Original Article

Emergency Service Admission Time and In-Hospital Mortality in Acute Coronary Syndrome

Julio Yoshio Takada, Larissa Cardoso Roza, Rogério Bicudo Ramos, Solange Desiree Avakian, José Antonio Franchini Ramires, Antonio de Pádua Mansur
Instituto do Coração – HC FMUSP, São Paulo, SP – Brazil

Abstract

Background: The relationship between admission time to an emergency service and in-hospital outcomes in acute coronary syndrome (ACS) is controversial. Admission during off-hours would be associated with worse prognosis.

Objective: To assess the influence of admission time on prolonged hospitalization and mortality for ACS patients, regarding regular hours (7AM-7PM) and off-hours (7PM-7AM).

Methods: The study assessed prospectively 1,104 consecutive ACS patients. In-hospital mortality and length of hospital stay ≥ 5 days were the outcomes analyzed.

Results: Admission during regular hours was greater as compared with that during off-hours (63% vs. 37%; p < 0.001). Unstable angina was more prevalent during regular hours (43% vs. 32%; p < 0.001), while non-ST-segment elevation myocardial infarction (NSTEMI) was during off-hours (33% vs. 43%; p = 0.001). Differences in neither mortality nor length of hospital stay were observed in the time periods studied. Predictive factors for length of hospital stay ≥ 5 days were as follows: age [OR 1.042 (95%CI: 1.025 – 1.058), p < 0.001]; ejection fraction (EF) [OR 0.977 (95%CI: 0.966 – 0.988), p < 0.001]; NSTEMI [OR 1.699 (95%CI: 1.221 – 2.366), p = 0.001]; and smoking [OR 1.723 (95%CI: 1.113 – 2.668), p = 0.014]. Predictive factors for in-hospital mortality were as follows: age [OR 1.090 (95%CI: 1.047 – 1.134), p < 0.001]; EF [OR 0.936 (95%CI: 0.909 – 0.964), p < 0.001]; and surgical treatment [OR 3.781 (95%CI: 1.374 – 10.409), p = 0.01].

Conclusion: Prolonged length of hospital stay and in-hospital mortality in ACS patients do not depend on admission time. (Arq Bras Cardiol 2012;98(2):104-110)

Keywords: Hospitalization, patient admission, time factors, first aid/mortality, myocardial infarction.

Introduction

Cardiovascular diseases are the major cause of death in Brazil[1]. This was confirmed by the 2008 DATASUS registries, showing 95,000 deaths due to ischemic heart disease[2] in a universe of 1,077 million deaths in Brazil. Considering that, management strategies for the acute phase of myocardial infarction, with emphasis on early treatment, are essential to reduce the morbidity and mortality associated with ischemic myocardial disease. However, there is still controversy regarding the literature on how time of presentation to the emergency service (ES) and delays in care may influence effective treatment. Some studies have reported an increase in the time leading up to angioplasty and administration of fibrinolytics for patients presenting during the night; outcomes, however, differ regarding in-hospital mortality[3-7].

This study aimed at assessing whether the admission time of patients with acute coronary syndrome (ACS) does influence mortality, length of hospital stay, and type of treatment (clinical, surgical, or angioplasty).

Methods

This study assessed 1,104 consecutive patients diagnosed with ACS and admitted to the ES of a tertiary university-affiliated hospital from January 2004 to June 2007. The research protocol was approved by the research ethics committee of the institution.

The inclusion criteria were as follows: patient's age over 18 years; and hospital admission due to ACS, meaning presence of suggestive chest pain, electrocardiographic changes suggestive of acute myocardial ischemia, or alterations in markers of myocardial necrosis. The exclusion criteria were as follows: patient's refusal to participate in the study; and chest pain assessment without subsequent hospitalization.

Mailing Address: Julio Yoshio Takada •
Av. Dr. Enéas de Carvalho Aguiar, 44 - Cerqueira César - 05403-000 – São Paulo, SP, Brazil
E-mail: jyt@bol.com.br, julio.takada@incor.usp.br
Manuscript received May 11, 2011; revised manuscript received August 23, 2011; accepted August 30, 2011.

The following patients' characteristics were assessed: presence of classical risk factors for coronary artery disease (CAD); use of medications; preliminary laboratory tests; time of presentation to the ES; number of coronary arteries affected; treatment; length of hospital stay; and in-hospital mortality.

The time of admission to the ES was categorized according to the time of arrival to the ES as follows: regular hours (7AM to 7PM) and off-hours (7PM to 7AM). The risk factors for CAD were as follows: smoking; diabetes mellitus; systemic arterial hypertension; dyslipidemia; and family history of CAD. Regarding presention, the ACS was classified as follows: unstable angina (UA); non-ST-segment elevation myocardial infarction (NSTEMI); and ST-segment elevation myocardial infarction (STEMI). In addition, laboratory tests, echocardiogram, use of medications during hospitalization, and coronary angiography were assessed. Coronary artery lesion was considered in the presence of at least a 50% reduction in the lumen of major epicardial coronary arteries. The treatment used was characterized as follows: clinical; angioplasty with stent placement; and coronary artery bypass graft surgery. A length of hospital stay ≥ 5 days was considered long, according to previous studies[5,8]. The primary objective of this study was to assess the influence of the admission time of ACS patients on in-hospital mortality. The secondary objective was to assess the length of hospital stay and type of treatment used (clinical, surgical, or angioplasty).

Statistical analysis

Categorical and continuous variables were analyzed by use of the chi-square and Student *t* tests, respectively. In-hospital mortality was assessed by use of Kaplan-Meyer curves and stratified according to the admission periods. For multivariate analysis, logistic regression and stepwise model were used, with inclusion and permanence of variables with $p < 0.05$. However, death was the dependent variable adjusted for: (1) presentation to the ES during regular hours or off-hours; (2) age; (3) presence of arterial hypertension; (4) presence of smoking; (5) familial history of dyslipidemia; (6) familial history of diabetes; (7) familial history of CAD; (8) sex; (9) type of ACS (UA, NSTEMI, and STEMI); (10) ejection fraction (EF); and (11) type of treatment (clinical, surgical, or angioplasty). The same model and independent variables were used for a second multivariate analysis, the length of hospital stay being the dependent variable (< 5 or ≥ 5 days). The level of statistical significance adopted was $p < 0.05$. The SAS software, version 9.2, was used.

Results

The patients' clinical and laboratory characteristics are shown in Table 1. The mean and median length of hospital stay were 5.1 ± 8.0 days and 3 days, respectively. On univariate analysis, the presentation during regular hours showed: a higher prevalence of dyslipidemias (48% *vs.* 42%; p = 0.043); higher BMI (26.9 *vs.* 26.3 kg/m^2; p = 0.043); lower diastolic blood pressure (87.6 *vs.* 89.9 mmHg; p = 0.047); lower total white blood cell count (9,120 *vs.* 9,628 cells/mm^3; p = 0.016); higher sodium levels (139.5 *vs.* 139.9 mEq/L; p = 0.032); and lower levels of total cholesterol (179.0 *vs.* 186.8 mg/dL; p = 0.042) and LDL-cholesterol (105.9 *vs.* 112.5 mg/dL; p = 0.048). Considering patients with UA or NSTEMI, 92% used clopidogrel or glycoprotein IIb/IIIa inhibitor before the angiographic study. Table 2 shows the diagnoses, the result of cardiac catheterization with blocked coronary arteries, and the outcomes death and length of hospital stay ≥ 5 days. Higher prevalence of UA (42.6% *vs.* 31.9%; p < 0.001) and lower prevalence of NSTEMI (33.4% *vs.* 43.3%; p = 0.001) were observed during regular hours. Regarding the blocked coronary artery, the anterior descending artery (32.7%) was more often affected than the right coronary (23.9%) and circumflex (20.9%) arteries. The diagonal artery (7.4%), saphenous vein grafts (2.3%) and left main coronary artery (1.8%) were less frequently affected. No difference was observed in the following: medications used; the blocked coronary artery type of treatment for ACS; and the outcomes death (3.4% *vs.* 4.7%; p = 0.292) and length of hospital stay ≥ 5 days (23.3% *vs.* 25.7%; p = 0.358).

Table 3 shows the variables identified, on multivariate analysis, as independent factors related to the length of hospital stay ≥ five days as follows: age (OR = 1.042; p < 0.001); EF (OR = 0.977; p < 0.001); NSTEMI (OR = 1.699; p = 0.001); and smoking (OR = 1.723; p = 0.014). The independent factors related to in-hospital death were as follows: age (OR = 1.090; p < 0.001); EF (OR = 0.936; p < 0.001); and surgical treatment (OR = 3.781; p = 0.01). No correlation was observed between the time of admission to the ES and the ACS presentation type (p = 0.636). Dividing patients according to ACS presentation, the results for in-hospital mortality were similar when the same model was used. For patients with UA (n = 427), in-hospital mortality related to higher age (OR = 1.155; 95% CI = 1.029 – 1.297; p = 0.015), while for those with NSTEMI (n = 409) in-hospital mortality related to lower age (OR = 1.087; 95% CI = 1.029 – 1.149; p = 0.003) and lower EF (OR = 0.924; 95% CI = 0.886 – 0.962; p < 0.001). For patients with STEMI (n = 268), no independent risk fator for in-hospital mortality was identified.

Table 4 shows the effects of the following variables on mortality and length of hospital stay ≥ 5 days: age over or under 65 years; ACS presentation; treatment type; and EF greater or lower than 50%. Mortality was higher in the following patients: elderly (7.0% *vs.* 1.9%; p < 0.001); patients with STEMI (6.0% *vs.* 3.5% *vs.* 1.6%, as compared with NSTEMI and UA, respectively; p < 0.001); patients requiring coronary artery bypass graft surgery in the same hospitalization (9.4% *vs.* 3.5% *vs.* 3.5%, as compared with angioplasty and clinical treatment, respectively; p < 0.001); patients with EF lower than 50% (7.6% *vs.* 1.9%; p < 0.001). The length of hospital stay ≥ 5 days was more common among patients with the following characteristics: age ≥ 65 years (32.4% *vs.* 19.0%; p < 0.001); NSTEMI (32.8% *vs.* 23.1% *vs.* 16.6%, as compared with STEMI and UA, respectively; p < 0.001); surgery (81.2% *vs.* 24.5% *vs.* 15.2%, as compared with angioplasty and clinical treatment, respectively; p < 0.001); and EF lower than 50% (39.8% *vs.* 27.1%; p < 0.001).

Figure 1 depicts the Kaplan-Meyer curve evidencing similar in-hospital mortality (log-rank; p = 0.317) for regular-hour and off-hour admissions.

Original Article

Table 1 – Clinical and laboratory characteristics according to regular-hour or off-hour presentation to the ES

Factor	All patientes	Regular hours	Off-hours	p
Patients, n (%)	1,104 (100%)	700 (63.4)	404 (36.6)	
Age (years)*	61.3 (±11.8)	61.3 (±11.7)	61.3 (±12.1)	0.934
Male sex, n (%)	670 (60.7)	434 (62.0)	236 (58.4)	0.240
Age > 65 years, n (%)	429 (38.9)	270 (38.6)	159 (39.4)	0.796
Risk factors, n (%)				
Previous coronary disease	554 (50.2)	350 (50.1)	204 (50.5)	0.892
Arterial hypertension	876 (79.3)	564 (80.6)	312 (77.2)	0.186
Smoking	250 (22.6)	156 (22.3)	94 (23.3)	0.707
Dyslipidemia	506 (45.8)	337 (48.1)	169 (41.8)	0.043
Diabetes	352 (31.2)	229 (32.7)	123 (30.5)	0.436
Family history of coronary disease	179 (16.2)	111 (15.9)	68 (16.8)	0.672
Physical examination*				
Body mass index	26.7 (±4.3)	26.9 (±4.2)	26.3 (±4.6)	0.043
Systolic blood pressure (mmHg)	142.8 (±29.4)	141.7 (±28.1)	144.9 (±31.4)	0.090
Diastolic blood pressure (mmHg)	88.4 (±17.3)	87.6 (±15.8)	89.9 (±19.5)	0.047
Laboratory tests*				
Hemoglobin (g/dL)	13.8 (±1.8)	13.9 (±1.7)	13.8 (±1.8)	0.617
Leukocytes (/mm3)	9,307.4 (±3,317.8)	9,120.4 (±3,207.7)	9,628.4 (±3,479.6)	0.016
Monocytes (%)	8.6 (±3.0)	8.7 (±8.4)	8.3 (±2.7)	0.086
Platelets (/mm3)	236,030.8 (±69,436.9)	235,461 (±72,273.1)	237,008 (±64,361.9)	0.720
Sodium (meq/L)	139.6 (±3.2)	139.5 (±3.2)	139.9 (±3.3)	0.032
Potassium (meq/L)	4.6 (±0.6)	4.6 (±0.6)	4.6 (±0.6)	0.720
Urea (mg/dL)	42.9 (±24.4)	42.8 (±23.5)	43.2 (±26.1)	0.794
Creatinine (mg/dL)	1.2 (±1.2)	1.3 (±1.4)	1.2 (±0.7)	0.065
Creatine kinase MB (CKMB) peak (ng/mL)	55.9 (±101.3)	52.9 (±100.0)	60.8 (±103.2)	0.223
Troponin I (ng/mL)	20.7 (±40.4)	18.8 (±38.8)	23.8 (±42.9)	0.057
Total cholesterol (mg/dL)	181.6 (±50.1)	179.0 (±50.3)	186.8 (±49.6)	0.042
HDL-cholesterol (mg/dL)	42.7 (12.7)	42.6 (±12.9)	43.1 (±12.3)	0.606
LDL-cholesterol (mg/dL)	108.1 (±41.1)	105.9 (±38.8)	112.5 (±44.8)	0.048
Triglycerides (mg/dL)	156.9 (±95.4)	154.5 (±100.8)	161.6 (±83.9)	0.312
Glycemia (mg/dL)	131.4 (±62.5)	130.1 (±62.2)	133.7 (±63.0)	0.413
Ejection fraction on echocardiogram (%)†	53.0 (±14.6)	53.1 (±14.7)	53 (±14.5)	0.910
Drugs, n (%)				
Nitrates	811 (76.1)	512 (75.7)	299 (76.7)	0.733
ASA	991 (93.2)	630 (93.3)	361 (93)	0.855
Statins	580 (54.4)	363 (53.7)	217 (55.5)	0.569
Angiotensin-converting enzyme inhibitors	599 (56.1)	385 (56.9)	214 (54.9)	0.527
Glycoprotein IIb/IIIa inhibitor	464 (43.6)	285 (42.3)	179 (45.8)	0.267
Clopidogrel	303 (28.4)	193 (28.5)	110 (28.4)	0.956
Unfractionated heparin	449 (42.1)	272 (40.2)	177 (45.5)	0.091
Low-molecular-weight heparin	367 (34.3)	236 (34.8)	131 (33.5)	0.665
Diuretics	105 (9.8)	65 (9.6)	40 (10.2)	0.733
Fibrinolytics	19 (1.8)	11 (1.6)	8 (2.0)	0.613
Calcium channel blockers	71 (6.6)	46 (6.8)	25 (6.4)	0.800
Beta-blockers	813 (73.6)	512 (73.1)	301 (74.5)	0.621

**Continuous variables are shown as mean ± standard deviation; † ejection fraction available in 723 patients.*

Discussion

In this study, no influence of the time of admission to the ES was observed on in-hospital mortality of patients with ACS. Ting et al[9] have reported that admission during off-hours can increase the delay time, because of the reduced size of the health care teams[9]. Usually, catheterization laboratories offer only on-call services during off-hours. The amount of time between a patient's arrival at the ES and the time the blocked artery is opened, the so called "door-to-balloon time" in primary angioplasty or "door-to-needle time" in fibrinolysis, can be compromised during off-hours, and fibrinolytics are preferred to primary angioplasty for STEMI. Although it has not been established that the early invasive strategy results in lower mortality in NSTEMI, some clinically or hemodynamically unstable patients can benefit from that procedure[8,10]. The baseline clinical characteristics of the patients studied were similar, except for the higher prevalence of UA for arrival during regular hours, and of NSTEMI for arrival during off-hours. This might be due to the fact that, during regular hours, patients with less specific symptoms can more easily seak the ES for assessment. The outcomes were also similar for the regular-hour and off-hour arrivals, and the major independent factors for death were as follows: higher age; lower left ventricular EF; and higher frequency of coronary artery bypass graft surgery in the same hospitalization[11,12]. For the outcome hospitalization ≥ five days, the independent variables were as follows: higher age; lower left ventricular EF; presence of smoking; and NSTEMI, which might be related to greater overall severity, because it was more frequent in elderly patients and those with a greater prevalence of previous CAD. The literature about the influence of the admission time on clinical outcomes is conflicting, but temporal and methodological influences can account for such differences. Using the Myocardial Infarction Data Acquisition System (MIDAS) from 1987 to 2002, Kostis et al[5] have assessed admission on weekends, mortality at 30 days being the primary outcome. Comparing with admission on weekdays, the broader analysis adjusted by use of Cox model, for the period from 1999 to 2002, has shown higher mortality from the second day of admission on and at one year for patients admitted on weekends. That might be explained by the lower rate of invasive cardiac procedures on weekends, since those patients underwent fewer coronary angiographies, angioplasties or surgeries on their first day of admission. Magid et al[3] have assessed patients with STEMI of the database of the National Registry of Myocardial Infarction (NRMI), in the period from 1999 to 2002, and compared their admissions during regular hours and off-hours. Patients admitted during off-hours had a longer door-to-balloon time, while door-to-needle time was similar in both groups. The model adjusted for all variables showed higher mortality for patients admitted off-hours; however, when also adjusted for reperfusion time, mortality did not differ. It is worth noting that two-thirds of the patients in that registry were admitted off-hours. Maier et al[6] have assessed, in the Berlin Myocardial Infarction

Table 2 - **Diagnoses, cardiac catheterization and outcomes of hospitalization**

Factor	All patients	Regular hours	Off-hours	p
CAD presentation, n (%)				
Unstable angina	427 (38.7)	298 (42.6)	129 (31.9)	<0.001
NSTEMI	409 (37.0)	234 (33.4)	175 (43.3)	0.001
STEMI	268 (24.3)	168 (24)	100 (24.7)	0.778
Cardiac catheterization – blocked coronary arteriy, n (%)†				
Left main coronary artery	20 (1.8)	13 (1.9)	7 (1.7)	0.881
Anterior descending artery	361 (32.7)	232 (33.1)	129 (31.9)	0.679
Diagonal artery	82 (7.4)	54 (7.7)	28 (6.9)	0.632
Right coronary artery	264 (23.9)	160 (22.8)	104 (25.7)	0.279
Circumflex artery	231 (20.9)	146 (20.8)	185 (21.0)	0.942
Saphenous graft	25 (2.3)	17 (2.4)	8 (2.0)	0.629
Treatment, n (%)				
Clinical	394 (35.7)	246 (35.1)	148 (36.6)	0.618
Angioplasty‡	648 (58.7)	408 (58.3)	240 (59.4)	0.716
Surgery‡	64 (5.8)	46 (6.6)	18 (4.5)	0.147
Outcomes, n (%)				
Death	43 (3.9)	24 (3.4)	19 (4.7)	0.292
Hospitalization ≥ 5 days	267 (24.2)	163 (23.3)	104 (25.7)	0.358

** Continuous variables are shown as mean ± standard deviation; † some patients have more than one artery affected; ‡ two patients underwent angioplasty and coronary artery bypass graft surgery. CAD - coronary artery disease; NSTEMI - non-ST-segment elevation myocardial infarction; STEMI - ST-segment elevation myocardial infarction.*

Original Article

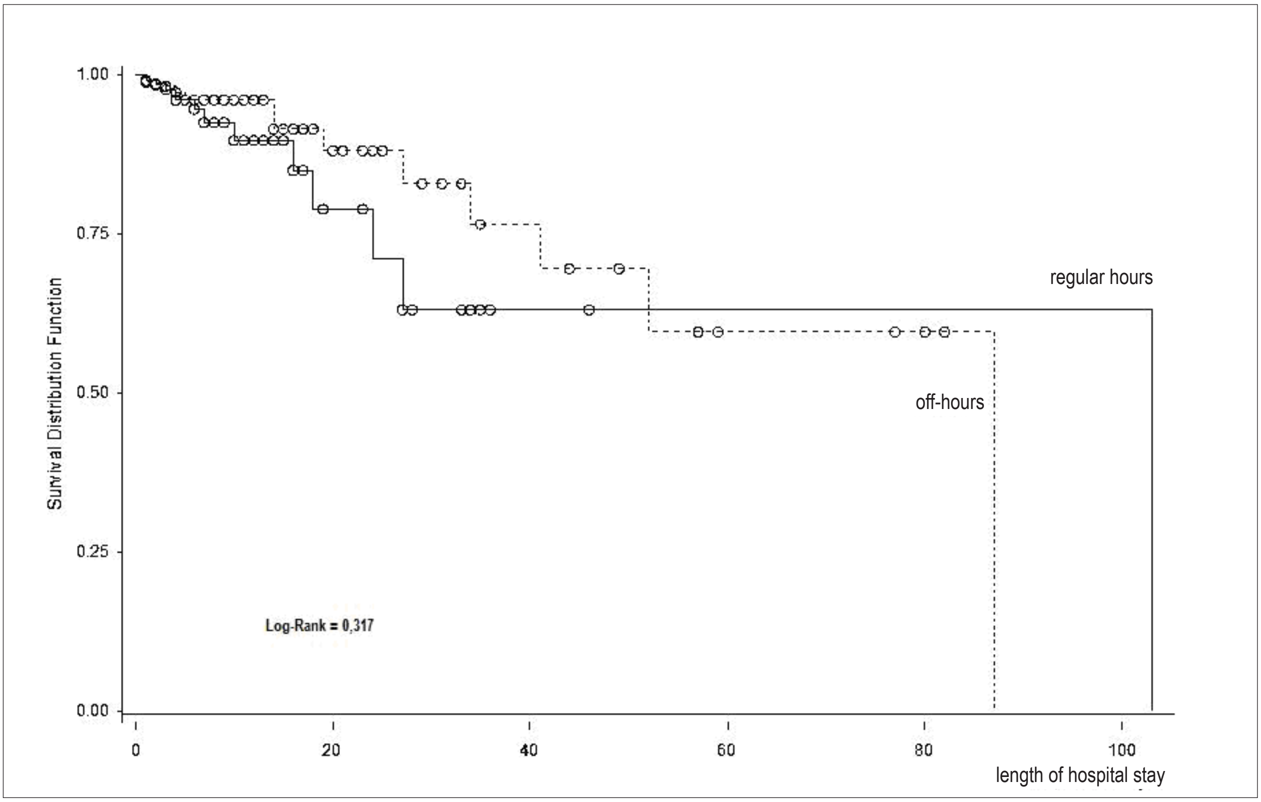

Figure 1 – *In-hospital event-free survival curve comparing regular-hour and off-hour admissions.*

Table 3 - Independent factors for length of hospital stay ≥ 5 days and mortality on multivariate analysis

Factor for length of hospital stay ≥ 5 days	Odds Ratio	Lower limit (95%)	Upper limit (95%)	p
Age	1.042	1.025	1.058	< 0.001
Ejection fraction	0.977	0.966	0.988	< 0.001
NSTEMI	1.699	1.221	2.366	0.015
Smoking	1.723	1.113	2.668	0.002
Factor for mortality - ACS				
Age	1.09	1.047	1.134	< 0.001
Ejection fraction	0.936	0.909	0.964	< 0.001
Surgery	3.781	1.374	10.409	0.01
Factor for mortality - UA				
Age	1.155	1.029	1.297	0.015
Factor for mortality - NSTEMI				
Age	1.087	1.029	1.149	0.003
Ejection fraction	0.924	0.886	0.962	< 0.001
Factor for mortality - STEMI				
* No independent factor				

NSTEMI - non-ST-segment elevation myocardial infarction; ACS - acute coronary syndrome; UA - unstable angina; STEMI - ST-segment elevation myocardial infarction.

Table 4 - **Univariate analysis comparing age, CAD presentation, treatment type, and ejection fraction related to mortality and length of hospital stay ≥ 5 days**

Factor, n (%)	Death	Length of hospital stay ≥ 5 days
< 65 years	13 (1.9)	128 (19.0)
≥ 65 years	30 (7.0)	139 (32.4)
p	< 0.001	< 0.001
Unstable angina	7 (1.6)	71 (16.6)
NSTEMI	20 (4.9)	134 (32.8)
STEMI	16 (6.0)	62 (23.1)
p	0.007	< 0.001
Clinical	24 (3.5)	60 (15.2)
Angioplasty	23 (3.5)	159 (24.5)
Surgery	6 (9.4)	52 (81.2)
p	0.019	< 0.001
Ejection fraction ≥ 50%	9 (1.9)	127 (27.1)
Ejection fraction < 50%	19 (7.6)	100 (39.8)
p	< 0.001	< 0.001

NSTEMI - non-ST-segment elevation myocardial infarction; STEMI - ST-segment elevation myocardial infarction.

Registry (BMIR), patients with STEMI treated exclusively with primary angioplasty, from 2004 to 2007. Patients admitted during off-hours had a longer door-to-balloon time (79 *vs.* 90 minutes; p < 0.001) and higher mortality (6.8% *vs.* 4.3%; p = 0.020). However, in the subgroup of patients cared for at the Medical Emergency Service (pre-hospital health care service comprising an ambulance and clinician, who contacts the catheterization laboratory team of the closest hospital, and takes the patient directly to the catheterization laboratory), mortality did not differ between regular hours and off-hours (7.2% *vs.* 5.1%; p = 0.128), even with a longer door-to-balloon time (80 *vs.* 68 minutes; p < 0.001). Those authors have concluded that the pre-hospital health care service could be a strategy to reduce both door-to-balloon time and mortality. Casella et al[7] have shown that patients admitted during off-hours had a longer pain-to-balloon time (195 *vs.* 186 minutes; p = 0.03), but similar mortality (5.8% *vs.* 7.2%), when angioplasty was performed at the reference center for infarction. Those authors have concluded that, at an efficient STEMI network focused on reperfusion, mortality does not differ according to admission time. Other factors, such as circadian rhythm[13,14] and treatment outcomes[15] can also contribute to differences between the admission times.

Limitations

Because of limitations in the database, the following variables were not assesed: door-to-balloon time; time between symptom onset and opening of the blocked coronary artery; electrocardiographic alterations; and risk scores. However, we believe that the final outcome (death and length of hospital stay) is the best tool to assess differences between the results of presentation during regular hours and off-hours. Our study was limited to assessing in-hospital outcomes, and did not assess differences over longer periods. This is a single-center study and included simultaneously UA, NSTEMI and STEMI. The morbidity and mortality of those ACS presentations are different, but, for the purpose of assessing differences between admission times, we believed that grouping those presentations would be more informative than the analysis of each component in isolation. Even if the impact of occasional delays on therapy can be greater in STEMI as compared with that in NSTEMI, in our study, we observed no independence in logistic regression for any specific ACS presentation.

Conclusion

In emergency services specialized in interventional care, the prognosis of patients with ACS do not depend on the admission time, but is related to age, systolic ventricular dysfunction, and the need for early coronary artery bypass graft surgery, reflecting the severity of the disease. The length of hospital stay relates to age, systolic ventricular dysfunction, smoking habit, and NSTEMI, factors that also reflect a more extensive CAD. Such results are similar to those of other countries, in services of high cardiological complexity.

Acknowledgements

To FAPESP, for the scientific initiation scholarship (protocol 06/52367-1), and to CNPq, for partial financial support.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

This study was funded by FAPESP and CNPq.

Study Association

This study is not associated with any post-graduation program.

References

1. Mansur AP, Favarato D, Avakian SD, Ramires JA. Trends in ischemic heart disease and stroke death ratios in brazilian women and men. Clinics. 2010;65(11):1143-7.
2. Ministério da Saúde. DATASUS. Óbitos por ocorrência por sexo segundo Grupo CID-10. [Acesso em 2011 abr. 14]. Disponível em: http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/obt10uf.def

3. Magid DJ, Wang Y, Herrin J, McNamara RL, Bradley EH, Curtis JP, et al. Relationship between time of day, day of week, timeliness of reperfusion, and in-hospital mortality for patients with acute ST-segment elevation myocardial infarction. JAMA. 2005;294(7):803-12.

4. Jneid H, Fonarow GC, Cannon CP, Palacios IF, Kilic T, Moukarbel GV, et al. Impact of time of presentation on the care and outcomes of acute myocardial infarction. Circulation. 2008;117(19):2502-9.

5. Kostis WJ, Demissie K, Marcella SW, Shao YH, Wilson AC, Moreyra AE; Myocardial Infarction Data Acquisition System (MIDAS 10) Study Group. Weekend versus weekday admission and mortality from myocardial infarction. N Engl J Med. 2007;356(11):1099-109.

6. Maier B, Behrens S, Graf-Bothe C, Kuckuck H, Roehnisch JU, Schoeller RG, et al. Time of admission, quality of PCI care, and outcome of patients with ST-elevation myocardial infarction. Clin Res Cardiol. 2010;99(9):565-72.

7. Casella G, Ottani F, Ortolani P, Guastaroba P, Santarelli A, Balducelli M, et al. Off-hour primary percutaneous coronary angioplasty does not affect outcome of patients with ST-segment elevation acute myocardial infarction treated within a regional network for reperfusion the REAL (Registro Regionale Angioplastiche dell'Emilia-Romagna) Registry. JACC Cardiovasc Interv. 2011;4(3):270-8.

8. Riezebos RK, Tijssen JG, Verheugt FW, Laarman GJ. Percutaneous coronary intervention for non ST-elevation acute coronary syndromes: which, when and how? Am J Cardiol. 2011;107(4):509-15.

9. Ting HH, Bradley EH, Wang Y, Lichtman JH, Nallamothu BK, Sullivan MD, et al. Factors associated with longer time from symptom onset to hospital presentation for patients with ST-elevation myocardial infarction. Arch Intern Med. 2008;168(9):959-68.

10. Montalescot G, Cayla G, Collet JP, Elhadad S, Beygui F, Le Breton H, et al. Immediate *vs.* delayed intervention for acute coronary syndromes: a randomized clinical trial. JAMA. 2009;302(9):947-54.

11. Aguiar AA, Mourilhe-Rocha R, Esporcatte R, Corrêa Natte LA, Tura BR, Albuquerque DC. Long-term analysis in acute coronary syndrome: are there any differences in morbidity and mortality? Arq Bras Cardiol. 2010;95:705-12.

12. Kim MC, Ahn Y, Cho KH, Lee MG, Ko JS, Park KH, et al. Early statin therapy within 48 hours decreased one-year major adverse cardiac events in patients with acute myocardial infarction. Int Heart J. 2011;52(1):1-6.

13. Holmes DR Jr, Aguirre FV, Aplin R, Lennon RJ, Nestler DM, Bell MR, et al. Circadian rhythms in patients with ST-elevation myocardial infarction. Circ Cardiovasc Qual Outcomes. 2010;3(4):382-9.

14. LaBounty T, Eagle KA, Manfredini R, Fang J, Tsai T, Smith D, et al. The impact of time and day on the presentation of acute coronary syndromes. Clin Cardiol. 2006;29(12):542-6.

15. Jernberg T, Johanson P, Held C, Svennblad B, Lindbäck J, Wallentin L; SWEDEHEART/RIKS-HIA. Association between adoption of evidence-based treatment and survival for patients with ST-elevation myocardial infarction. JAMA. 2011;305(16):1677-84.