Impact of COVID-19 on ST-segment elevation myocardial infarction care. The Spanish experience

Impacto de la COVID-19 en el tratamiento del infarto agudo de miocardio con elevación del segmento ST. La experiencia Española

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ABSTRACT

Introduction and objectives: The impact of the COVID-19 outbreak on the treatment and outcomes of patients with ST-segment elevation myocardial infarction (STEMI) is unclear. The aim of this study was to assess changes in STEMI management during COVID-19 outbreak.

Methods: Using a multi-center, nationwide, retrospective, observational, registry of consecutive patients who were managed within 75 specific STEMI-care centers in Spain, we compared patient and procedure characteristics and in-hospital outcomes in 2 different cohorts with 30-day follow-up, according to whether they had been treated before or after COVID-19.

Results: Cases of STEMI attended in STEMI-networks decreased by 27.6% and patients with confirmed STEMI reduced from 1305 to 1009 (22.7%). There were no differences in reperfusion strategy (> 94% treated with primary percutaneous coronary intervention in both cohorts). Patients treated with primary percutaneous coronary intervention during COVID-19 had longer ischemic time (233[150-375] vs 200[140-332] minutes, $P < .001$) with no differences in time between first medical contact and reperfusion. In-hospital mortality was higher during COVID-19 (7.5% vs 5.1%, unadjusted Odds Ratio (95% confidence interval): 1.50 (1.07-2.11), $P < .001$); this association remained consistent after adjusting for confounding (risk-adjusted Odds Ratio (95%CI) = 1.88 (1.12-3.14); $P = .017$). In 2020, there was a 6.3% incidence of confirmed SARS-CoV-2 infection during hospitalization.

Conclusions: There was a decrease in the number of STEMI patients treated during the current COVID-19 outbreak, alongside an increase in median time between symptoms onset to reperfusion and with a significant 2-fold increase of in-hospital mortality. No changes in reperfusion strategy have been detected with primary percutaneous coronary intervention for the vast majority of cases. Combination of STEMI and SARS-CoV-2 infection was relatively infrequent.

Keywords: STEMI. COVID-19. Primary angioplasty. STEMI-network.

RESUMEN

Introducción y objetivos: El impacto del brote de COVID-19 sobre el tratamiento del infarto agudo de miocardio con elevación del segmento ST (IAMCEST) no está claro. El objetivo de este estudio fue evaluar los cambios en el tratamiento de IAMCEST durante el brote de COVID-19.

Métodos: Se utilizó un registro multicéntrico, nacional, retrospectivo, observacional, de pacientes consecutivos atendidos en 75 centros, se compararon las características de los pacientes y los procedimientos y los resultados hospitalarios en 2 cohortes según fueron tratados antes o durante la COVID-19.

Resultados: Los casos con sospecha de IAMCEST disminuyeron un 27,6% y los pacientes con IAMCEST confirmado se redujeron de 1.305 a 1.009 (22,7%). No hubo diferencias en la estrategia de reperfusión (> 94% tratados con angioplastia primaria). El tiempo de isquemia fue más largo durante la COVID-19 (233 [150-375] frente a 200 [140-332] minutos, p < 0,001) sin diferencias en el tiempo de primer contacto médico-reperfusión. La mortalidad hospitalaria fue mayor durante la COVID-19 (7,5% frente a 5,1%, OR no ajustado (IC95%): 1,50 (1,07-2,11), p < 0,001); esta asociación se mantuvo tras ajustar por factores de confusión (OR ajustado (IC95%) = 1,88 (1,12-3,14); p = 0,017). La incidencia de infección confirmada por SARS-CoV-2 fue 6,3%.

Conclusiones: El brote de COVID-19 ha comportado una disminución en el número de pacientes con IAMCEST, un aumento del tiempo entre el inicio de los síntomas y la reperfusión y un aumento en la mortalidad hospitalaria. No se han detectado cambios en la estrategia de reperfusión. La combinación de infección por SARS-CoV-2 e IAMCEST fue relativamente infrecuente.

Palabras clave: IAMCEST. COVID-19. Angioplastia primaria. Red de atención al infarto.

Abbreviations

COVID-19: coronavirus disease 2019

PCI: percutaneous coronary intervention

PCR: polymerase chain reaction

PPCI: primary percutaneous coronary intervention

STEMI: ST-segment elevation acute myocardial infarction

Abreviaturas

COVID-19: enfermedad por coronavirus 2019

IAMCEST: infarto agudo de miocardio con elevación del segmento ST

ICP: intervencionismo coronario percutáneo

ICPP: intervencionismo coronario percutáneo primario

PCR: reacción en cadena de la polimerasa

INTRODUCTION

On 31 December 2019, a cluster of pneumonia cases of unknown etiology was reported in Wuhan, Hubei Province, China. On 9 January 2020, a new coronavirus, SARS-CoV-2, was identified as the causative agent of this outbreak and its associated disease was named coronavirus disease 2019 (COVID-19). The infection spread rapidly, and the World Health Organization, on March 11, characterized COVID-19 as a pandemic.[1] On May 1, 2020, more than 1.6 million cases had been diagnosed in 179 countries in five continents with nearly 100 000 confirmed deaths.[1] The Spanish Government activated a State of Alarm on March 14, by which citizens were therefore to restrict all movement with the exception of those going to work, hospitals or health centers, financial institutions, and those shopping for groceries, pharmaceuticals, and basic necessities.[2]

The influence of this new disease on society behavior as well as on healthcare systems performance is unprecedented in recent history. During the current COVID-19 outbreak, some preliminary reports have drawn attention to a decrease in the number of ST-segment elevation myocardial infarction (STEMI) patients attending hospitals in Europe and North America,[3-5] but we have limited information on how it has affected STEMI networks in terms of delays to reperfusion, revascularization strategy and clinical outcomes.[6,7]

The objective of this study was to compare clinical characteristics, management and hospital outcomes of STEMI patients attended during the COVID-19 outbreak period with those of a period prior to COVID-19 in a nationwide cohort, during the first 30 days that followed the country lock-down during the current COVID-19 outbreak.

METHODS

Spanish STEMI Registry

There are 17 regional public service STEMI care networks which comprise 83 hospitals capable of performing primary percutaneous coronary interventions (PPCI) in 24/7/365 programs. In

2018, 21 261 interventions in STEMI (91.6% PPCI, 3.2% rescue percutaneous coronary interventions and 5.1% routine early percutaneous coronary interventions strategy after fibrinolysis) were performed, representing 417 PPCI per million inhabitants.[8]

In 2019, the Interventional Cardiology Association of the Spanish Society of Cardiology, sponsored a prospective registry of consecutive STEMI patients who were treated within these specific STEMI care networks, the Spanish Infarct Code Registry, with the aim of detecting between-regional differences in the treatment of STEMI. Information was collected in terms of number of cases, clinical characteristics, clinical management and outcomes of STEMI patients. This registry enrolled 5240 consecutive patients treated between April and June 2019.

During the current COVID-19 outbreak, the Spanish Interventional Cardiology Association called for a twin registry, with the participation of the same 2019 centers by collecting retrospectively information of all consecutive STEMI patients. Since March 16, just after the activation of the State of Alarm and the country lock-down, information on number of cases, clinical characteristics, clinical management and outcomes were retrospectively recorded.

The research protocol was approved by the Working Group on STEMI Code of the Spanish Interventional Cardiology Association and by one central ethics committee from León and Bierzo Health Areas.

Study design

Multi-center, retrospective, observational cohort study which evaluates procedures recorded in the Spanish Infarct Code Registry database to assess whether current COVID-19 outbreak has a relevant impact on STEMI treatment in terms of number of cases, clinical characteristics, delays to reperfusion, in-hospital management and in-hospital clinical outcomes. Two different cohorts of patients were set according to whether they had been treated between April 1 and April 30, 2019 (prior to COVID-19 outbreak cohort), or between March 16 and April 14, 2020 (during COVID-19 outbreak cohort). We included in the analysis data from 75 hospitals that enrolled patients in both periods. Delay times were defined according to the European Guidelines.[9] Patients with final diagnosis different from STEMI were not included in the final analysis. Data was collected reviewing clinical records. Main outcome measure was in-hospital mortality.

Statistical analysis

Continuous variables are summarized by mean ± standard deviation, whereas categorical variables are presented by frequencies and percentages. Baseline comparisons by cohorts were performed using t tests, or chi-square tests, as appropriate. Highly skewed distributed variables (i.e. times involving first medical contact, symptom onset, catheterization laboratory arrival and reperfusion) were presented by median and inter-quartile range, and compared using the non-parametric Mann-Whitney U test. Univariate logistic regression models were produced to evaluate the association between in-hospital mortality and the cohort group. Multivariate logistic regression modelling was performed to remove potential confounding and assess the consistency of our findings. The covariates included in multivariate models (symptoms onset to reperfusion time, age, sex, Killip class and positive polymerase chain reaction [PCR] test for COVID-19) were selected based on medical knowledge and the findings of the univariate analysis. Adjusted odds ratios (OR) and their 95% confidence intervals (95%CI) were therefore used to estimate for the association between cohort and outcomes.

The robustness of our findings was tested through two sensitivity analyses by *a)* removing COVID-19 subjects from the main analyses to account for their potential contribution on the increase of outcomes; and *b)* using a mixed regression model including hospital as a random variable, in which some heterogeneity is allowed to take into account the expected variation between hospitals (between-hospital variation), weighting each hospital accordingly to obtain an overall estimate. Two-tailed *P-values* $< .05$ were considered statistically significant. All analyses were performed using STATA software version 15.1 (Stata Corp, College Station, United States).

RESULTS

Patients

STEMI-networks from 75 hospitals attended a total of 1113 patients during the COVID-19 outbreak, while in the same period the previous year there were 1538 subjects, representing a drop of 27.6%. Figure 1 shows the flowchart of patients treated in the STEMI networks in the two periods of time evaluated. Patients with confirmed STEMI diagnosis were, respectively, 1009 and 1305 (shrink of 22.7%). The trend was consistent between centers (65 of 75, an 87%, presented less STEMI cases). There were also significant differences in the number of patients who required STEMI-network assistance but ended up with a non-ST-elevation acute myocardial infarction diagnosis: 232 (15.1%) subjects in 2019, whereas 104 (9.3%) in 2020 ($P < .001$).

Figure 2 shows the absolute number of PPCI per day during both periods of time and official number of confirmed cases according to Spanish Government data.[7]

During COVID-19 outbreak, only 33 patients (3.3%) had confirmed COVID-19 diagnosis at admission; during admission, COVID-19 was diagnosed in 30 additional patients (3%), resulting in 63 patients (6.3%) diagnosed with COVID-19. Figure 3 show COVID-19 status diagnosis path in the 2020 cohort.

Table 1 shows patients' clinical baseline characteristics. With the exception of previous coronary artery disease (more frequent during COVID-19 cohort), clinical characteristics were not different between groups. The mode of presentation significantly differed between groups (during COVID-19 patients showed more frequently via extra-hospital Emergence Medical Service) and, once at PPCI hospital, were more frequently admitted direct to catheterization laboratory.

Angiographic and procedural characteristics

Table 2 shows the angiographic characteristics and the treatment performed. Radial access was more frequent during COVID-19, and although there were no differences in initial and final TIMI flow, an increase in mechanical thrombectomy and IIbIIIa inhibitors administration was observed. There was no difference in the reperfusion strategy after coronary angiography, with up to 94% of patients treated with PPCI in both cohorts and with less than 2% of patients in whom no percutaneous coronary intervention was performed.

Time intervals between symptoms onset and reperfusion

During the COVID-19 outbreak, both time from symptoms onset to first medical (105 [45-222] vs 71 [30-180] minutes, $P < .001$), and from symptoms onset to reperfusion (233 [150-375] vs 200 [140-332] minutes, $P < .001$) were longer. On the contrary, no differences were observed in the time from first medical contact to reperfusion (110 [80-155] minutes vs 110 [81-151] minutes, $P = .54$). Table 3 and Figure 4 shows five time intervals between symptoms onset and reperfusion.

In-hospital outcomes

Table 4 shows differences in in-hospital outcomes between both cohorts. All-cause mortality during COVID-19 was 7.5%, compared to 5.1% in prior to COVID-19 group (unadjusted OR (95%CI): 1.50 (1.07-2.11), $P < .001$). This association remained consistent after adjustment for age, sex, Killip class, and time from symptom onset to reperfusion: OR (95%CI) = 1.88 (1.12-3.14); $P = .017$, but it was attenuated after additional adjustment for confirmed COVID-19 diagnosis: OR (95%CI) = 1.56 (0.91-2.67), $P = .108$.

Sensitivity analyses

The robustness of our findings was tested through two sensitivity analyses. By excluding COVID-19 subjects from the main analyses, we removed their potential contribution on the increase of outcomes and confirmed that the excess in mortality was partly explained by COVID-19 itself: unadjusted OR (95%CI) for patients in 2020 was 1.28 (0.77-1.83), *P* = .173, which remained non-significant after adjusting for confounding: OR (95% CI) 1.56 (0.90-2.68), *P* = .11. By using a random effect models, we allowed for some random heterogeneity across hospitals and obtained similar statistical significance (*P* = .044) for the association between in-hospital mortality and patients recruited during the COVID-19 outbreak compared with those recruited one year before: subjects with STEMI during the COVID-19 were at high risk for in-hospital mortality after adjusting for confounding (*P* = .033), but this significant association vanished when COVID-19 status was introduced into the model (*P* = .203), suggesting that COVID-19 was the driving force of part of the increase of in-hospital mortality observed between cohorts.

DISCUSSION

In our study we evaluated the influence of the COVID-19 outbreak in the management of patients with STEMI attended in specific-care networks nationwide in Spain, one of the countries most affected during the current outbreak. We compared data from a national registry establishing 2 different 30-day cohorts of patients: prior to COVID-19 outbreak (April 1 to 30, 2019) and during COVID-19 (March 16 to April 14, 2020).

Decrease in the number of STEMI patients and longer delays to reperfusion

A previous report from our group revealed a 40% decrease in patients treated for STEMI during the first week of the current outbreak.[3] In the same direction, an American study revealed an estimated 38% reduction in catheterization laboratories STEMI activations in 9 high-volume centers during the early phase of the COVID-19 pandemic.[4] Our results confirm a consistent decrease in the number of patients with STEMI treated (in up to 87% of centers), albeit of lesser magnitude (22.7%) than initially believed.[3] In addition, patients attended in STEMI-networks who ended-up with diagnosis different from STEMI also decreased significantly, reinforcing the idea that patients avoid attending hospitals. Furthermore, patients had with longer delays to reperfusion, basically due to consulting the health system later, since we found no differences in time between medical contact and reperfusion. Ischemic time duration is a major determinant of infarct size in patients with STEMI, and prompt recognition and early management of acute STEMI is critical in reducing morbidity and mortality.[10-12] Interestingly, patients during COVID-19 had higher prevalence of previous coronary artery disease and more multivessel disease, suggesting that, probably, patients with a history of ischemic heart disease may have less reluctance to go to hospitals. Despite logistical difficulties caused by COVID-19 outbreak, we have not detected an increase in time between first medical contact and reperfusion which indicates a good adaptation of STEMI networks to the current crisis. On the contrary, there was a longer time between catheterization laboratory arrival and reperfusion, probably due to time spent on protective measures under which procedures were carried out.[13]

Potential etiologies for this behavior should be a combination of avoidance of medical care due to social distancing or concerns of contracting COVID-19 in the hospitals. The ongoing outbreak has received massive news coverage with particular emphasis to the description of the most common forms of contagion and places where SARS-CoV-2 spreads more easily. Fear is a well-known determinant of medical care avoidance[14] and hospital avoidance behaviors during pandemics have been previously reported.[15]

Reperfusion strategies and angiographic findings in STEMI during COVID-19 outbreak

Different scientific societies have developed recommendations on reperfusion strategy during COVID-19 outbreak, with advices that may be opposed, depending on the conditions in each country. In China, the Pekin Union Medical College Hospital recommended thrombolysis as first choice of treatment, and only recommend coronary intervention after ruling out COVID-19 even in case of thrombolytic contraindication.[16] The American College of Cardiology Interventional Council and the Society for Cardiovascular Angiography & Interventions stated that fibrinolysis could be considered an option for the relatively stable STEMI patient with active COVID-19 to prevent staff exposure.[17] In Spain, there have not been changes in reperfusion strategy, with more than 98% of STEMI treated with PPCI, without an increase in the use of thrombolysis, in accordance to Spanish Interventional Cardiology Association recommendations STEMI management during COVID-19 outbreak.[18]

Two recently published short series of patients with COVID-19 who had ST-segment elevation showed a high prevalence of nonobstructive disease.[19,20] Overall, we didn't find an increase in the number of cases without obstructive lesions. This could be *a)* because we analyzed only patients with confirmed STEMI diagnosis so we excluded other causes of myocardial infarction with non-obstructive coronary arteries such as Myocarditis, Takotsubo Syndrome, non- STEMI or pulmonary embolism which, in our series, represent approximately 10% of patients or *b)* because previously published data probably were about non-consecutive highly selected patients.

Impact of COVID-19 outbreak on STEMI-related mortality

A very relevant finding of our study is a disturbing in-hospital mortality increase during the COVID-19 outbreak, that remained consistent after adjustment for age, sex, Killip class, time from symptom onset to reperfusion.

Recent epidemiologic data suggest a significant increase in mortality during this period that was not fully explained by COVID-19 cases alone.[21] The current situation, in which patients avoid going to the emergency services -or if they go they do it with long delays-, could explain an increase in out-of-hospital cardiac arrest STEMI-related mortality, as recently described in

Italy.[22] Although it is difficult to know the real prevalence of out-of-hospital cardiac arrest in the setting of STEMI, we didn't observe an increase in cases of ventricular fibrillation, asystole nor need of mechanical ventilation prior to catheterization laboratory in patients with confirmed STEMI. It is estimated that up to 75% of mortality occurs before contact with health system[23] and the main way to prevent out-of-hospital cardiac arrest is to seek hospital treatment as soon as symptoms of STEMI occur,[24] therefore it is possible that an increase in out-of-hospital cardiac arrest may not be reflected in our study.

Lack of access to reperfusion treatment would also lead to an increase in subacute STEMI complications, such as heart failure and/or cardiogenic shock, intraventricular thrombus formation and peripheral embolism or mechanical complications.[25] These patients were not included in the present registry as they were not candidates for PPCI but for sure contribute to a STEMI-related excess in mortality.

Finally, in the long-term, suboptimal revascularization and larger infarct size will lead to an increase in complications related to worse ventricular remodeling, such as chronic heart failure or ventricular arrhythmias.[26]

Limitations

This study has limitations inherent to an analysis of multicentric observational data. The assessment of baseline and follow-up data at center-level by each clinician-investigator, without central confirmation, potentially resulting in inaccuracies and misclassification. Nevertheless, data on interventional cardiology is quite standardized worldwide and the electronic case report form was designed to be intuitively and universally applied by all clinicians. Moreover, we applied a mixed regression model including hospital as a random variable, which took into account within- and between-hospital variations over time and, in any case, the potential variability between clinicians makes our findings very close to clinical practice and even more generalizable. Any potential selection bias was addressed by adjusting logistic regressions for potential confounders with prognostic implications, though some residual confounding (either measured or unmeasured) might remain after multivariate modelling.

CONCLUSIONS

In conclusion, this nationwide, observational study has shown a decrease in the number of patients with STEMI attended during the current COVID-19 outbreak, with an increase in time between symptoms onset to reperfusion and with a significant 2-fold increase of in-hospital mortality. No changes in reperfusion strategy have been detected. Concomitant SARS-CoV-2 infection in STEMI patients was infrequent but had an impact on inhospital mortality.

CONFLICTS OF INTEREST

A. Pérez de Prado has received personal fees from iVascular, Boston Scientific, Terumo, B. Braun and Abbott Laboratories; Á. Cequier has received personal fees from Ferrer International, Terumo, AstraZeneca and Biotronik. All other authors have reported that they have no relationship relevant to the contents of this paper to disclose.

APPENDIX

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WHAT IS KNOWN ABOUT THE TOPIC?

- Some preliminary reports have drawn attention to a decrease in the number of STEMI patients attending hospitals during the current COVID-19 outbreak.

- There is little information available about the influence of the COVID-19 on STEMI care and outcomes.

WHAT DOES THIS STUDY ADD?

- We found a significant decrease in the number of patients with STEMI attended in specific care networks in Spain during COVID-19.
- When compared to a prior to COVID-19 cohort, during COVID-19 patients had longer ischemia time as well as an increase in mortality although there were no differences in reperfusion strategy.

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Table 1

Baseline clinical characteristics of patients with confirmed diagnosis of STEMI

	Prior to COVID-19 N = 1305	During COVID-19 N = 1009	*P*
Age - yr	63.7 ± 13.2	63.1 ± 12.5	.24
Male gender - no. (%)	1023 (78.4)	786 (78.4)	.99
Clinical history - no. (%)			
Hypertension	647 (50.0)	520 (51.9)	.36
Diabetes	324 (25.2)	226 (22.6)	.15
Hyperlipidemia	592 (45.8)	466 (46.7)	.67
Current smoker	581 (45.7)	442 (44.6)	.60
Previous coronary artery disease	131 (10.2)	139 (13.9)	.006
First medical contact – no./total no. (%)			
Out-of-hospital emergency medical	463 (35.8)	424 (42.3)	.017

Service			
Primary care centers	319 (24.6)	219 (21.8)	
Non-PCI hospitals	266 (20.6)	192 (19.1)	
PCI Hospitals	246 (19.1)	168 (16.7)	
Reperfusion strategy at first medical contact – no./total no. (%)			
PPCI	1113 (87.7)	881 (87.8)	.86
Fibrinolysis	51 (4.0)	34 (3.3)	
Diagnosis doubt, transfer to PPCI hospital for decision	85 (6.7)	71 (7.1)	
Diagnosis doubt, transfer to non-PPCI hospital for decision	20 (1.6)	17 (1.7)	
Complications before PCI – no. (%)			
Ventricular fibrillation	84 (6.4)	63 (6.2)	.85
Asystole	15 (1.1)	5 (0.5)	.092
Cardiogenic shock	53 (4.1)	42 (4.1)	.90

Mechanical ventilation	42 (3.2)	37 (3.7)	.56

PCI, percutaneous coronary intervention; PCR, polymerase chain reaction; PPCI, primary percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction.

Plus–minus values are means ± standard deviation.

Table 2

Angiographic and procedural characteristics of patients with confirmed diagnosis of STEMI.

	Prior to COVID-19 N = 1305	During COVID-19 N = 1009	*P*
Patient reception site al PPCI hospital – no. (%)			
Direct to catheterization laboratory	679 (57.3)	658 (66.0)	< .001
Emergency room	398 (33.6)	258 (25.9)	
Critical care unit	49 (4.1)	40 (4.0)	
Coronary critical care unit	45 (3.8)	25 (2.5)	
Previously admitted to the hospital	14 (1.2)	14 (1.4)	
Others	1 (0.1)	2 (0.2)	
Killip class on catheterization laboratory arrival – no. (%)			
I	1024 (81.0)	821 (82.4)	.86
II	115 (9.1)	83 (8.3)	
III	34 (2.7)	25 (2.5)	

IV	91 (7.2)	67 (6.7)	
Coronary artery disease extension – no. (%)			
1-vessel disease	789 (63.1)	597 (60.1)	.003
2-vessels disease	301 (24.1)	296 (29.8)	
3-vessels disease	161 (12.9)	100 (10.1)	
Radial access – no. (%)	1087 (88.7)	910 (91.4)	.036
Location of culprit vessel – no. (%)			
Left main coronary artery	16 (1.2)	15 (1.5)	.59
Left anterior descending	542 (41.5)	454 (45.0)	.095
Left circumflex	198 (15.1)	150 (14.9)	.84
Right coronary artery	476 (36.5)	388 (38.5)	.33
By-pass graft	9 (0.7)	5 (0.5)	.55
Basal TIMI flow – no. (%)			
0	847 (68.9)	724 (72.2)	.18
1	114 (9.3)	75 (7.5)	

2	116 (9.4)	99 (9.9)	
3	153 (12.4)	105 (10.5)	
Final TIMI flow – no. (%)			
0	22 (1.8)	17 (1.7)	.95
1	15 (1.2)	11 (1.1)	
2	48 (3.9)	43 (4.3)	
3	1152 (93.1)	925 (92.9)	
PCI characteristics – no. (%)			
IIbIIIa inhibitors administration	112 (8.6)	150 (14.9)	< .001
Mechanical thrombectomy	337 (25.8)	356 (35.3)	< .001
Balloon angioplasty	428 (32.8)	361 (35.8)	.13
Bare-metal stent implantation	97 (7.4)	24 (2.4)	< .001
Drug-eluting stent implantation	1066 (81.7)	887 (87.9)	< .001
Decision after coronary angiography – no. (%)			
PPCI	1209 (93.9)	943 (94.7)	.74

Rescue PCI	29 (2.3)	23 (2.3)	
Routine early PCI after fibrinolysis	24 (1.9)	14 (1.4)	
Coronary angiography without PCI	26 (2.0)	16 (1.6)	

PCI, percutaneous coronary intervention; PPCI, primary percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction; TIMI, Thrombolysis in Myocardial Infarction.

Table 3

Time intervals between symptoms onset and reperfusion.

	Median [Interquartile Range]	*P*
Symptoms onset to first medical contact, minutes		
Prior to COVID-19 (n = 1160)	71 [30-180]	< .001
During COVID-19 (n = 901)	105 [45-222]	
Symptoms onset to reperfusion, minutes		
Prior to COVID-19 (n = 895)	200 [140-332]	< .001
During COVID-19 (n = 895)	233 [150-375]	
First medical contact to reperfusion, minutes		
Prior to COVID-19 (n = 892)	110 [81-151]	.54
During COVID-19 (n = 892)	110 [80-155]	
First medical contact to catheterization laboratory arrival, minutes		
Prior to COVID-19 (n = 1174)	86 [59-125]	.089

During COVID-19 (n = 904)	83 [55-125]	
Catheterization laboratory arrival to reperfusion, minutes		
Prior to COVID-19 (n = 898)	20 [15-30]	< .001
During COVID-19 (n = 906)	24 [17-31]	

Table 4

In-hospital outcomes of patients with confirmed diagnosis of STEMI.

	Prior to COVID-19 N = 1305	During COVID-19 N = 1009	*P*
Mortality	67 (5.1)	75 (7.5)	.019
Acute stent thrombosis	11 (0.8)	11 (1.1)	.54
Major bleeding	8 (0.6)	11 (1.1)	.21
Cardiogenic shock developed after PCI	75 (5.7)	48 (4.8)	.29
Pulmonary edema developed after PCI	30 (2.3)	17 (1.7)	.30
Mechanical ventilation after PCI	31 (2.4)	19 (1.9)	.42
Mechanical complication	5 (0.4)	9 (0.9)	.12

PCI denotes percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction.

FIGURE LEGENDS

Figure 1. Flowchart of patients. NSTEMI, non-ST-elevation acute myocardial infarction, PCI, percutaneous coronary intervention; STEMI, non-ST-elevation acute myocardial infarction.

Figure 2. Absolute number of primary percutaneous coronary intervention per day during both periods of time and official number of COVID-19 confirmed cases. Confirmed COVID-19 cases according to official Spanish Government data.[7] PCI, percutaneous coronary intervention.

Figure 3. COVID-19 diagnostic status path. Patients were categorized on admission according to their COVID-19 status in 4 groups: unknown, no symptoms compatible with COVID-19 nor previous polymerase chain reaction (PCR) test, symptoms compatible with COVID-19 but no previous PCR test or previous positive PCR test. Although it is essential to perform PCR assay at admission in all patients, it should be noted that at the beginning of the pandemic, when this study was carried out, PCR was not available in many facilities.

Figure 4. Time intervals between symptoms onset and reperfusion.

Figura 1

Click here to access/download;Figuras (Figures);Figura 1_Flowchart.tiff

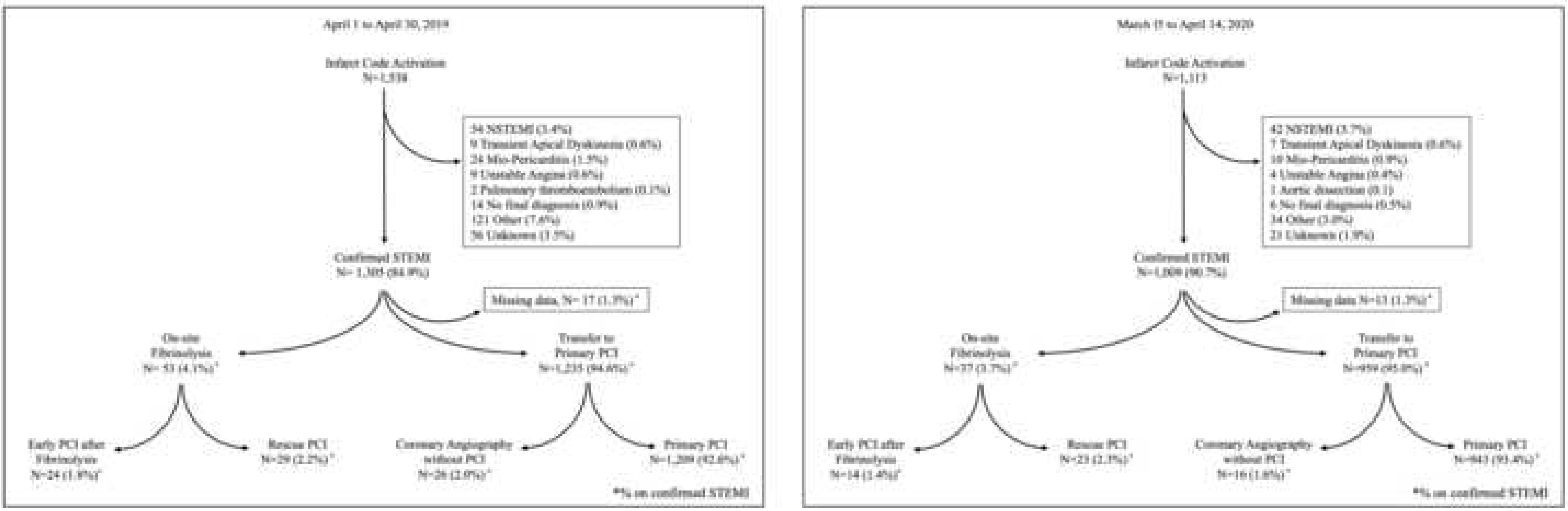


Figura 2

Click here to access/download;Figuras (Figures);Figura 2_Casos por dia y por num covids.tiff

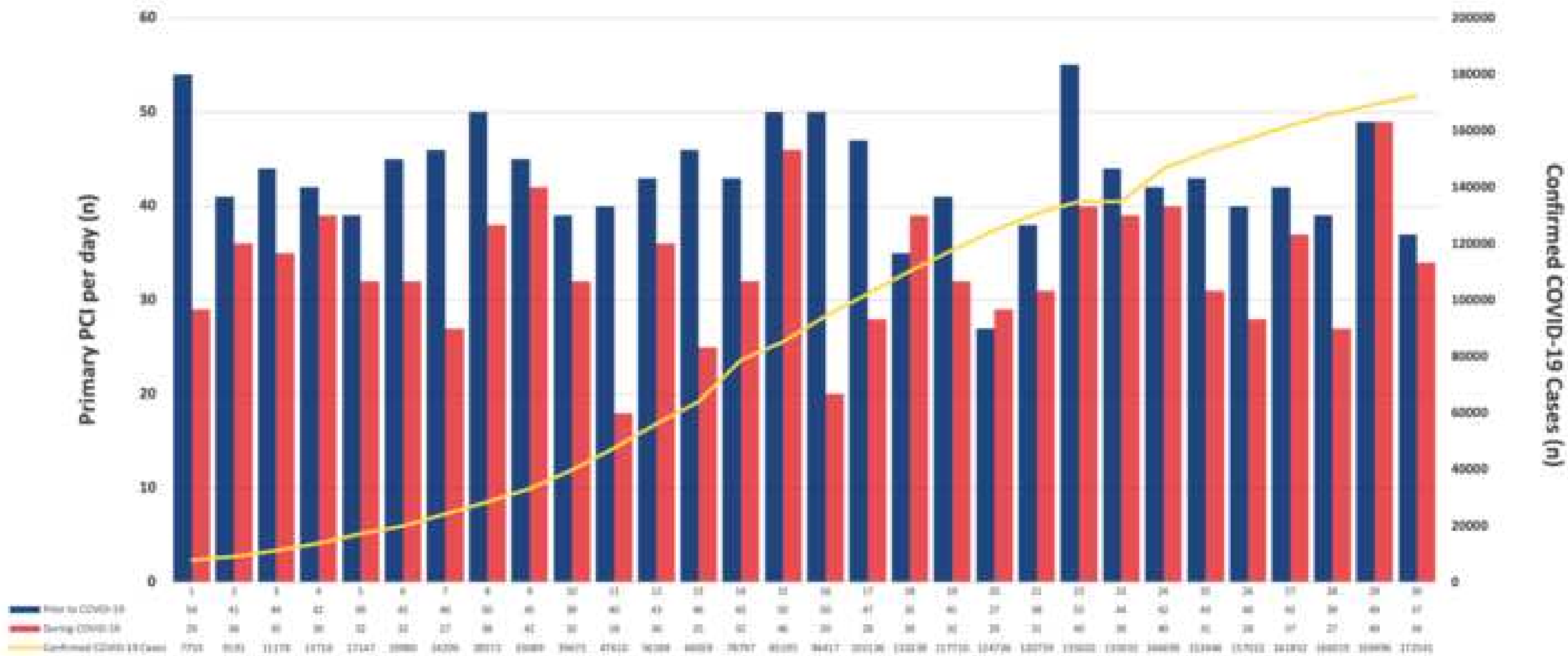
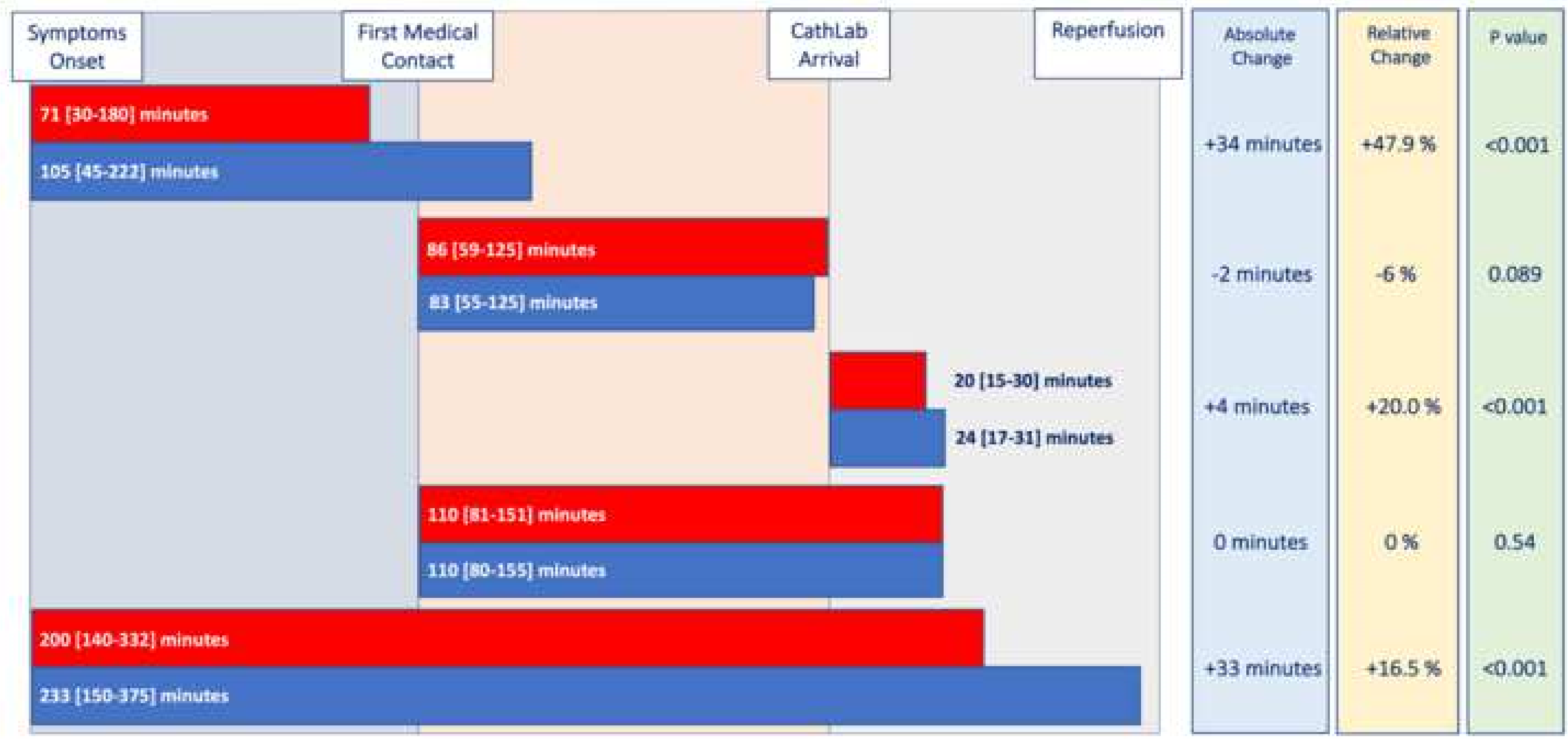


Figura 3 Click here to access/download;Figuras (Figures);Figura 3_COVID status.tiff

Covid-19 diagnostic status on admission		Covid-19 diagnostic status during hospitalization			
Unknown	**111 (11%)**	Not available	1 (0.9%)		
		PCR test not performed	79 (71.2%)		
		PCR performed	**31 (27.9%)**	Negative	30 (27%)
				Positive	**1 (0.9%)**
No symptoms compatible with Covid-19 / No previous PCR test	**803 (79.5%)**	Not available	9 (1.1%)		
		PCR test not performed	575 (71.6%)		
		PCR performed	**219 (27.3%)**	Negative	212 (26.4%)
				Positive	**7 (0.9%)**
Symptoms compatible with Covid-19 / No previous PCR test	**63 (6.2%)**	Not available	2 (3.2%)		
		PCR test not performed	4 (6.3%)		
		PCR performed	**57 (90.5%)**	Negative	35 (55.6%)
				Positive	**22 (34.9%)**
Previous positive PCR test	**33 (3.3%)**	Not available	0 (0%)		
		PCR test not performed	10 (30.3%)		
		PCR performed	**23 (69.7%)**	Negative	3 (9.1%)
				Positive	**20 (60.6%)**

Figura 4


Symptoms Onset
First Medical Contact
CathLab Arrival
Reperfusion
Absolute Change
Relative Change
P value
71 [30-180] minutes
105 [45-222] minutes
+34 minutes
+47.9 %
<0.001
86 [59-125] minutes
83 [55-125] minutes
-2 minutes
-6 %
0.089
20 [15-30] minutes
24 [17-31] minutes
+4 minutes
+20.0 %
<0.001
110 [81-151] minutes
110 [80-155] minutes
0 minutes
0 %
0.54
200 [140-332] minutes
233 [150-375] minutes
+33 minutes
+16.5 %
<0.001