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Acute myocardial infarction during late COVID-19 era: patient characteristics, presentation and outcomes

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Abstract

COVID-19 pandemic has unquestionably influenced care of acute myocardial infarction (AMI). Still, its impact on patients (pts) characteristics, presentation, treatment, and outcomes remains not well established in late pandemic times. To address this issue, we performed a prospective study of type-1 AMI patients admitted in a tertiary care hospital. Pts were enrolled during 6-months in 2019 [n=122; pre-COVID-19 (PC) group] and in 2021 [n=196; late-COVID-19 (C) group]. Data was based on pts interview and review of medical records. Age and gender distribution, as well as ST/non-ST-elevation myocardial infarction (STEMI/NSTEMI) proportion and access to coronariography and revascularization were similar between groups. Group C patients presented more pre-existing established cardiovascular disease (CVD) (43% *vs* 30%; p=0.03); more frequent description of typical chest pain (94% vs 84%; p=0,002); higher levels of pain intensity, in a 0-10 scale (8±2 *vs* 7±2; p=0.02); higher frequencies of AMI complications (27% *vs* 15%; p=0.01) and worse Killip (K) class evolution (K≥2 in 22% C *vs* 13% PC patients; p=0.05). In conclusion, late pandemic AMI patients presented worse in-hospital outcomes in our study, though pre-hospital and hospital care were comparable to pre-pandemic times. COVID patients had a higher burden of pre-existing established CVD and a more typical and intense symptom presentation. Therefore, it can be hypothesized that "sicker" patients continued to look for help when presenting AMI symptoms, while "less sick" patients and the ones with less typical and intense symptoms possibly avoided contact with health care services during late pandemic period.

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Introduction

COVID-19 pandemic has undoubtedly and profoundly shaped patients (pts) healthcare worldwide. Concerning the impact on acute myocardial infarction (AMI) pts care, data regarding early COVID-19 period, repeatedly and consistently shows a decrease in AMI admissions, when confronting these numbers with pre-COVID-19 AMI admissions [1-3]. This avoidance of contact with healthcare services may translate the applied lockdown strategies, as well as the pts fear of exposure to SARS-CoV-2 infection. Both facts can also justify the reported increase in the proportion of pts presenting to the Emergency Medical Services (EMS) with time-sensitive conditions [4].

However, heterogeneous, and even divergent data has been reported regarding AMI pts management and their outcomes, as well as AMI time-delays. Some studies point to an increase in AMI-time delays, less access to standard care and worse short-term outcomes of AMI pts admitted during COVID-19 pandemic [5-12]. Focusing time-delays, it has even been described a continuous increase in such delays through COVID-19 waves [13]. Still, other published studies describe distinct data, where time-delays do not seem to be affected by the pandemic [14] and, even a decreased door-to-balloon time has been reported in the context of ST-elevation myocardial infarction (STEMI) [15]. Some studies also point to an absence or residual influence of COVID-19 pandemic in AMI

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care and outcomes [1,16]. These apparently contradicting results may only be the consequence of distinct responses of different populations and healthcare systems to the pandemic, as well as observations made in distinct pandemic phases.

Our aims are to characterize and evaluate management and in-hospital outcomes of pts admitted with AMI in our tertiary care hospital during late COVID-19 (C) and compare them with AMI pts admitted during pre-COVID-19 era (PC).

Materials and Methods

This is a single-center prospective study of patients admitted due to type-1 AMI in a tertiary care hospital in the north of Portugal. Patients were consecutively enrolled during a six-month period in 2021 (n=194) – from May to November 2021 - and during a similar period of time in 2019 (n=122). Data were gathered through a patient interview within 48 h of admission and a review of medical records. Data collected in these two periods of time allowed us to compare AMI pts admitted during pre-COVID-19 (PC) with pts admitted during late-COVID-19 (C) pandemic times.

Patient interview was performed using a well-defined questionnaire, after a written informed consent was obtained. The survey included sociodemographic aspects, precise characterization of AMI event, as well as questions concerning pts knowledge about AMI and self-perception of their cardiovascular (CV) risk and the AMI event itself. A review of medical records was performed for each patient included, in order to collect clinical and analytical data, as well as to precisely characterize time to first medical contact (FMC).

Statistical analysis was performed with the use of IBM SPSS Statistics software, version 26 (SPSS). Continuous variables were compared with the use of non-parametric or parametric tests, when adequate, and are reported as median with interquartile range (IQR) or as mean with standard deviation (SD); categorical variables were compared with the use of chi-square tests and are reported as frequencies and percentages; p-values of less than 0.05 were considered to indicate statistical significance.

Results

Both populations were comparable in terms of sociodemographic characteristics (Table 1). Mean age was 62 years (SD of 13 years) in C group and 64 years (SD of 13 years) in PC group. Male pts corresponded to 78% of all included pts in C group and to 76% in PC group. Concerning baseline characterization (Table 1), C pts presented significantly higher pre-existing established cardiovascular disease (CVD), as well as higher frequencies of chronic kidney disease. Presence of cardiovascular risk factors was ubiquitous in both groups. Regarding clinical characterization and treatment approach (Table 2), both groups presented a near 1:1 proportion of ST/non-ST-elevation myocardial infarction (STEMI/NSTEMI) events. Presence of a typical chest pain was significantly more frequent in C pts, as well as a higher level of reported pain intensity, when using the visual analogue scale (VAS). Access to coronariography and revascularization was comparable between groups - 97% and 80% of C pts *vs* 96% and 81% of PC pts were submitted to coronariography and revascularization, respectively. Percutaneous coronary intervention (PCI) was the most used method of revascularization in both groups. Approximately half of pts in both groups presented complex coronary artery disease, defined by the presence of left-main or multivessel disease.

Table 1. Baseline and sociodemographic characterization of patients.

			C pts (n=194)	PC pts (n=122)	p-value
Male gender		n (%)	151 (78)	93 (76)	0.7
Age (years)		Mean (SD)	62 (13)	64 (13)	0.37
Cardiovascular background	Previous CVD, CAD or PAD	n (%)	83 (43)	37 (30)	0.03*
Cardiovascular risk factors	At least one	n (%)	188 (97.4)	118 (96.7)	0.74
	Obesity	n (%)	54 (27.8)	32 (26.2)	0.76
	Dyslipidaemia	n (%)	133 (68.9)	84 (68.9)	0.99
	Arterial Hypertension	n (%)	114 (59.1)	81 (66.4)	0.19
	Diabetes Mellitus	n (%)	67 (34.7)	34 (27.9)	0.21
	Smoking (current or previous history)	n (%)	121 (62.7)	66 (56.2)	0.29
	Family history of premature CAD	n (%)	16 (8.3)	8 (6.6)	0.57
Chronic kidney disease		n (%)	22 (11.4)	5 (4.1)	0.024*
Living alone		n (%)	31 (16)	17 (14)	0.64
Urban residence		n (%)	121 (62.4)	75 (61.5)	0.91
Marital status	Married	n (%)	138 (71.1)	84 (68.8)	0.35
	Divorced	n (%)	20 (10.3)	19 (15.6)	
	Widowed	n (%)	19 (9.8)	14 (11.5)	
	Single	n (%)	17 (8.8)	5 (4.1)	
Educational level	First cycle	n (%)	83 (42.8)	51 (42.5)	0.17
	Second cycle	n (%)	53 (27.3)	40 (33.3)	
	Third cycle	n (%)	38 (19.6)	10 (10.8)	
	Higher education	n (%)	20 (10.3)	16 (13.3)	
Employment status	Employed	n (%)	90 (46.4)	46 (37.7)	0.09
	Unemployed	n (%)	14 (7.2)	6 (4.9)	
	Retired	n (%)	90 (46.4)	70 (57.4)	

C, COVID-19; PC, pre-COVID-19; Pts, patients; SD, standard deviation; CVD, cerebrovascular disease; CAD, coronary artery disease; PAD, peripheral artery disease; *p<0.05.

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Focusing in-hospital outcomes (Table 3), C pts presented significatively higher frequencies of at least one AMI-complication (28% in C group *vs* 15% in PC group), as well as a worse Killip class evolution (22% of C pts presented a Killip class ≥2 *vs* 13% of PC pts). Frequencies of each AMI-complication (Figure 1), as well as cardiac arrest and in-hospital mortality rates were numerically superior in C group, although not reaching a statistical significance. Finally, concerning pre-hospital setting, curious disparities were found in the type of first healthcare facility contacted by pts (Figure 2), as well as means of transport used (Figure 3). In pre-pandemic era, the majority of AMI pts used private vehicles or public transports to reach healthcare facilities (92%), contrasting with AMI pts admitted during the pandemic (45%), when ambulance was the most used transport (53% of C pts *vs* 6% of PC pts). Public hospital emergency was the most common healthcare facility contacted by AMI pts in both periods of time (91% in C group *vs* 66% in PC group). A significant proportion of pre-pandemic pts first recurred to private or primary healthcare services (34%), contrasting with pandemic pts (9%). Despite these differences, activation of EMS and median time to first medical contact (FMC) were comparable between groups (p-values of 0.5 and 0.3, respectively) - 54% of pandemic pts activated EMS and presented a median FMC of 116 min (IQR of 229 minutes) *vs* 50% of pre-pandemic pts activated EMS and presented a median FMC of 110 minutes (IQR of 311 min).

Discussion

Our study characterizes the reality experienced during late-pandemic times in our tertiary care hospital located in the north of Portugal. When comparing AMI pts admitted during this period with the ones admitted in pre-pandemic era, a higher frequency of pre-existing established CVD and a more typical and intense chest pain description were observed. Worse in-hospital outcomes were also documented in AMI pandemic pts.

A worse Killip class evolution and development of at least one AMI complication were observed in pandemic pts, in statistically significant manner. In-hospital mortality and cardiac arrest rates, as well as frequencies of each AMI-complication were superior in AMI pandemic pts, although these outcomes did not reach statistical significance. Inherently low frequencies of the latter outcomes, as well

Table 2. Clinical and management characterization.

			C pts (n=194)	PC pts (n=122)	p-value
Type of AMI	STEMI	n (%)	99 (51)	67 (55)	0.5
	NSTEMI	n (%)	95 (49)	55 (45)	
Symptom onset on weekdays		n (%)	142 (73.2)	94 (77)	0.51
Symptom onset by period of the day	Morning	n (%)	63 (32.5)	44 (36.1)	0.3
	Afternoon	n (%)	42 (21.6)	31 (25.4)	
	Night	n (%)	89 (45.9)	47 (38.2)	
Typical chest pain		n (%)	182 (94)	102 (84)	0.002*
Chest pain intensity (0-10 scale)		Median (IQR)	8 (2)	7 (2)	0.02*
Associated symptoms		n (%)	123 (63.7)	90 (74.4)	0.062
EMS activation		n (%)	105 (54)	61 (50)	0.49
Coronariography		n (%)	188 (97)	117 (96)	0.5
Revascularization	All	n (%)	155 (80)	99 (81)	0.7
	CABG	n (%)	36 (18.8)	15 (12.8)	0.21
	PCI	n (%)	120 (62.2)	82 (70.1)	0.18
Left-main or multivessel disease		n (%)	92 (48.2)	63 (53.8)	0.35

C, COVID-19; PC, pre-COVID-19; Pts, patients; AMI, acute myocardial infarction; STEMI, ST elevation myocardial infarction; NSTEMI, non-STelevation myocardial infarction; IQR, interquartile range; EMS, emergency medical services; CABG, coronary artery bypass graft surgery; PCI, percutaneous coronary intervention; *p<0.05.

Table 3. In-hospital outcomes.

			C pts (n=194)	PC pts (n=122)	p-value
Cardiac arrest	Total	n (%)	11 (5.7)	4 (3.3)	0.42
	Out-of-hospital	n (%)	2 (1)	1 (0.8)	1
	In-hospital	n (%)	6 (3.1)	3 (2.5)	
In-hospital mortality		n (%)	5 (2.6)	2 (1.6)	0.71
Hospital length of stay (days)		Median (IQR)	5 (5)	6 (5)	0.22
Killip class ≥2		n (%)	43 (22)	16 (13)	0.05*
Left ventricular disfunction	Any degree	n (%)	97 (50)	61 (50)	0.9
	Moderate to severe	n (%)	48 (25)	36 (29.5)	0.43
≥1 AMI-complication		n (%)	53 (27.5)	18 (14.8)	0.012*

C, COVID-19; PC, pre-COVID-19; Pts, patients; IQR, interquartile range; AMI, acute myocardial infarction; *p<0.05.

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as the absence of a larger sample of pts, may justify why a statistically significant difference was not obtained.

Though worse in-hospital outcomes were observed, activation of EMS and time to FMC, as well as access to coronariography and revascularization remained unchangeable from pre-pandemic to late pandemic periods.

As previously mentioned, divergent realities have been described regarding this topic. Our work is in accordance with those showing worse short-term outcomes [5,12] and the ones presenting no differences in time-delays and access to standard care [14]. As far as we know, there is no reported data regarding late pandemic analysis of AMI pts in Portugal. Confronting our results with the existing ones describing the early pandemic Portuguese reality, which globally showed worse outcomes and pts care [3,6,7,11], our study found no differences concerning EMS activation, FMC time or AMI standard care provision. These contrasting realities may translate some sort of "returning to normal life" phenomenon during late pandemic period.

Reflecting on our study key messages, it can be hypothesized that "sicker" pts continued to look for help when presenting AMI symptoms, while "less sick" pts and the ones with less typical and/or less intense symptoms possibly avoided contact with healthcare services during late-pandemic period. This hypothesis may be a plausible explanation for the worse in-hospital outcomes observed in our study, as "sicker" pts may have been the ones who preferentially recurred to healthcare facilities. A worrisome issue can be brought up for discussion, concerning the clinical impact of the pandemic in "less sick" pts with possible AMI events during this period that were

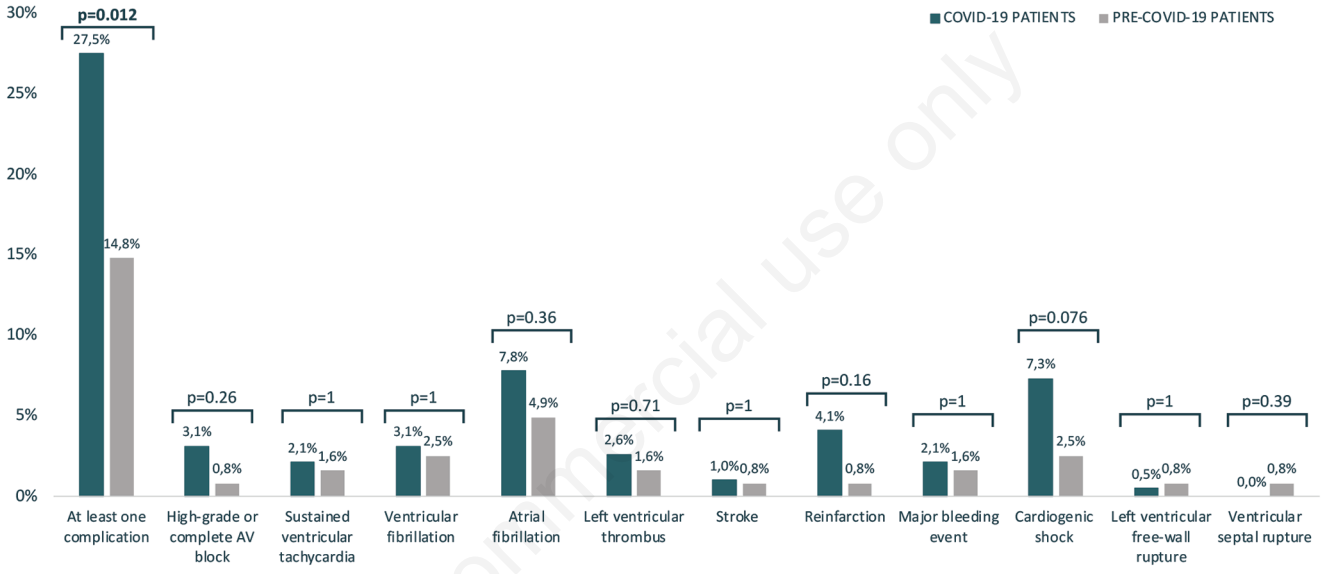

Figure 1. Distribution of acute myocardial infarction complications between groups.

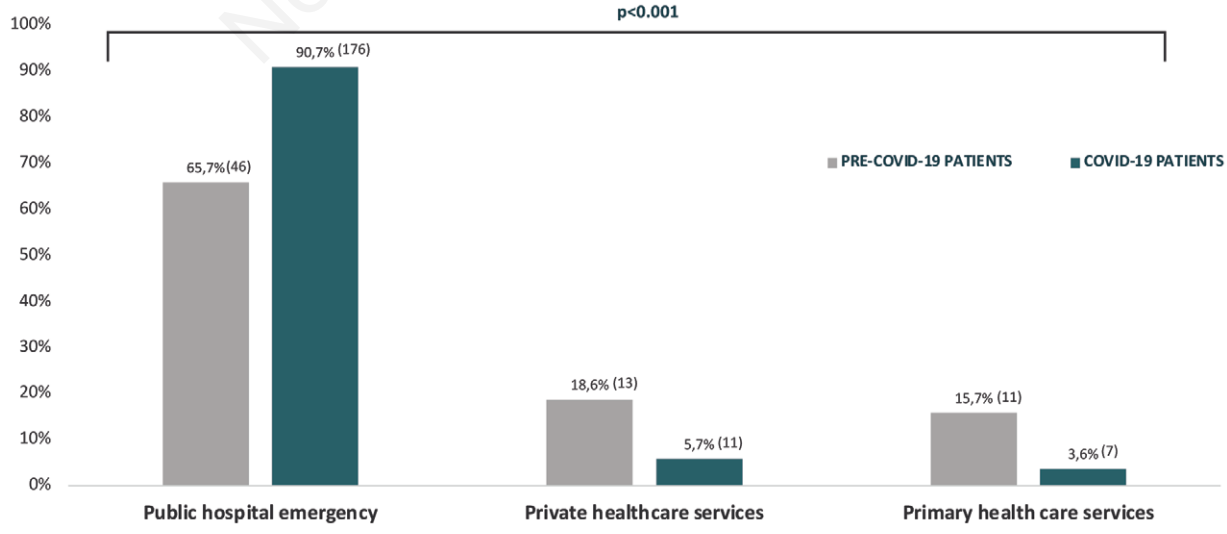

Figure 2. First healthcare facility contacted by patients.

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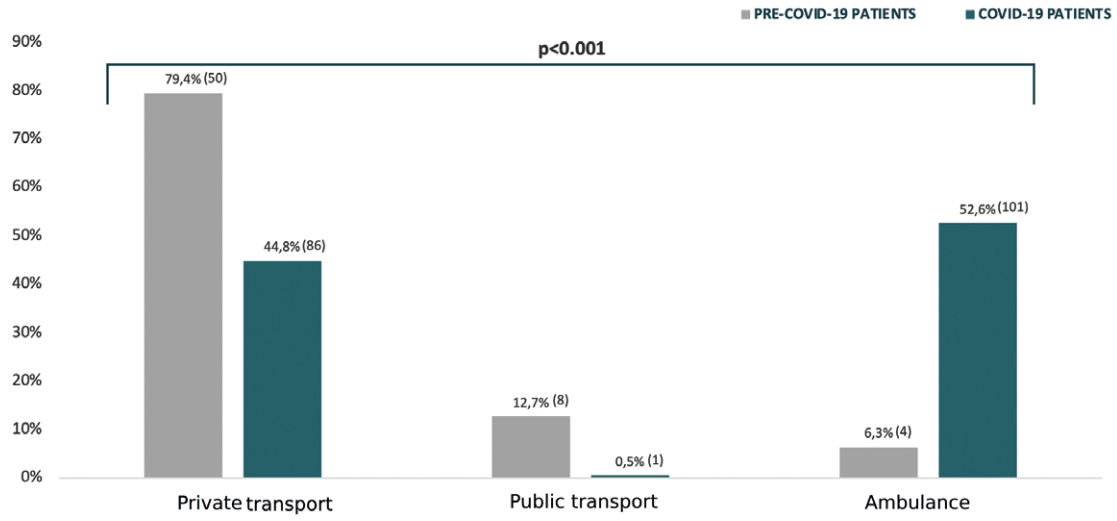

Figure 3. Means of transport used by patients to reach healthcare facilities.

not medically detected and properly treated. Future studies should focus, not only in the follow-up of AMI pts admitted during the pandemic, but also in this unsettling question regarding clinical impact in this vulnerable population of "less sick" pts.

Conclusions

AMI pts admitted in the late pandemic period in our center presented an overall similar baseline profile to PC pts and, despite identical pre-hospital and hospital care, pandemic pts presented worse outcomes. Further studies are needed to explore the reasons behind this reality and to eventually confirm the above-mentioned hypothesis.

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