March 2020, 5 out of the 24 cardiology departments included in the analysis were reorganized to provide care for COVID-19 patients, the rest remained unaltered. At the very peak of the pandemic in November 2020, the number of reorganized departments grew to 14 out of the 24 cardiology departments to provide care for COVID-19 patients (**Suppl. Table 1**). Most departments designated beds for COVID-19 patients inside of the existing wards in areas separated from other patients. The number of additional beds for COVID-19 patients closely followed the peaks of the pandemic, beginning with 66 beds in March 2020, reaching up to 264 beds in November 2020 (**Suppl. Table 1**). Four of the investigated cardiology departments were completely transformed to provide care only for COVID-19 patients in November and December 2020 (**Suppl. Table 1**).

Number of hospitalizations

The total number of hospitalizations in reorganized cardiology departments was reduced by 50.6% (from 14,674 hospitalizations in 2019 to 7,254 hospitalizations in 2020; p < 0.0001). In unaltered cardiology departments the total number of hospitalizations was reduced by far less — 21.3% (from 44,501 hospitalizations in 2019 to 35,004 hospitalizations in 2020; p < 0.0001) (Fig. 1). 239 patients were identified with concomitant AHF and COVID-19 — 90.0% of them hospitalized in reorganized cardiology departments (**Suppl. Table 1**). The number of hospital admissions for AHF decreased by 46.5% (from 2,585 in 2019 to 1,383 in 2020; p < 0.0001) in reorganized cardiology departments, and by only 15.2% (from 7,268 in 2019 to 6,163 in 2020; p < 0.0001) in unaltered cardiology departments (Fig. 2).

Mode of hospital referral for AHF

The analysis of the structure of hospital admissions for AHF revealed a significantly higher percentage of patients brought in by ambulance to reorganized vs. unaltered cardiology departments since the beginning of the COVID-19 pandemic (Fig. 3). The difference was most prominent in March 2020 accounting for a 61.7% vs. 32.8% proportion of AHF patients brought in by ambulance to reorganized vs. unaltered cardiology departments, respectively. Simultaneously, the percentage of self-referrals was lower in reorganized vs. unaltered cardiology departments (45.7% vs. 58.4%; p < 0.0001).

Length of hospital stay

The length of hospital stay for AHF was longer in reorganized cardiology departments (9.4 days in 2020 vs. 7.9 days in 2019; p < 0.01), but constant

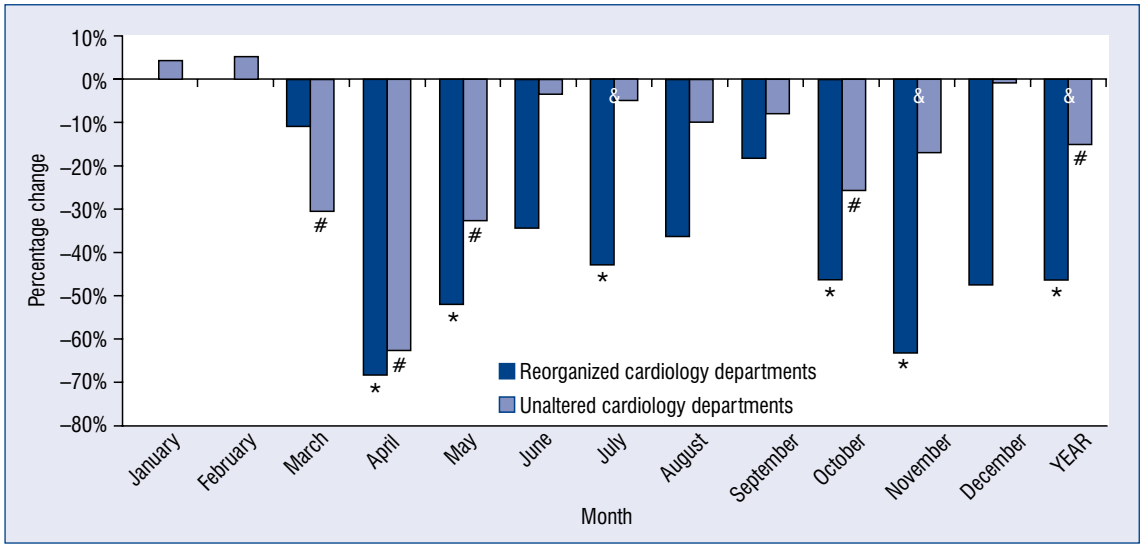

Figure 2. Reduction of acute heart failure hospitalizations during the COVID-19 pandemic in 2020 vs. 2019; *p < 0.05 for the comparison 2020 vs. 2019 in reorganized cardiology departments; #p < 0.05 for the comparison 2020 vs. 2019 in unaltered cardiology departments; &p < 0.05 for the comparison reorganized vs. unaltered cardiology departments in 2020.

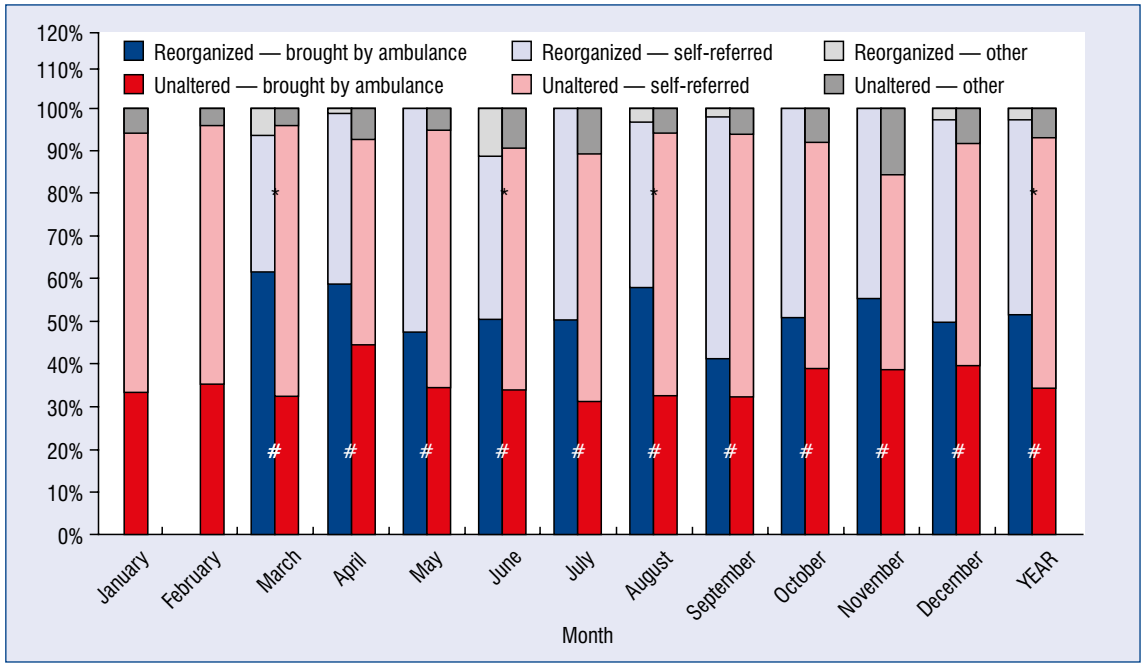

Figure 3. Modes of hospital admissions in reorganized vs. unaltered cardiology departments during the COVID-19 pandemic; *p < 0.05 for the comparison of self-referred patients in reorganized vs. unaltered cardiology departments; #p < 0.05 for the comparison of patients brought in by ambulance in reorganized vs. unaltered cardiology departments.

in unaltered cardiology departments (7.8 days in 2020 vs. 7.6 days in 2019; p = 0.84; p = 0.47 for the comparison of reorganized vs. unaltered cardiology departments in 2020; **Suppl. Table 2**).

In-hospital mortality

During the COVID-19 pandemic in 2020, the rate of all-cause in-hospital mortality in AHF patients was higher in reorganized vs. unaltered car-

diology departments (10.9% vs. 6.4%; $p < 0.0001$; Table 1). The difference was most spectacular in November 2020 with a mortality rate reaching up to 26.9% in reorganized vs. 9.1% in unaltered cardiology departments ($p < 0.0001$). However, when AHF patients with concomitant COVID-19 were excluded, the differences in all-cause in-hospital mortality rates vanished (6.9% vs. 6.4%; $p = 0.55$), except at the very peak of the pandemic in November 2020, when the mortality rate for AHF excluding COVID-19 patients was 19.4% in reorganized vs. 8.6% in unaltered cardiology departments ($p = 0.007$; Table 1).

Discussion

The COVID-19 pandemic overwhelmed healthcare systems worldwide. Organizational challenges of reallocation of available resources together with postponement of all non-urgent medical care have negatively affected treatment of other medical conditions. The present subanalysis was performed with over 100,000 patients included in the COV-HF-SIRIO 6 study to assess the impact of reorganization of cardiology departments in order to provide care for COVID-19 patients on hospital admission and mortality rates in patients with AHF. In Polish reorganized vs. unaltered cardiology departments, the following was found: i) greater reduction in hospital admissions in 2020 vs. 2019; ii) higher percentage of patients brought by ambulance and lower percentage of self-admissions; and iii) higher all-cause in-hospital mortality for AHF due to COVID-19 related deaths.

At the very beginning of the COVID-19 pandemic, reports from many countries showed reduced rates of hospital admissions for AHF [14–20]. Based on linear extrapolation, Moayedi et al. [21] predicted an incoming surge of AHF patients following the first wave of the COVID-19 pandemic in the province of Ontario, Canada. In the COV-HF-SIRIO 6 subanalysis even greater reductions in all-cause and AHF hospital admissions were found in reorganized vs. unaltered cardiology departments in 2020 vs. 2019. Without any increase in the AHF admissions in 2020 vs. 2019.

Regarding modes of hospital admissions, a significantly higher percentage of patients brought in by ambulance and lower percentage of self-referrals to reorganized vs. unaltered cardiology departments was found. This contradicts other reports from the very beginning of the COVID-19 pandemic showing reductions in the number of emergency medical team interventions [22, 23]. The reluctance to seek medical care is one of the potential causes of a 35% increase in the number of cardiovascular community deaths in comparison with the pre-COVID-19 era in a large, retrospective analysis of 587,225 cardiovascular deaths in England and Wales [24]. Interestingly, the authors reported no excess of in-hospital cardiovascular deaths during the COVID-19 pandemic. A similar analysis including 397,042 cardiovascular deaths in the United States revealed an increased number of deaths due to ischemic heart disease (ratio of the relative change in deaths per 100,000 in 2020 vs. 2019: 1.11; 95% confidence interval [CI] 1.04–1.18) or hypertensive disease (1.17; 95% CI 1.09–1.26), but not for heart failure [25].

Multiple studies have documented increases in-hospital mortality for concomitant AHF and COVID-19 [26–30]. However, only scarce data on in-hospital mortality for AHF without concomitant SARS-CoV-2 infection during the COVID-19 pandemic are available. In a single center report from the United Kingdom, a 27% reduction of hospital admissions due to AHF was reported during the first peak of the COVID-19 pandemic as compared with the first months of 2020 [31]. The length of hospital stay was similar in both groups, but the 30-day mortality for AHF was significantly higher during the COVID-19 pandemic vs. before accounting 21% vs. 11%, respectively (risk ratio: 1.9; 95% CI 1.09–3.3). In a previous subanalysis of the COV-HF-SIRIO-6 multicenter study, longer hospitalizations were found (9.6 vs. 6.6 days; $p < 0.001$) and higher in-hospital mortality (10.7% vs. 3.2%; $p < 0.001$) was found for AHF during the COVID-19 pandemic in larger vs. smaller cardiology departments [32]. As reported in a retrospective study including 13,484 patients hospitalized in a German network of 67 hospitals, in-hospital mortality for AHF was higher during the COVID-19 pandemic vs. time-related period in 2019 (7.3% vs. 6.0%; $p = 0.02$) [33]. According to a retrospective analysis from two referral centers in London, the number of hospital admissions due to AHF was reduced by 29.4% from January to June 2019 vs. a time-related period in 2020 (725 vs. 519) [34]. Due to organizational issues, patients with AHF were more frequently treated in general wards than in cardiology departments ($p = 0.04$) during the COVID-19 pandemic. No significant changes regarding the length of hospital stay were found in 2020 vs. 2019 (7 vs. 6 days; $p = 0.22$). The reported post-discharge mortality was higher in 2020 vs. 2019 ($p < 0.01$). In the subanalysis of the COV-HF-SIRIO 6 study, the in-hospital all-cause mortality was higher in reorganized vs. unaltered cardiology

Table 1. All-cause in-hospital mortality in reorganized vs. unaltered cardiology departments in 2020.

Month	Reorganized cardiology departments				Unaltered cardiology departments				P (including COVID-19 patients)	P (excluding COVID-19 patients)
	Mortality rate for AHF including concomitant COVID-19		Mortality rate for AHF excluding concomitant COVID-19		Mortality rate for AHF including concomitant COVID-19		Mortality rate for AHF excluding concomitant COVID-19			
	N	%	N	%	N	%	N	%		
1	–	–	–	–	–	–	45	5.7%	–	–
2	–	–	–	–	–	–	47	6.6%	–	–
3	2	1.6%	2	1.6%	38	8.8%	38	8.9%	0.0052	0.0067
4	9	12.0%	4	6.4%	23	12.0%	22	11.8%	0.9962	0.2233
5	8	8.6%	5	6.0%	20	5.6%	20	5.6%	0.2804	0.8915
6	7	6.5%	6	6.0%	28	5.7%	28	5.7%	0.7452	0.9185
7	3	3.4%	3	3.6%	26	4.6%	25	4.5%	0.7947	0.9475
8	3	3.2%	2	2.3%	21	4.2%	21	4.2%	0.8714	0.5561
9	11	6.1%	9	5.1%	24	5.7%	24	5.7%	0.8669	0.7766
10	25	12.8%	7	5.2%	33	9.9%	32	9.9%	0.2909	0.0949
11	50	26.9%	25	19.4%	15	9.1%	14	8.6%	< 0.0001	0.0071
12	33	14.0%	17	9.1%	10	5.1%	10	5.2%	0.0023	0.1344
Year	151	10.9%	80	6.9%	330	6.4%	326	6.4%	< 0.0001	0.5452

AHF — acute heart failure; COVID-19 — coronavirus disease 2019

departments (10.9% vs. 6.4%; p < 0.0001), but did not differ after exclusion of COVID-19-related deaths (6.9% vs. 6.4%; p = 0.55).

Limitations of the study

Several limitations of this study need to be acknowledged. Firstly, the COV-HF-SIRIO 6 study included a substantial part, but not all, Polish cardiology departments. Secondly, the data were collected retrospectively from hospital electronic databases and the information on the detailed characteristics of the study participants and clinical course of AHF is missing. Finally, readmissions were not analyzed, nor any follow-up of the study participants beyond hospital discharge.

Conclusions

The outbreak of the COVID-19 pandemic became a major challenge for healthcare systems worldwide, including cardiology departments. Our study indicates that the COVID-19 pandemic has led to: greater reduction in hospital admissions in 2020 vs. 2019, higher percentage of patients brought by ambulance together with lower percentage of self-admissions and higher all-cause in-hospital mortality for AHF due to COVID-19 related deaths in Polish cardiology departments recognized to provide care for COVID-19 patients vs. unaltered ones.

Conflict of interest: None declared

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