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The changing spectrum of cardiovascular emergencies during the COVID-19 pandemic

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Abstract

The outbreak of the COVID-19 pandemic in March 2020 influenced treatment strategies and behaviors, particularly cardiovascular emergencies, which may have led to cardiovascular collateral damage. This review article covers aspects of the changing spectrum of cardiac emergencies with a focus on acute coronary syndrome rates and cardiovascular mortality and morbidity based on a selected literature review including the most recent comprehensive meta-analyses.

Keywords
SARS-CoV-2 · Acute coronary syndrome · Cardiovascular emergency · Morbidity · Mortality

The outbreak of the COVID-19 pandemic was reported in December 2019 in Wuhan, China, and recognized as a worldwide pandemic on 11 March 2020. The severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) leads to pneumonia in around 10% of patients, which is severe in approximately 2% and has led to the death of more than 6 million people worldwide. The COVID-19 pandemic also influenced other diseases and in particular cardiovascular emergencies, which may have led to cardiovascular collateral damage. This contribution covers the changing spectrum of cardiac emergencies based on a selected literature review.

COVID-19 pandemic effects on health system and cardiovascular emergencies

The outbreak of the pandemic in Germany and many other countries in spring 2020 led to multiple changes in the health system during the different COVID-19 waves. (1) One aim was to be able to care for the expected increasing number of seriously ill patients with SARS-CoV-2. (2) There were different approaches and appreciation of symptoms and diseases of the emergency personnel in prehospital as well as in-hospital settings, leading to changes in treatment. (3) There were changes in treatment recommendations in particular for acute coronary syndromes (ACS) that differed partly from current European Society of Cardiology (ESC) guidelines. In general, the Society for Cardiac Angiography and Interventions (SCAI) and the American College of Cardiology (ACC) as well as the ESC continued to recommend primary PCI as the standard treatment for patients with ST-elevation myocardial infarction (STEMI) during the current pandemic [1, 2].

However, in regions with a high disease rate of COVID-19—such as in Lombardy in the first wave—all patients were considered to be infective and the procedure therefore had to be performed in dedicated COVID-19 catheterization laboratories. If a timely reperfusion was not possible, some advocated even fibrinolysis in this setting [2]. For non-ST-elevation (NSTE)-ACS, the management of patients should generally be guided by risk stratification [3]. Patients are categorized into three risk groups (i.e., very high risk, high risk,

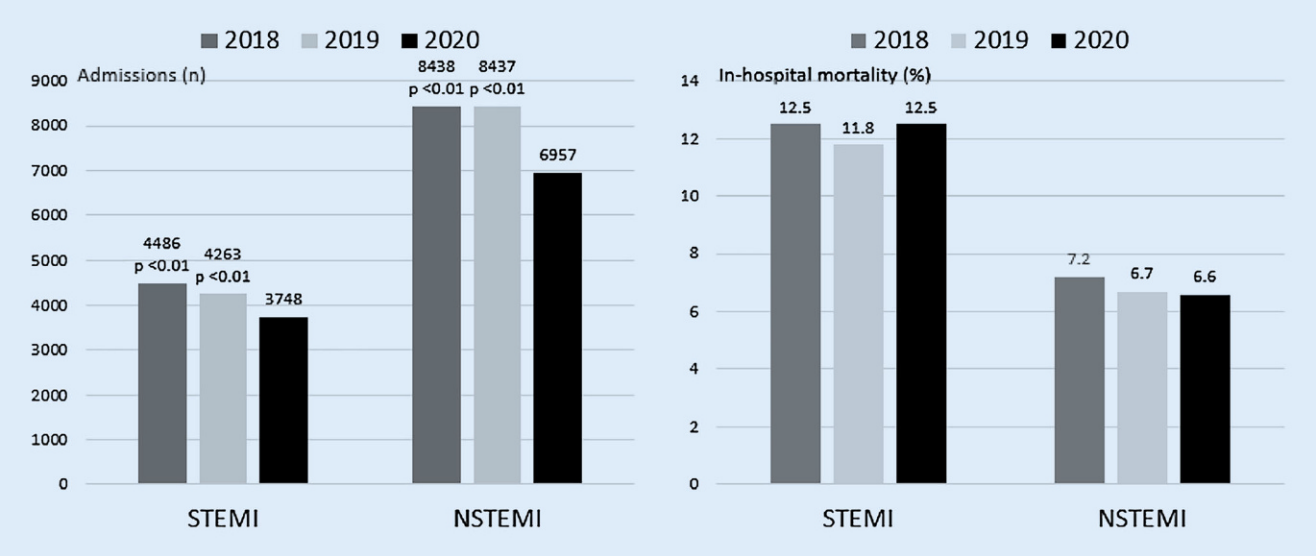

Fig. 1 ▲ Comparison of admissions and in-hospital mortality for ST-elevation myocardial infarction (*STEMI*) and non-STEMI (*NSTEMI*) in 2018, 2019, and 2020 in Germany. Data derived from 159 centers in Germany. (With permission from [20], ©Zeymer et al. http://creativecommons.org/licenses/by/4.0/)

and low risk) and managed accordingly. Based on COVID-19 infection rates in the specific region, either patients only with suggestive symptoms or all patients with NSTE-ACS were recommended to undergo testing for COVID-19 as soon as possible following the first medical contact in order to allow healthcare personnel to implement adequate protective measures and management pathways. In the ESC specific COVID-19 recommendations, even conservative approaches—differing from ESC guideline recommendations—were considered for some high-risk patients [2].

In addition, there were multiple patient-related factors possibly influencing hospital admission. These included: (1) refusal to admit a patient to the hospital or even not calling emergency services because of the fear of COVID-19 infection in the hospital; (2) the misinterpretation of angina pectoris and dyspnea by individual patients; and (3) longer delay by the patient until seeking help.

Impact on cardiovascular emergencies

Cardiovascular emergencies in COVID-19 times can be best divided into ACS, heart failure decompensation, or acute rhythm disturbances. In general, epidemic infectious situations such as influenza and also COVID-19 together with heightened environmental and psychosocial stressors lead to an increase in ACS [4]. Therefore, an increase in the number of patients with ACS during the COVID-19 pandemic was to be expected. By contrast, during the COVID-19 pandemic reduced hospitalization rates for various cardiovascular and also non-cardiovascular diseases were observed in a multitude of registries worldwide [5–12]. Several reports have shown a significant decrease of patients with STEMI admitted to cardiac catheterization laboratories in the range of 40% during the COVID-19 pandemic. In addition, times from symptom onset to reperfusion were much longer in several regions [13–15]. Multiple reports from various registries have also shown remarkable reductions in the number of patients admitted with ACS, not only STEMI [10–12, 14].

From Germany, there are also numerous studies on this topic available, in particular for ACS [16–19]. Because the majority of these observational data were limited by single-center or limited regional multicenter designs and also restrictions to the first waves of the COVID-19 pandemic, our group provided the most comprehensive data analysis. There was a reduction in ACS admissions both for STEMI and non-STEMI (NSTEMI) in the first wave of the pandemic in all states of the Federal Republic of Germany (**Fig. 1**; [20]).

The most comprehensive data on reduction in hospital admissions were derived from a systematic meta-analysis, which also included more data on the second wave of the pandemic [21]. Hospitalization rates for each subtype of ACS declined; STEMI (incidence rate ratio [IRR]: 0.78, 95% confidence interval [CI]; 0.72–0.85), NSTEMI (IRR: 0.66, 95% CI: 0.60–0.72), and unstable angina (IRR: 0.80, 95% CI: 0.66–0.98). Hospitalizations for heart failure also declined (IRR: 0.66, 95% CI: 0.59–0.73), reflecting a decline in admissions with both decompensated chronic and also de novo heart failure. The total number of hospitalizations for arrhythmias also declined (IRR: 0.70, 95% CI: 0.57–0.85). This effect was consistently reported for bradyarrhythmias, atrial fibrillation/flutter, and ventricular arrhythmias (**Fig. 2**).

In summary, the COVID-19 pandemic had a strong influence on cardiovascular emergency admissions for all kinds of cardiovascular emergencies. The magnitude of decline in hospitalizations for cardiovascular diseases did not differ between the first and second wave. However, more data on subsequent waves of the pandemic, which in particular had an influence on care in Germany, are not available to date.

Reasons for the reduction in hospital admissions are most likely that patients did not seek hospital care because of the fear

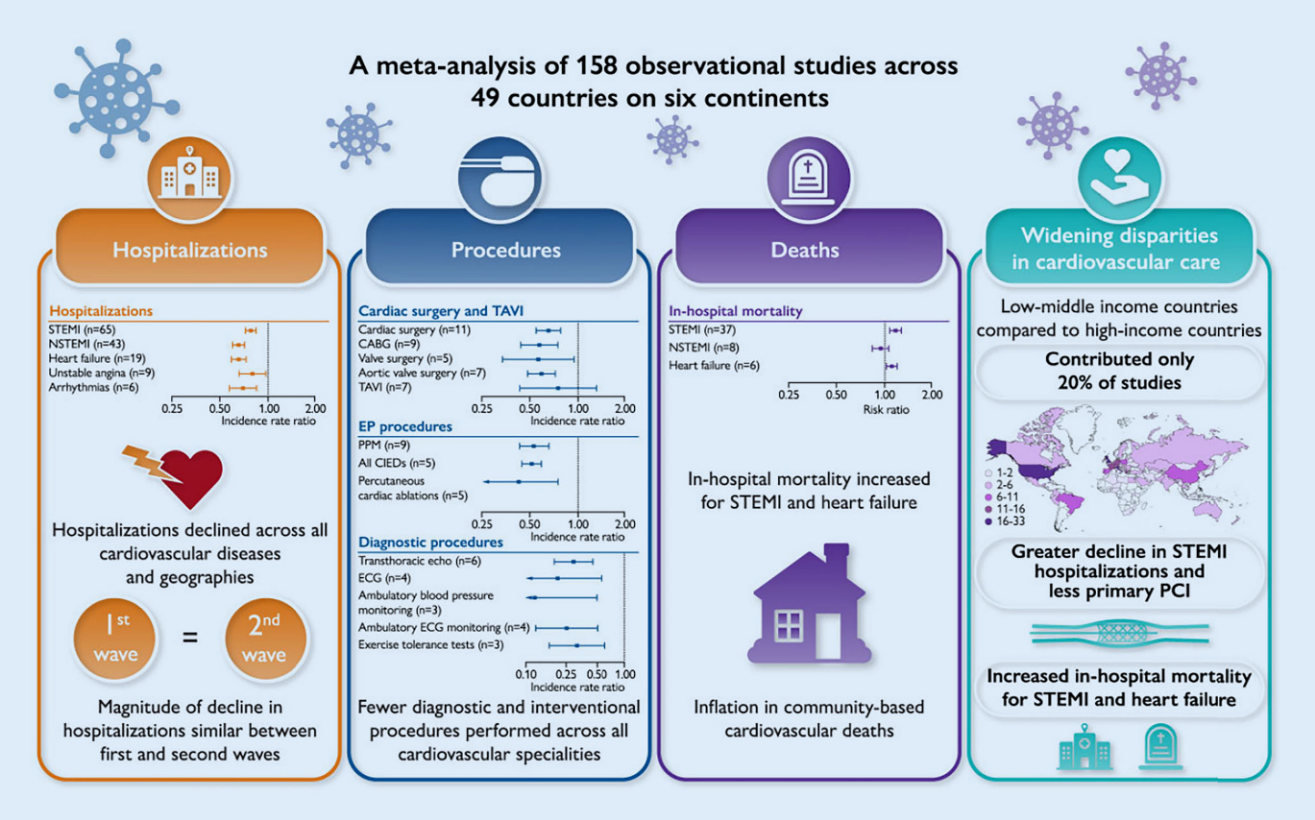

Fig. 2 ▲ Major findings of the collateral damage of the COVID-19 pandemic on cardiovascular services based on a systematic meta-analysis. *CIED* cardiac implantable electronic device, *EP* electrophysiology, *NSTEMI* non-ST-segment elevation myocardial infarction, *PCI* percutaneous coronary intervention, *PPM* permanent pacemaker, *STEMI* ST-segment elevation myocardial infarction, *TAVI* transcatheter aortic valve implantation. (Reproduced by permission of Oxford University Press from Nadarajah et al. [21])

of COVID-19 infections or so as to avoid burdening an already overwhelmed health service. However, alternative explanations for the reduced number of ACS admissions also included less stress because of the increase in home-office work and reduced social contacts as well as due to less air pollution because of decreased car and air traffic [22].

Impact on ACS mortality

COVID-19 may have increased cardiovascular mortality both through direct and indirect impacts on the incidence and management of acute cardiovascular disease, which is considered collateral damage [20, 21]. These aforementioned behaviors of healthcare providers and patients may have led to increased morbidity and mortality, especially in patients with STEMI, in whom a longer time delay has a significant negative impact on myocardial salvage and maintenance of left ventricular function. Interestingly, larger infarct sizes could be observed during the phases of the COVID-19 pandemic most likely due to longer delays in reperfusion, as shown by an Austrian group [23].

The absolute impact of the COVID-19 pandemic on mortality of patients with ACS must be divided into two populations, the first one dying at home or before hospital admission and the second one admitted to the hospital and dying after admission. In multiple studies, only reports for the second group, i.e., hospital mortality, were available and many did not find an increase in in-hospital mortality compared with the years before the COVID-19 pandemic [24]. However, the data are heterogeneous. In the Spanish ISACS-STEMI COVID-19 registry, where a total of 6609 STEMI patients were analyzed and compared with patient data from 2019, there was a significant reduction in the number of primary percutaneous coronary intervention (PCI) procedures during the pandemic (in 2020) compared to 2019 [31]. In addition, a higher mortality rate was observed [31]. There are similar reports from other countries such as Italy and the United Kingdom [32, 33]. The reasons for the reported higher mortality rates might be different according to region, healthcare systems, and in some reports due to chance because of the small sample size. In addition, based on the overall COVID-19 infection rate, some regions allocated all resources to the care of COVID-19 patients, leading to a lower use of primary PCI and thus higher mortality.

These observations on mortality could not be confirmed by a comprehensive analysis of all states of the Federal Republic of Germany with a representative sample size from German hospitals [20]. In these hospitals, revascularization procedures and in-hospital mortality did not differ between 2018, 2019, and 2020, regarding both NSTEMI and STEMI patients (◘ **Fig. 1**). This might be due to the fact

that German hospitals were still able to adequately care for ACS patients in 2020 and did not reach their capacity limit during the care of COVID-19 patients. This is in line with a systematic meta-analysis—limited to the first wave—which confirmed the reduction in STEMI admission but no effect on in-hospital mortality [25].

However, it may well be that the overall mortality of ACS patients increased due to a higher number of patients dying at home. This hypothesis is supported by the findings from northern Italy where there was an increase in the number of out-of-hospital cardiac arrests during the first wave, which has also been observed in other regions such as in the United States or the United Kingdom [26–29]. Therefore, it is rather likely that ACS patients stayed at home too long and did not seek medical care because of an unproven fear of becoming infected in the hospitals. These findings are in line with an analysis from central Germany in which an 8.5% increase in cardiovascular mortality was reported during the first wave, due to an increase of in-hospital and out-of-hospital mortality [30].

The increased total mortality in Germany—with the highest mortality rate of 1,023,723 cases in 2021 since 1946—for the years 2020 and 2021 supports the likelihood of an increase in out-of-hospital mortality of ACS patients and the collateral damage. Other factors such as a delay in treatment for cardiovascular disease (e.g., heart failure and aortic stenosis) or a delay in treatment for cancer may have contributed to the excess in mortality in these years.

Impact on other cardiovascular mortality

The effect of the COVID-19 pandemic on care and outcomes across non-COVID-19 cardiovascular diseases was evaluated in the aforementioned systematic review and meta-analysis, which was performed to quantify the effect and investigate the variation by cardiovascular disease, geographic region, country income classification, and the time course of the pandemic (first and second wave predominantly as the search was restricted to January 2019 to December 2021). A total of 158 studies were included in this meta-analysis, covering 49 countries from six continents. Interestingly, most studies (80%) reported information for high-income countries but data were also available from low- to middle-income countries. Across all cardiovascular disease and geographies there were fewer hospitalizations, diagnostic and interventional procedures, and outpatient consultations during the pandemic. In low- to middle-income countries, in-hospital mortality increased for STEMI (RR: 1.22, 95% CI: 1.10–1.37) and heart failure (RR: 1.08, 95% CI: 1.04–1.12; **Fig. 2**; [21]).

Conclusion

Cardiovascular emergency treatment in COVID-19 pandemic times was challenging. For subsequent pandemics or possible additional waves of the COVID-19 pandemic, we should make sure to treat patients as well as possible in order to avoid any relevant collateral damage. Irrespective of this, there was substantial global collateral cardiovascular damage during the COVID-19 pandemic with disparity in severity according to national income classifications.

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Declarations

Conflict of interest. H. Thiele declares that he has no competing interests. U. Zeymer declares grants and personal fees from Astra Zeneca, grants and personal fees from Bayer, grants and personal fees from BMS, grants and personal fees from Daiichi Sankyo, personal fees from Boehringer Ingelheim, personal fees from Medicines Company, personal fees from Sanofi, personal fees from Ferrer, grants and personal fees from Novartis, outside the submitted work.

For this article no studies with human participants or animals were performed by any of the authors. All studies mentioned were in accordance with the ethical standards indicated in each case.

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Zusammenfassung

Das veränderte Spektrum kardiovaskulärer Notfälle während der COVID-19-Pandemie

Der Ausbruch der COVID-19-Pandemie im März 2020 beeinflusste Behandlungsstrategien und Verhaltensweisen, insbesondere kardiovaskuläre Notfälle, die zu einem kardiovaskulären Kollateralschaden geführt haben könnten. Der vorliegenden Übersichtsartikel behandelt Aspekte des sich verändernden Spektrums kardialer Notfälle mit Schwerpunkt auf der Rate des akuten Koronarsyndroms und der kardiovaskulären Mortalität und Morbidität, basierend auf einer ausgewählten Literaturrecherche einschließlich der neuesten umfassenden Metaanalysen.

Schlüsselwörter
SARS-CoV-2 · Akutes Koronarsyndrom · Kardiovaskulärer Notfall · Morbidität · Mortalität

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