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Admissions and In-hospital Outcomes of Acute Coronary Syndromes during Corona Virus Disease 19 Pandemic in Albania

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Abstract

BACKGROUND: Cardiologists and surveys from all over the world have reported an important drop in admissions of patients with acute coronary syndromes (ACS) and related coronary procedures during the outbreak of coronavirus disease 19 (COVID 19) pandemic.

AIM: We investigated the impact of the COVID 19 pandemic on hospitalizations for ACS and related invasive procedures in a country with low COVID 19 incidence.

METHODS: We conducted a single-center, observational retrospective study including all consecutive patients admitted for ACS in the Cardiology Department of University Hospital Center Mother Theresa from March 9, 2020 (1st day of application of social distance measures) to April 30th (period of total lockdown). Patients admitted in the same time period in 2019 served as controls. All data were collected from the medical files. Admissions were classified as ST-elevation myocardial infarction (STEMI) or non-ST-elevation ACS (NSTEACS). Total and weekly admissions and invasive procedures were assessed. Mean incidence difference (MID) in weekly ACS admissions and procedures was also calculated.

RESULTS: Overall, 781 patients were included in this analysis: 321 patients (37%) were admitted during study period and 550 patients (63%) were admitted during the control period (overall reduction of 41.6%; weekly MID of 28.6 (95% confidence interval [CI] 13.3 to 44.0; p = 0.001). The occurrence of all ACS types was reduced: STEMI, by 28.1%; weekly MID 7.3 [0.6-15.2]; p = 0.048]; NSTEACS by 50.5%, weekly MID 19.1 [13.9-24.4]; p < 0.001]. Invasive procedures were also reduced: coronary angiography by 42.5%, weekly MID 26.6 [13.4-39.2]; p = 0.001; percutaneous coronary intervention (PCI) by 42.3%, weekly MID 16.1 [5.9-26.3], p = 0.004]. Compared to 2019, during the COVID-19 period, there was a 2.4 fold increase in the inhospital death (3% vs 7.2%) with a significant weekly MID 1.4 [0.2-2.7] P=0.032]. A 2.6-fold increase in the occurrence of cardiogenic shock was also observed (13.1% vs. 5.1%, p < 0.0001).

CONCLUSIONS: The admissions for ACS and invasive revascularization procedures were significantly reduced, whereas the death rate was increased during COVID 19 pandemic outbreak in Albania compared with the same period in 2019.

Introduction

Cardiologists and surveys from all over the world have reported an important drop in admissions of patients with acute coronary syndromes (ACS) and related coronary procedures during the outbreak of coronavirus disease 19 (COVID-19) pandemic [1], [2]. However, contradictory results were reported regarding acute myocardial infarction (AMI) complications and mortality [3], [4], [5], [6].

The first case of COVID 19 in Albania was reported in March 8, 2020 [7], which was followed by a gradual national lockdown from 9th of March with school and universities closure [8] and a total lockdown starting on 15th of March [9], [10]. During the lockdown period, the population was urged to physical distancing and self-isolation and strict movement measures were ordered. The mitigation of measures begun on the 25th of April [11] and continued throughout May with restriction measures removed almost completely in June 2020 [12]. Albania, during the outbreak of the pandemic had a low spreading of the virus. By the end of April 2020, the COVID19 incidence was 27/100000 and related death 1.08/100000 inhabitats [13]. Cardiovascular diseases are the most common cause of mortality in Albania accounting for 57–59% of all deaths and the standardized death rate from ischemic heart disease is 155/100000 inhabitants [14]. We observed an important decrease of admissions for ACS during the months of pandemic outbreak in our center, mainly during the last week of March and the first one of April. We undertook this observational study to investigate the impact of pandemic on ACS admissions, invasive procedures, and in-hospital outcomes.

Methods

Data sources

We conducted a single-center, observational, retrospective study including all consecutive patients

hospitalized for an ACS in the Department of Cardiology of University Hospital Center Mother Theresa in Tirana, Albania from March 9, 2020 (first day of application of social distance measures) to April 30th (period of total lockdown). The same time period in 2019 served as control. All information was collected using patients' medical files. Patients included presented with ST-segment elevation ACS (STE-ACS or STEMI) and non-ST-segment elevation ACS (NSTE-ACS). STEMI was diagnosed using the 4th Universal Definition of Myocardial Infarction criteria [15]. NSTEACS were diagnosed according to the European Society of Cardiology (ESC) 2019 guidelines [16]. Demographic data, cardiovascular risk factors, previous comorbidities, and outcomes were collected.

Procedures

Coronary angiography was performed as per standard practice. Angiographic data - angiographic obstructive coronary artery disease (CAD), critical stenosis, number of affected vessels and treated vessel - and data obtained from revascularization procedures - percutaneous coronary intervention (PCI) or coronary artery bypass surgery (CABG) were analyzed.

Admission, procedural, and in-hospital outcomes

The primary outcome of this analysis was the overall rate and weekly incidence of admissions for ACS during the study period and control time period. Other outcomes analyzed and compared between the two study time periods were: overall admissions for ACS, proportions of patients undergoing coronary angiography and revascularization procedures (PCI or CABG), cardiac troponin I (cTnI) on admission (normal values 0.00–1.00ng/ml), time from symptom onset to intensive care unit (ICU), time from arrival in ICU to sheath insertion (for STEMI patients), left ventricular ejection fraction (at discharge), in-hospital all-cause mortality, cardiogenic shock, life-threatening arrhythmias, mechanical complications, stroke, stent thrombosis, and reinfarction. Changes in the rate of admissions for ACS and related procedures were calculated by comparing the total admission/procedure number for the period March 9, 2020 to April 30, 2020 with the number during 2019 and expressed as a percentage. Percentage changes in weekly ACS admission and related procedures were calculated similarly by comparing the admission/procedure number of each week (starting with the first week from March 9, 2020 and following 6 other weeks until April 26, 2020) with the weekly number during 2019.

The differences in the incidence of ACS admissions during the study period and the control period are shown as weekly mean incidence difference (MID) which was calculated by comparing the weekly mean of ACS admissions during the 7 week study period with the mean admission during 2019. Mean incidence differences are present with 95CIs. Mean incidence difference of admissions among ACS subgroups, related procedures, and death were calculated similarly.

Statistical analyses

Demographic characteristics, angiographic and procedural continuous data are presented as mean ± SD and compared using t-test: Discrete data are shown as counts and proportions and are compared using the using chi-squared (χ^2) test. T-test for Equality of Means was used to calculate the weekly mean incidence difference (MID) for events including admissions, procedures, deaths, and complications for the study and control periods. Mean difference between the groups is presenting with a 95% confidence interval (CI). A two-sided $p < 0.05$ is considered to indicate statistical significance. The statistical analysis was performed using the Statistical Package IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0 Armonk, NY: IBM Corp.

Results

Patients characteristics

Overall 781 patients admitted with the diagnosis of ACS were included in this analysis. Of them, 321 (37%) were admitted during the study period and 550 during the control period (63%). Baseline data are shown in Table 1. There were no differences between patients admitted in the study and control periods regarding gender, age, and cardiovascular risk factors (arterial hypertension, dyslipidemia, diabetes mellitus, and smoking). Patients admitted during the study period had less prior myocardial infarction, known CAD, and dilated cardiomyopathy compared to the 2019 period. The proportion of patients receiving calcium channel blockers was higher during the study period (41% vs. 32%; p = 0.007). There were no significant differences in the use of other drugs.

Admissions for ACS during the COVID-19 and control periods

The admissions for ACS in the study period were reduced by 41.6% compared with the control period. The weekly MID in the admissions for ACS during the control and study periods was highly statistically significant (28.6, 95% confidence interval [CI] 13.29 to 43.96, p = 0.001. (Figure 1 and Table 2) Admissions according to ACS type, coronary angiography, and

Table 1: Baseline demographic, clinical, and angiographic characteristics

	Control period n (%)	Study period n (%)	p value*
All patients	550	321	
Male	400 (73)	238 (74)	0.707
Age, yrs (SD)	66.0±10.7	65.4±10.5	0.402
STEMI	217 (39.5)	156 (48.6)	0.010
NSTEACS	333 (60.5)	165 (51.4)	0.001
Diabetes Mellitus	244 (44.4)	136 (42.4)	0.616
Arterial hypertension	500 (90.9)	291 (90.6)	0.990
Dyslipidema	289 (52.5)	178 (55.4)	0.448
Familiar history of CAD	129 (23.5)	56 (17.4)	0.050
Smoking	172 (31.3)	92 (28.7)	0.464
Previous MI	133 (24)	53 (17)	0.010
Previous PCI	77 (14)	33 (10)	0.137
Previous CABG	29 (5)	16 (5)	0.979
Previous CAD	131 (24)	49 (15)	0.004
Dilated CMP	45 (8)	12 (4)	0.016
Impaired renal function	71 (13)	43 (13)	0.980
Previous stroke	26 (5)	11 (3)	0.457
Coronary Angiography	494 (89.8)	284 (88.5)	0.970
Refuse	38 (6.9)	29 (9)	0.875
CAD extent	434 (87.85)	255 (89.8)	0.516
1 vessel CAD	119 (24)	72 (25)	0.758
2 vessel CAD	153 (31)	68 (24)	0.044
3 vessel CAD	161 (33)	115 (40)	0.032
LM disease	41 (8)	37 (13)	0.047
No critic stenoses	60 (12.15)	29 (10.2)	0.484
PCI (% angiography)	303 (61.3)	175 (61.6)	0.990
PCI of LAD	184 (61)	105 (60)	0.950
PCI of LCX	84 (28)	47 (27)	0.950
PCI of RCA	134 (44)	70 (40)	0.422
CABG recommended (% angiography)	96 (19.4)	60 (21.1)	0.635
CABG performed (% angiography)	30 (6)	23 (8.1)	0.462
CAD with medical treatment	52 (10.5)	25 (8.8)	0.516
Beta-blocker	433 (79)	248 (77)	0.900
Calcium channel blockers	177 (32)	133 (41)	0.007
ACEIs/ARBs/Sacubitril-valsartan	402 (73)	235 (73)	1.000
Aspirin	531 (97)	309 (96)	0.900
Clopidogrel	496 (90)	308 (96)	0.800
Statins	530 (96)	311 (97)	0.900
Furosemid/Spironolacton	251 (46)	156 (49)	0.800
Heparine/ enoxaparine	548 (99.6)	320 (99.7)	1.000

ACS, acute coronary syndrome; STEMI, ST-segment elevation myocardial infarction; NSTEACS, non-ST-segment elevation acute coronary syndrome; CAD, coronary artery disease; PCI: percutaneous coronary intervention; CABG, coronary artery bypass grafting; CMP, cardiomyopathy; LM, left main; LAD, left anterior descending; LCx, left circumflex; RCA, right coronary artery, ACEIs, angiotensin-converting enzyme inhibitors; ARBs, angiotensin II receptor blockers, ASA, acetylsalicylic acid. *To determine statistical significance for the comparison regarding each one of demographic characteristics, angiographic and procedure-related variables was summarized using mean ± SD for continuous variables compared using t-tests and frequency and percentage for categorical variables compared using chi-squared (χ^2) tests

revascularization procedures during the study and control period are shown in Figure 1. As seen there was a significant reduction for all ACS types with admissions for STEMI reduced by 28.1% and admissions for NSTE-ACS reduced by 50.5%. The admissions with STEMI were significantly higher during COVID-19 compared to control period (48.6% vs. 39.5%; P=0.001) whereas admissions for NSTE-ACS were reduced (51.4% vs. 60.5%; p < 0.001; Table 2).

Table 2: Admissions presentation, procedures, and correspondent weekly mean incidence difference

Admission presentation and procedures	COVID-19	Control	Weekly Mean Incidence Difference (95% CI)[†]	p-value*
All ACS	321	550	28.6 (13.3–44.0)	0.001
STEMI n (%ACS)	156 (48.6)	217 (39.5%)	7.26 (0.6–15.2)	0.048
NSTEACS n (%ACS)	165 (51.4)	333 (60.5%)	19.14 (13.9–24.4)	<0.0001
Angiography n (%ACS)	284 (88.5)	494 (89.8%)	26.63 (13.4–39.2)	0.001
PCI n (% angiography)	175 (61.6)	303 (61.3%)	16.13 (5.9–26.3)	0.004
Performed CABG n (%angiography)	23 (8.1)	30 (6.0%)	1.00 (-2.13–4.1)	0.5

ACS, acute coronary syndrome; STEMI, ST◻segment elevation myocardial infarction; NSTEACS, non-ST-segment elevation acute coronary syndrome; PCI: percutaneous coronary intervention; CABG, coronary artery bypass grafting. †Weekly mean incidence difference for all ACS and each type (STEMI and NSTEACS), angiography, PCI, and CABG procedures obtained from the analyses of 7 weeks in COVID-19 and control period is expressed in mean and 95%CI. *To determine statistical significance for the comparison regarding each one of the ACS types and each procedure, the t-test for Equality of Means was used.

The greatest fall in admissions (reduction by 61–62%) was observed during the third and fourth week of pandemic outbreak (Figure 2).
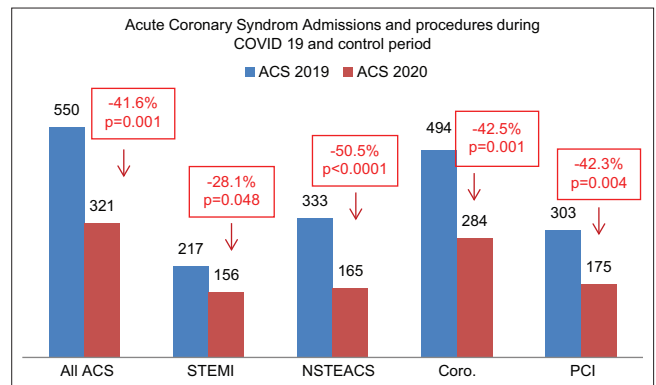

Figure 1: Acute Coronary Syndrome (ACS), ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation acute coronary syndrome (NSTEACS) admissions, and invasive procedures (coronary-angiography and percutaneous coronary intervention), during the COVID-19 period (red bars) are significantly reduced compared with the control period (blue bar)

Angiographic and procedural findings

The number of patients undergoing coronary angiography during the study period compared with the control period was reduced by 42.5% with a weekly MID of 26.62 [13.4-39.15] (p = 0.001). The number of patients undergoing PCI was also reduced by 42.3% during the COVID-19 period compared with the control period. (Table 2, Figures 1 and 2). During both study periods there were no significant differences in the proportion of patients undergoing coronary angiography (89.8% vs. 88.5%), PCI (61.3% vs. 61.6%), the proportion of patients recommended for CABG (19.4% vs. 21.1%) or those undergoing CABG (6.0% vs. 8.1%) (Table 1). There was no significant differences in patients undergoing CABG with a weekly MID of 1.00 [-2.13 to 4.13]: p = 0.5; (Table 2). The frequency of three-vessel disease (40% vs. 33%; p = 0.032) and left main involvement (13% vs 8%; p = 0.046) was higher among patients of the study period compared with the control period. In both study groups, the left anterior descending artery (LAD) was the most commonly treated vessel but without significant differences between the groups (Table 1).

In-hospital outcomes

In-hospital outcomes are shown in Table 3. The symptom onset to our ICU time was significantly higher in 2020 than in 2019 (940.0 ± 1122 vs. 436.1±383 minutes p < 0.0001) Likewise, the cTnI was higher on admission (20.4 ± 34.8 vs. 10.8 ± 43.5 ng/ml p = 0.0007) and ejection fraction lower (44.0 ± 12.1 vs. 50.9 ± 11.6; p = 0.003) among patients admitted during the study compared with the patients admitted during the control period. Conversely, the time between ICU arrival and sheath insertion in patients with STEMI was shorter (49.3 ± 29.6 vs. 57.2 ± 33.2; p = 0.04). There was a 2.4-fold higher in-hospital mortality among patients admitted during the study period compared
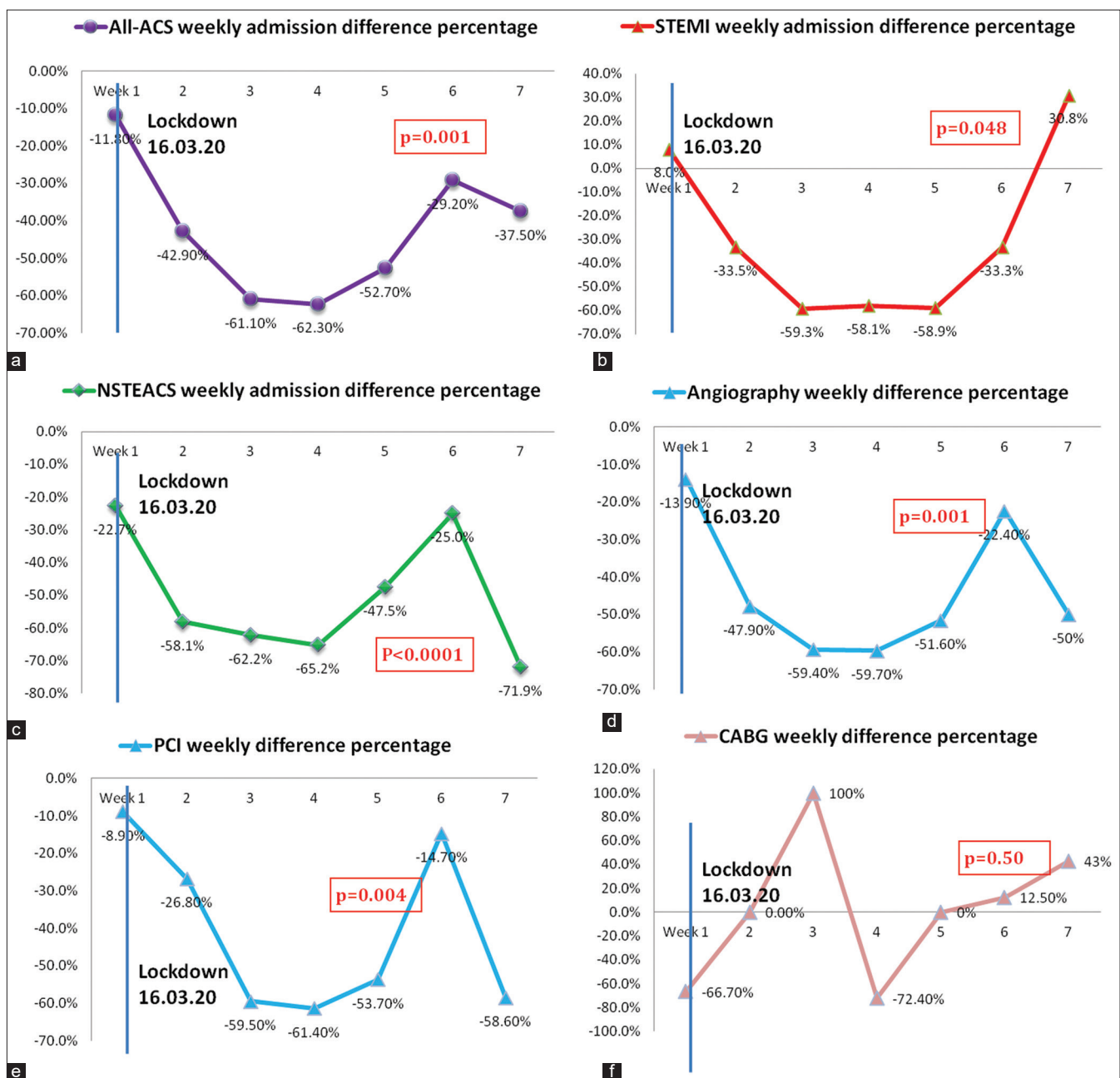
Figure 2: a, b, c, The weekly admission difference percentage (percentage change in COVID-19 compared to control period) assessed for all-Acute coronary syndromes (ACS), ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation acute coronary syndrome (NSTEACS) showing an important reduction for all admissions during 3^d and 4th week of the study compared to control period. d, e, f, the weekly procedure difference percentage (percentage change in COVID-19 compared to control period) assessed for coronary-angiography, percutaneous coronary intervention (PCI), coronary artery bypass grafting (CABG) showing an important reduction for invasive procedures (angiography and PCI) during 3^d and 4th week of the study compared to control period. No differences were found for CABG

with the control period (7.4% vs. 3%: p = 0.021) with a weekly MID of 1.43 [0.15-2.71] (p = 0.032). Among patients admitted during the study period, there was also a 2.6-fold increase in the incidence of cardiogenic shock (13.1% vs.5.1%; p < 0.0001) and a higher rate of ventricular fibrillation (4.7% vs. 2%; p = 0.042) and atrioventricular block (5.9% vs. 2.7% p = 0.03) compared with patients admitted during the control period.

Discussion

Our study showed a significant reduction of admissions for ACS, coronary angiography, and PCI during the pandemic COVID 19 outbreak in Albania. Thus the reduction of admissions was 41.6% for the overall group, 28.1% for admissions for STEMI, and 50.5% for admissions for NSTEACS. The number of coronary angiography procedures and PCI was also

Table 3: In-hospital outcomes

	Control period n (%)	Study period n (%)	p value*
All ACS	550	321	
Symptom-ICU time (SD)	436.1 ± 382.9	940.0±1122.4	<0.0001
ICU- sheath time (SD)	57.2 ± 33.2	49.3±29.6	0.040
cTn I (SD)	10.8 ± 43.5	20.4±34.8	0.001
Ejection Fraction (SD)	50.9 ± 11.6	48.4±12.1	0.003
Death n (%)	19 (3.0)	24 (7.4)	0.021
Cardiogenic shock n (%)	28 (5.1)	42 (13.1)	<0.0001
VF n (%)	11 (2)	15 (4.7)	0.042
VT n (%)	19 (3.5)	15 (4.7)	0.475
AV Block n (%)	15 (2.7)	19 (5.9)	0.030
AF n (%)	52 (9.5)	36 (11.2)	0.470
Thrombosis n (%)	10 (1.8)	9 (2.8)	0.50
Reinfarction (n%)	11 (2.0)	9 (2.8)	0.597
Mechanic complications (n%)	5 (0.9)	5 (1.6)	0.590
Stroke n(%)	9 (1.6)	8 (2.5)	0.5307

ACS: Acute coronary syndrome; ICU: Intensive care unit; cTn I : Cardiac Troponin I; VF: Ventricular fibrillation; VT: Ventricular tachycardia; AV: Atrioventricular; AF: Atrial fibrillation. *To determine statistical significance for the comparison regarding each one of in-hospital characteristics, angiographic and procedure-related variables were summarized using mean ± SD for continuous variables compared using t-tests and frequency and percentage for categorical variables compared using chi-squared (χ^2) tests.

reduced by 42.5% and 42.3%, respectively compared with the control period. The greatest reduction of admissions and procedures was observed during the third to the fifth week following the pandemic outbreak. The admissions for STEMI followed a U-curve relationship with greatest reduction by 58-59% in the fourth and fifth week of the study period.

Our results are in line with other studies reporting a reduction of ACS admissions in countries that were severely hit by the pandemic. In Italy, De Rosa [3] found a reduction of 48.4% in overall AMI admissions including a 26.5% reduction in admissions for STEMI and a 65.1% reduction for admissions for NSTEMI. Another study in Northern Italy found a 30% reduction in ACS admissions during COVID 19 period compared with the same period in 2019 [17]. In United Kingdom, a substantial reduction in ACS weekly overall admissions of 40% and 23% for STEMI, by the end of March was reported [18]. Along the same lines, in France admissions for AMI decreased 30% after lockdown [19] with admissions for STEMI and NSTEMI being decreased 24% and 35%, respectively. In Greece, a country that had low COVID-19 incidence during March-April, but with strict social measures applied, similar to Albania, an overall reduction of ACS admissions by 28.4% in 2020 compared to 2019 was reported [20]. The reduction of hospitalizations was 24.5% for STEMI, 26.5% for NSTEMI, and 36.5% for UA. A survey conducted in Spain [21], observed an important reduction in the activity of interventional cardiology (reduction of diagnostic procedures by 56%, PCI by 48%, structural interventions by 81%, and PCI in STEMI by 40%.

The pandemic didn't have a great impact on Albanian health care system during the first months. COVID patients were treated in dedicated COVID centers and the overall low incidence of infection, hospitalizations, and deaths did not affect much activity in other health departments. The most noticeable impact observed in our department was a reduction of total admissions, meanwhile, no differences were observed on the rate of coronary angiographies or PCI in admitted patients.

We believe that the fear of infection played a major role in reducing admissions for ACS even in COVID-free wards. Furthermore, other important factors could have been the STAY AT HOME order of the authorities, the call for self-isolation and so-called police hour, impeding the movement, which may have provided subjective or objective reasons and underestimation on the side of the population by ignoring symptoms and not seeking or postponing medical care. The greatest reduction of ACS admissions (62%) was during the past week of March and the first one of April, which coincides with the complete lock-down and the state of national natural disaster declared by the authorities [22]. People seeking medical care from emergency services were those with more severe presentation. Apparently less urgent cases might have been postponed, explaining the reduction in STEMI and NSTEACS admissions. Another indicator of the severity of patients admitted during the time of the study was the greater presence of 3 vessels coronary artery disease and left main disease. The same trend was seen in neighboring Greece [20] and also Southern Italy, which was affected less than Northern Italy during the outbreak of the pandemic, with the last one being the epicenter of the pandemic [17]. We think that the total lockdown was associated with less physical activity by the population. The reduction of physical triggers might have induced less myocardial ischemia, reducing the symptoms and signs of ischemic heart disease.

In our study, we documented an increase in the rate of cardiac death in ACS patients during the COVID 19 pandemic, with a significant increase by at least 1 death per week. An increase of MI complications such as cardiogenic shock, ventricular fibrillation, and the atrioventricular block was also observed. In this regard, our results are in the same line with the Italian study, which analyzed the week between March 12, 2020 and March 19, 2020 compared with the same week in 2019 in which STEMI case mortality (13.7% vs. 4.1%) and complications (18.8% vs. 10.4%) were increased in 2020 compared with 2019 [3]. An increase of case fatality rate was also reported in a study in the USA where the observed/expected (O/E) ratio for mortality related to all AMI (STEMI and NSTEMI) was increased in the period of a pandemic by 27% (OR=1.27 [95% CI 1.0 to 1.48]) [4]. However, in studies from Denmark [5] and Hong-Kong [6] no significant differences in the MI-related mortality or complications were observed. The Danish study [5] showed that the management of patients was similar in the 2020-period compared with the 2015-2019-period and the resources in the health care systems were enough, and especially the intensive care units never were near maximum capacity.

The increase of mortality in our center may be related to the longer time from symptom onset to presentation in the ICU, supported also by significantly higher cTnI levels and lower ejection fraction (as a possible indicator delayed MI) on admission, compared

with the same time on 2019. Timely reperfusion therapy is critical for avoiding AMI-related complications and deaths [23]. Longer times from symptom onset to medical contact and higher levels of cTnI on admission and more LV systolic impairment (EF < 40%) are reported also in other studies in the United Kingdom [24], France [25], Italy [3], and Greece [22]. Further analysis is needed to elucidate and understand this phenomenon.

Congruent with other studies, we found a reduction of ACS admissions which may not mean a reduction in the ACS incidence *per se*. AMI recovered late or not recovered at all will impact on cardiovascular morbidity, disability, and mortality in the subsequent future. What would be the impact of the COVID-19 pandemic on overall public health is expected to be assessed in months and years after the pandemic. Many efforts should be made to minimize the consequences, addressing the fear of being infected with the virus by reassuring that all safety measures are taken. The language used by officials and media should encourage the population to call family physicians or emergency services whenever the symptoms of ischemic disease or other possible pathologies are present. All efforts should be done to secure that the population takes the standard medical care and consultations, examinations, and hospital services as needed to prevent any possible cardiac events should be encouraged.

Strength and limitations

Our data included all consecutive patients admitted with ACS in the Cardiology Department of University Hospital Center Mother Theresa in Tirana, Albania in two different periods providing a full view of the admissions and complications during the COVID-19 pandemic. However, this is a single-center study in Tirana. Our center is the largest public tertiary hospital in the country with primary PCI service where all AMI patients from all the regions are presented. The reduction of ACS was observed in all counties of Albania (Table 4), but the proportion of patients transferred versus those treated in clinics in local counties during the pandemic remains unknown.

Table 4: Number of patients admitted from every county of Albania with the acute coronary syndrome (ACS) during COVID-19 and control period

County	ACS 19 n. patients	ACS 20 n patients
Berat	45	17
Durres	63	45
Elbasan	36	28
Fier	30	26
Gjirokaster	11	9
Korce	34	17
Kukes	10	2
Lezhe	15	14
Diber	19	10
Shkoder	16	12
Tirane	229	126
Vlore	27	12

Our study did not include patients diagnosed (or suspected) with COVID-19 because these patients were hospitalized in COVID hospitals equipped with catheterization laboratories.

Conclusions

Our study demonstrated a significant reduction of ACS (including subtypes) hospitalizations, invasive revascularization procedures, and an increase in the rates of death and complications in hospitalized patients during the COVID 19 pandemic outbreak in Albania compared with the same period in 2019. Measures should be taken to assure patients for the availability and safety of health services at the time of pandemic and to encourage them to seek medical care, cardiac consultations, and treatments when needed to avoid preventable deaths and disability.

References

1. Pessoa-Amorim G, Camm CF, Gajendragadkar P, De Maria GL, Arsac C, Laroche C, *et al*. Admission of patients with STEMI since the outbreak of the COVID-19 pandemic: A survey by the European society of cardiology. Eur Heart J Qual Care Clin Outcomes. 2020;6(3):210-6. https://doi.org/10.1093/ehjqcco/qcaa046
   PMid:32467968

2. Roffi M, Capodanno D, Windecker S, Baumbach A, Dudek D. Impact of the COVID-19 pandemic on interventional cardiology practice: Results of the EAPCI survey. Eur Interv. 2020;16(3):247-250. https://doi.org/10.4244/eij-d-20-00528

3. De Rosa S, Spaccarotella C, Basso C, Calabrò MP, Curcio A, Filardi PP, *et al*. Reduction of hospitalizations for myocardial infarction in Italy in the COVID-19 era. Eur Heart J. 2020;41(22):2083-8.
   PMid:32412631

4. Krasne M, Gluckman TJ, Marine JE, Blumenthal RS, Sharma G. Outcomes of Acute Myocardial Infarction Hospitalizations During the COVID-19 Pandemic. Available from: https://www.acc.org/latest-in-cardiology/articles/2020/08/24/09/38/outcomes-of-acute-myocardial-infarction-hospitalizations-during-the-covid-19-pandemic. [Last accessed on 2021 Mar 03]. https://doi.org/10.3410/f.739623293.793586181

5. Lauridsen MD, Butt JH, Østergaard L, Møller JE, Hassager C, Gerds T, *et al*. Incidence of acute myocardial infarction-related cardiogenic shock during corona virus disease 19 (COVID-19) pandemic. Int J Cardiol Heart Vasc. 2020;31:100659. https://doi.org/10.1016/j.ijcha.2020.100659
   PMid:33072848

6. Tam CF, Cheung KS, Lam S, Wong A, Yung A, Sze M, *et al*. Impact of coronavirus disease 2019 (COVID-19) outbreak on outcome of myocardial infarction in Hong Kong, China. Catheter Cardiovasc Interv. 2020;13(4):e006631. https://doi.org/10.1002/ccd.28943

7. Mars 2020/Informacion i Përditësuar Për Koronavirusin COVID-19. Available from: https://www.shendetesia.gov.al/9-mars-2020-informacion-i-perditesuar-per-koronavirusin-covid_19. [Last accessed on 2021 Mar 03].

8. Për Mbylljen e Institucioneve Arsimore Për Parandalimin e Përhapjes së Covid-19 (Order of Minister of Health and Social Protection). Available from: https://www.qbz.gov.al/eli/urdher/2020/03/09/135/07a95e7a-b538-4420-b888-a392020b116d. [Last accessed on 2021 Mar 03].

9. Për Marrjen e Masave të Veçanta në Parandalimin e Përhapjes së Infeksionit të Shkaktuar Nga Covid-19 (Order of Minister of Health and Social Protection). Available from: https://www.qbz.gov.al/eli/urdher/2020/03/10/156/ef6f88e4-2dde-4c03-86d8-dca1d58275d5. [Last accessed on 2021 Mar 03].

10. Për Marrjen e Masave të Veçanta Administrative Gjate Kohezgjatjesse Periudhesse Infeksionitte Shkaktuar Nga COVID-19 (Normative act of Prime Minister). Available from: https://www.qbz.gov.al/eli/akt-normativ/2020/03/15/3/333da18e-47fd-4cc7-b38c-562ec56da463. [Last accessed on 2021 Mar 03].

11. Lehtësimi i Masave, Manastirliu: Nga e Hëna Fasha e Lëvizjes Zgjerohet në 2 Orë Fjala e Plotë e Ministres së Shëndetësisë Dhe Mbrojtjes Sociale Ogerta Manastirliu; 2020. Available from: https://www.new.shendetesia.gov.al/lehtesimi-i-masave-manastirliu-nga-e-hena-fasha-e-levizjes-zgjerohet-ne-2-ore-fjala-e-plote-e-ministres-se-shendetesise-dhe-mbrojtjes-sociale-ogerta-manastirliu. [Last accessed on 2021 Mar 03]. https://doi.org/10.33107/ubt-etd.2020.14

12. Maj 2020/Informacion i Përditësuar Për Koronavirusin COVID-19; 2020. Available from: https://www.new.shendetesia.gov.al/26-maj-2020-informacion-i-perditesuar-per-koronavirusin-covid-19. [Last accessed on 2021 Mar 03].

13. Available from: https://www.coronavirus.al/statistika. [Last accessed on 2021 Mar 03].

14. National Program on Prevention and Control of NCDs in Albania 2016-2020, Tirana, 2017 Available from: https://www.extranet.who.int/ncdccs/Data/alb_B3_NCD%20strategy%20albania_english.pdf. [Last accessed on 2021 Mar 03].

15. Thygesen K, Alpert JS, Jaffe AS, Chaitman BR, Bax JJ, Morrow DA, *et al*, ESC Scientific Document Group. Fourth universal definition of myocardial infarction. Eur Heart J. 2019;3:237-69. https://doi.org/10.1016/j.gheart.2018.08.004

16. Roffi M, Patrono C, Collet JP, Mueller C, Valgimigli M, Andreotti F, Bax JJ, *et al*, ESC Scientific Document Group. 2015 ESC guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: Task force for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation of the European society of cardiology (ESC). Eur Heart J. 2016;3:267-315. https://doi.org/10.1093/eurheartj/ehv320

    PMid:26320110

17. De Filippo O, D'Ascenzo F, Angelini F, Bocchino PP, Conrotto F, Saglietto A, *et al*. Reduced rate of hospital admissions for ACS during COVID-19 outbreak in Northern Italy. N Engl J Med. 2020;383(1):88-9.

    PMid:32343497

18. Mafham MM, Spata E, Goldacre R, Gair D, Curnow P, Bray M, *et al*. COVID-19 pandemic and admission rates for and management of acute coronary syndromes in England. Lancet. 2020;396(10248):381-9. https://doi.org/10.1016/s0140-6736(20)31356-8

19. Mesnier J, Cottin Y, Coste P, Ferrari E, Schiele F, Lemesle G, *et al*. Hospital admissions for acute myocardial infarction before and after lockdown according to regional prevalence of COVID-19 and patient profile in France: A registry study. Lancet Public Health. 2020;5(10):e536-42. https://doi.org/10.1016/s2468-2667(20)30188-2

20. Papafaklis MI, Katsouras CS, Tsigkas G, Toutouzas K, Davlouros P, Hahalis GN, *et al*. Missing acute coronary syndrome hospitalizations during the COVID-19 era in Greece: Medical care avoidance combined with a true reduction in incidence? Clin Cardiol. 2020;43:1142-9. https://doi.org/10.1002/clc.23424

    PMid:32691901

21. Rodríguez-Leor O, Alvarez-Álvarez B, Ojeda S, Martín-Moreiras J, Rumoroso JR, López-Palop R, *et al*. Impacto de la pandemia de COVID-19 sobre la actividad asistencial en cardiología intervencionista en España. REC Interv Cardiol. 2020;2(2):82-89. https://doi.org/10.24875/recic.m20000120

22. Për Shpalljen e Gjendjes së Fatkeqësisë Natyrore (Order of Prime Minister). Available from: https://www.qbz.gov.al/eli/vendim/2020/03/24/243/dc183551-1297-44e2-b35c-ffb33ee669c7. [Last accessed on 2021 Mar 03].

23. Bahit MC, Kochar A, Granger CB. Post myocardial infarction heart failure. JACC Heart Fail. 2018;6(3):179-86. https://doi.org/10.1016/j.jchf.2017.09.015

    PMid:29496021

24. Abdelaziz HK, Abdelrahman A, Nabi A, Debski M, Mentias A, Choudhury T, *et al*. Impact of COVID-19 pandemic on patients with ST-segment elevation myocardial infarction: Insights from a British cardiac center. Am Heart J. 2020;226:45-8. https://doi.org/10.1016/j.ahj.2020.04.022

    PMid:32497914

25. Hauguel-Moreau M, Pillière R, Prati G, Beaune S, Loeb T, Lannou S, *et al*. Impact of Coronavirus Disease 2019 outbreak on acute coronary syndrome admissions: four weeks to reverse the trend. J Thromb Thrombolysis. 2020;51(1):31-32. https://doi.org/10.1007/s11239-020-02201-9

    PMid:32601849