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 [9.6-15.2; 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 inhabitants [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 (\( \chi^2 \)) 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
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                                | 550      | 321     | 321 (13.3–44.0)                           | 0.001        |
| STEMI (%)                              | 217      | 156     | 156 (38.5%)                               | 0.004        |
| NSTEACS (%)                            | 333      | 156     | 156 (60.5%)                               | \(<0.0001\)  |
| Angiography n (%)                      | 284      | 156     | 156 (80.5%)                               | 0.001        |
| PCI (%)                                | 303      | 156     | 156 (66.1%)                               | 0.004        |

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; HF, heart failure; NM, non-medicant; ACEIs, angiotensin-converting enzyme inhibitors; ARBs, angiotensin II receptor blockers. *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).

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 (88.9% 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

The table and figures are not directly translatable to a plain text format without the specific context or layout. However, the content can be summarized as follows:

- **Table 1**: Baseline demographic, clinical, and angiographic characteristics

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

- **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 (88.9% 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).

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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 NSTEMI. The number of coronary angiography procedures and PCI was also
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 understimation 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 lockdown 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 NSTEMI 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 atroventricular 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 [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.

### Table 3: In-hospital outcomes

|                     | Control period n (%) | Study period n (%) | p value* |
|---------------------|----------------------|-------------------|----------|
| All ACS             | 550                  | 321               |          |
| Symptom-ICU time (SD) | 43±1.3 ± 38.8       | 940±1.1±122.4     | <0.0001  |
| ICU-ICU sheath time (SD) | 57.2 ± 3.2         | 49±3±236.9        | 0.04     |
| cTn I (SD)          | 10.8 ± 4.3          | 20±4±34.8         | 0.001    |
| Ejection Fraction (SD) | 59.9 ± 1.1          | 48±4±12.1         | 0.003    |
| Death n (%)         | 19 (3.0)            | 24 (7.4)          | 0.012    |
| 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)          | 0.303    |
| 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)           | 0.507    |

ACS: Acute coronary syndrome; ICU: Intensive care unit. cTn I: Cardiac Troponin I; VT: Ventricular fibrillation; VF: Ventricular fibrillation; AF: Atrial fibrillation; AV: Atrioventricular; **To determine statistical significance for the comparison regarding each one of in-hospital characteristics, a t-Test or a Chi-square test was used.**
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                  |
| Lezha    | 15                 | 14                 |
| Dibër    | 19                 | 10                 |
| Shkodër  | 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.

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