

This is the peer reviewed version of the following article:

Roffi, M., Guagliumi, G., & Ibanez, B. (2020). The Obstacle Course of Reperfusion for ST-Segment-Elevation Myocardial Infarction in the COVID-19 Pandemic. *Circulation*, *141*(24), 1951-1953.  
doi:10.1161/CIRCULATIONAHA.120.047523

which has been published in final form at:

<https://doi.org/10.1161/CIRCULATIONAHA.120.047523>

# **The Obstacle Course of Reperfusion for STEMI in the COVID-19 Pandemics**

Marco Roffi<sup>1</sup>, MD Giulio Guagliumi<sup>2</sup>, MD Borja Ibanez<sup>3,4,5</sup>, MD PhD

<sup>1</sup>Cardiology Division, University Hospitals, Geneva, Switzerland

<sup>2</sup>Interventional Cardiology, Cardiovascular Department, Papa Giovanni Hospital, Bergamo, Italy.

<sup>3</sup>Centro Nacional de Investigaciones Cardiovasculares Carlos III (CNIC), Madrid, Spain

<sup>4</sup>Department of Cardiology, IIS-Fundación Jiménez Díaz Hospital, Madrid, Spain

<sup>5</sup>CIBERCV, Madrid, Spain.

MR, GG and BI declare no conflicts of interest and have approved the final version of the manuscript.

Word count 1121

## Address for correspondence

Marco Roffi, MD

Director, Interventional Cardiology Unit

Chairman European Society of Cardiology Congress 2019 and 2020

Geneva University Hospital

Rue Gabrielle Perret-Gentil 4

1211 Geneva 14 - Switzerland

Phone (direct): +41 79 55 33391

Office /secretary: +41 22 37 23 743

Fax: +41 22 37 27 229

Email: [marco.roffi@hcuge.ch](mailto:marco.roffi@hcuge.ch)

COVID-19 infection, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), poses a double threat to public health; the immediate one is the morbidity and mortality related to the infection; the more subtle one is the shift of attention and resources away from the care of “regular” diseases.

**Patient- and healthcare network-related factors:** Multiple investigators across Europe have reported a reduction in patients admitted for ST-elevation myocardial infarction (STEMI) since the COVID pandemic began.<sup>1</sup> This may be the result of a decreased awareness/shift of attention of patients, the desire not to overload the emergency medical systems (EMS), as well as the fear of infection and/or not receiving proper treatment. For similar reasons, clinicians and nurses visiting patients at home or nursing homes may have higher threshold to refer patients with chest pain to the emergency departments (ED) (Figure). EMS alert may be challenging because of jammed phone lines and limited number of ambulances. Trained ambulance personnel may not be available to make STEMI diagnosis on site. In addition, shared experiences estimate an up to 60 minutes increase in intrinsic delay from diagnosis to reperfusion with primary PCI in regions deeply affected by the COVID-19 pandemics, due to suboptimal EMS availability and implementation of personal protective equipment (PPE) at any level of care (pre-hospital, ED, and cardiac catheterization laboratory [cathlab]). Moreover, uncertainty regarding diagnosis, given reports of myopericarditis presenting as a STEMI mimic, may add to delays. Spoke centers may have been converted to COVID hospitals, be more restrictive in transferring STEMI patients for primary PCI, and adopt fibrinolytic treatment without subsequent systematic referral for angiography. Importantly, safety and efficacy of fibrinolysis in COVID-19 patients presenting with ST-elevation who may have associated myopericarditis or coagulopathy — ranging from isolated D-dimer level elevation observed in up to 40% of patients to disseminated intravascular coagulation, remain unknown.<sup>2</sup>

**Impact on primary PCI:** In patients with STEMI and multivessel coronary artery disease guidelines recommend complete revascularization, which in many institutions is performed as a staged procedure. In the COVID-19 pandemics, two considerations based on the disease complexity may change this strategy. If the culprit lesion has been treated successfully with no complications, the additional coronary lesions are easily accessible and the patient is hemodynamically stable, immediate complete revascularization may be an attractive guideline-conforming option to avoid a staged procedure, which would prolong hospital stay

or require a second admission as well as additional personnel exposure if the patient is COVID-19 positive.<sup>3</sup> If revascularization of the culprit lesion has been challenging or associated with a complication (e.g., no reflow), the patient is unstable or non-culprit disease would require complex PCI, the operator may opt for medical management of non-culprit disease to avoid the risk of hemodynamic deterioration and/or need for (prolonged) intensive care unit surveillance.

**The Bergamo's experience** At the end of February 2020, the city of Bergamo, Italy, became the place where COVID-19 hit Europe first and in the most hard way. The EMS, one of the most efficient local and regional network for time-dependent disease transportation in Italy, was flooded by calls of patients in severe respiratory distress. During a 40-day period starting February 23, 2020, the ED of the Papa Giovanni Hospital (where one of the authors, GG practices) admitted 1407 patients with interstitial pneumonia, over 400 and 150 of them requiring non-invasive ventilation and endotracheal intubation, respectively. A survey from administrative data, provided by 138 municipalities representing 70% of the total population in the province of Bergamo, showed that in March 2020 more than 5400 people died, six times more than in the corresponding month of the previous year.<sup>4</sup> Among them, 2060 were COVID-19 in-hospital deaths, while the remaining occurred at home or nursing homes without diagnosis. Therefore, they were not integrated in the COVID-19 statistics.

The regional STEMI network was quickly changed into a model of macro-hubs to concentrate personnel and urgent activities, such as primary PCI for STEMI or interventional stroke management, while expanding health resources for COVID-19 patients in all remaining hospitals. Protocols were implemented to allow and regulate separate patient admission of STEMI patients, from triage through the cathlab, to reduce cross-infections and to train the personnel to the new PPE standards. Despite an increase in delays, primary PCI was offered to the vast majority of STEMI patients. Decision was made not to perform primary PCI, and instead administer fibrinolytic treatment, in COVID-19 patients presenting with severe respiratory distress syndrome but not qualifying for endotracheal intubation based on age or comorbidities. All primary PCI patients in severe respiratory distress were intubated prior to arrival to the cathlab to minimize contamination. During the month of March 2020, a marked reduction in primary PCI for STEMI (-37%) and an increase in late presentations (+25%) were observed in the province, as compared with the monthly average of the previous year. Extensive infarctions, heart failure, high coronary thrombus burden and no reflow were more frequent.

**The Madrid's experience** Spain is among the countries that have been hit hard by the COVID-19 pandemic, with >166,000 infected people and >17,000 deaths (~350 per million inhabitants) as of April 12, 2020. Madrid (where one of the authors, BI practices) is the region of Spain with the highest prevalence of the disease, with > 47,000 confirmed cases and approximately 6,300 deaths (~870 deaths per million inhabitants) at the same date. According to the Spanish Ministry of Health, the first COVID-19 patient was admitted to intensive care in Madrid on March 8, while the peak of COVID-19 intensive care patients was achieved on April 5 with 1510 patients). The pandemic has disrupted the “Codigo Infarto Madrid”, a successful STEMI network treating approximately 2,500 STEMI patients a year, >98% of them by primary PCI, in 11 cathlabs 24/7. The main challenge in the Madrid area, as well as in other affected areas of Spain, has been the saturation of the EMS. A survey conducted in Madrid has shown that the number of primary PCIs has been reduced by half from the inception of the COVID-19 pandemics as compared with the previous weeks. This has been accompanied by a slight increase in the use of fibrinolysis, mainly in patients presenting at non-PCI centers.<sup>5</sup> Following a massive reduction in patients seeking EMS for chest pain, the cardiology community in the region is performing a public awareness campaign in newspapers and social media. The primary PCI program is still working and remains the preferred reperfusion strategy in the region, provided it can be done timely. All patients are handled as potential COVID-19 positive.

## **Conclusion**

The COVID-19 pandemic represents an unprecedented challenge for healthcare systems and negatively affects time-dependent care of acute cardiovascular conditions such as STEMI. The examples of two hardly hit European cities, Bergamo, Italy, and Madrid, Spain, are described.

## **Figure legend**

Obstacles affecting timely reperfusion in ST-elevation myocardial infarction (STEMI) at the patient, emergency services (EMS) and institutional levels during the COVID-19 pandemic. While patient and primary care workers may be reluctant to call EMS, it is estimated that the

overload of the healthcare systems, the increase in transportation time, and the need for personal protection equipment (PPE) may increase the time to reperfusion up to 60 minutes. Late presentations are more common and decrease the efficacy of both primary percutaneous coronary intervention (PCI) and fibrinolytic therapy. An increase in complications of myocardial infarction such as pump failure, ventricular arrhythmias, and mechanical complications is expected. ICU = intensive care unit..

## References

<sup>1</sup><https://www.tctmd.com/news/mystery-missing-stemis-during-covid-19-pandemic>

<sup>2</sup>Lippi G, Plebani M. Laboratory abnormalities in patients with COVID-2019 infection. *Clin Chem Lab Med.* 2020; doi: 10.1515/cclm-2020-0198.

<sup>3</sup>Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, Caforio ALP, Crea F, Goudevenos JA, Halvorsen S, Hindricks G, Kastrati A, Lenzen MJ, Prescott E, Roffi M, Valgimigli M, Varenhorst C, Vranckx P, Widimský P; ESC Scientific Document Group. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. *Eur Heart J.* 2018;39:119-77.

<sup>4</sup>Newspaper Eco di Bergamo, April 1, 2020. [https://www.ecodibergamo.it/stories/bergamo-citta/coronavirus-the-real-death-toll-4500-victims-in-one-month-in-the-province-of\\_1347414\\_11/](https://www.ecodibergamo.it/stories/bergamo-citta/coronavirus-the-real-death-toll-4500-victims-in-one-month-in-the-province-of_1347414_11/)

<sup>5</sup>Rodríguez-Leora O, Cid-Álvarez B, Ojeda S, Martín-Moreiras J, Rumoroso JR, López-Palop R, Serrador A, Cequier A, Romaguera R, Cruz I, Pérez de Prado A, Moreno R. [Impact of the COVID-19 pandemic on interventional cardiology activity in Spain]. *REC Interv Cardiol.* 2020 (In Press). DOI : 10.24875/RECIC.M20000120

