CLINICAL STUDIES

Review of Clinical Characteristics and Management of Patients with ST Segment Elevation Myocardial Infarction at aTertiary Care Center

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Background: **Information from recent multiple trials on the pathophysiology and outcome of ST-segment elevation myocardial infarction (STEMI) has changed its clinical perspective and strategic management, leading to a revision of the 1999 ACC/AHA practice guidelines for that condition.** *Objective:* **Analyze the clinical characteristics, management strategies, the timing of therapeutic interventions and outcome of patients with STEMI referred to the Cardiovascular Center of Puerto Rico (CVCPR).** *Methods:* **Retrospective review of medical records of all patients admitted to the CVCPR with a diagnosis of STEMI from January 1, 2003 to December 31, 2003.** *Results: A* **total of 184 medical records were reviewed. Seventy- six percent of patients were men, mean age was 62.1 ± 11.8 years. A high prevalence of coronary risk factors was present: systemic hypertension (64%), diabetes mellitus (40%), dyslipidemia (35%), smoking (33%) and previous CAD (32%). Less than 1/4 of referral forms contained data indicative of whether patients had received antiplatelet therapy, beta-blockers, ACE inhibitors or statins. Fifty percent of patients arrived to the CVCPR more than 48 hours after diagnosis. Only forty-two patients (23%) arrived within 12 hours. Thrombolytic therapy had been used in 27% of them. 179 (97%) patients underwent coronary angiography, 69.2% of which had multivessel disease. 114 (62%) patients underwent percutaneous coronary interventions (PCI) with stenting. Patients submitted to PCI and stenting of the culprit lesion had a better outcome and survival than the ones not exposed to those procedures (p=0.02). Approximately two-third of patients received secondary prevention medications upon discharge.** *Conclusions:* **Relevant findings of this review were that in spite of high prevalence of CAD major risk factors, the use of medications of proven benefit for prevention and treatment of CAD at referral centers was less than that recommended by current guidelines, a significant delay in the transfer of patients to the tertiary care facility (in most cases that period exceeded more than 48 hours after diagnosis) and a reduced utilization of thrombolytic therapy. Intensification of the education of physicians throughout the island regarding these matters is to be encouraged. Additional measures should include, development of written protocols at referral centers to assure a more expedite clinical assessment of patients, an enhancement of their capability for utilizing fibrinolytic agents in suitable candidates and the timely transfer to PCI-capable facilities of patients that may still benefit from catheter reperfusion.**

Key words: ST segment elevation myocardial infarction, STEMI, myocardial infarction, diagnosis, revascularization, percutaneous coronary intervention, thrombolysis.

The information gathered during recent years regarding the pathophysiology and clinical outcome of ST segment elevation myocardial infarction [STEMI] (including true posterior MI or MI with new or presumably new left bundle-branch block) in multiple clinical trials, has dramatically changed the clinical perspective and strategic management of this condition (1-3). Current goals in the management of STEMI are the relief of ischemic pain, assessment and stabilization of the hemodynamic status, prompt initiation of reperfusion therapy and administration of antithrombotic agents for prevention of recurrent thrombosis of an ulcerated plaque or a subtotal coronary stenosis. Urgent reperfusion therapy, either pharmacologically (thrombolysis) or through a catheter-based approach (primary percutaneous intervention [PCI]) is the mainstay of such therapy (4, 5).

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Although, PCI, if performed in a timely fashion, is the reperfusion modality of choice, lack of readily available cardiac catheterization facilities and skilled operators along with considerable delays in its implementation, have left thrombolysis as the most frequently used approach worldwide. What is considered essential is that when employing either of such intervention modalities, reperfusion should occur as early as possible after the onset of symptoms, for salvaging the at-risk myocardial tissue and reduction of infarct size, mortality and other clinical events (6-8).

The American College of Cardiology and the American Heart Association (ACC/AHA) Task Force on Practice Guidelines has recently updated the 1999 guidelines for the management of STEMI (9). The updated guidelines reflect recent advances in the treatment of STEMI and encourage the development of guideline-based, institutional-specific protocols for timely compliance with vital time frames in the diagnostic evaluation and therapeutic interventions for this condition. Adherence to those vital time frames is a must for prompt restoration of flow to the infarct-related artery. Persistence of room for improvement in of caring for STEMI patients in the United States has been reported (10, 11). Little information is available regarding an overview of the management of patients with STEMI in Puerto Rico. This study summarizes the clinical characteristics, the timing of the diagnostic and therapeutic interventions, the management strategies, and the hospital course and outcome of patients with STEMI referred to the Cardiovascular Center of Puerto Rico (CVCPR) during the period of one year.

Methods

A retrospective review of all medical records of patients, eighteen years and older admitted to the CVCPR with a diagnosis of STEMI since January 1 to December 31 2003 was performed. A written permission for medical record review was requested and granted by the Ethical and Research Committee of the CVCPR.

Statistical analysis. Epi-Info version 6.04d was utilized for data entry and validation, and the Statistical Analysis System (SAS software, version 8.02, SAS Institute, Cary, North Carolina) was used to perform the statistical analysis. Continuous variables were expressed as mean ± standard deviation (SD). Categorical variables were expressed as percentages. Chi-square test or Fisher's exact test, when appropriate, was used to determine characteristics associated with in-hospital mortality. A p value less than 0.05 was defined as statistical significance.

Results

A total of 184 records of patients admitted to the CVCPR from January 1, 2003 to December 31 2003 with a diagnosis of STEMI were reviewed. A summary of the demographic and clinical characteristics of the studied population is presented in Table 1. Seventy-six percent of patients were men and their mean age was 62.1 ± 11.8 years (range 32 to 96 years). A high prevalence of coronary risk factors was observed, the most prevalent of which were systemic hypertension (64%), diabetes mellitus (40%), and dyslipidemia (35%). Approximately 18% of the patients had previous history of cardiovascular disease. Twenty-seven percent had received thrombolytic therapy at their source of referral. Less than one-fourth of the patients' referral forms included data on whether they had received antiplatelet therapy, beta-adrenergic blocking drugs, ACE inhibitors or statins prior to arriving to the CVCPR. Most of the patients were referred from medical institutions outside this center. Ninety-two patients (50%) arrived to the CVCPR more than 48 hours after their diagnosis of STEMI and only forty-two patients (23%) arrived to the tertiary center within 12 hours after their diagnosis (Table 2). The clinical information after the patients' arrival to the

Table 1. Baseline Clinical Characteristics (n= 184)

Characteristics	Number (%)
Demographics	
Age* ≥ 65 years	79 (43.4)
Men	137 (76)
Clinical risk factors	
Hypertension	117 (64)
Diabetes mellitus	73 (40)
Dyslipidemia	64 (35)
Smoking	61 (33)
Cardiovascular history	
Prior infarction	18 (10)
Prior CABG	6 (3.3)
Peripheral arterial disease	8 (4.3)
Trombolytic therapy	50 (27)
Streptokinase	41 (82)
Drug Therapy at source of referral	
Aspirin	44 (24)
ACE inhibitors	34 (18)
Angiotensin receptor blockers	15 (8)
Beta blockers	38 (21)
Nitrates	27 (15)
Clopidogrel	17 (9)
Statins	24 (13)
Calcium channel blockers	20 (11)
Source of referral	
University Hospital	61 (33)
Outside Institutions	123 (67)

* Mean age ± SD: 62.1 ± 11.8 (Range: 32 - 96)

Table 2. Time of Arrival after Diagnosis

Time of Arrival of Patients after Diagnosis (n = 182)*	
Time	**Number (%)**
1-2 hours	8 (4.4)
3-6 hours	15 (8.2)
7-12 hours	19 (10.3)
13-24 hours	26 (14.1)
25-48 hours	22 (12.0)
>48 hours	92 (50.0)

*Two cases not quantified

CVCPR is described in Table 3. The anatomical localization of most infarctions was the anterior myocardial wall. One hundred seventy-seven patients (97%) underwent coronary angiography,and presence of multivessel coronary artery disease was disclosed in 127 (71.7%) of them. In agreement with the location of most infarctions most target lesions were located in the left anterior descending coronary artery (LAD). Approximately two-thirds of the patients underwent PCI. Of those, 95(83.3%)underwent stenting. Complications that occurred in the study population at the tertiary center are included in Table 4. There were 23 (12.6%) deaths. The most commonly observed complications in those that died were cardiac arrhythmias, heart failure, need for mechanical ventilation and cardiac arrest. Female gender, blood glucose over 200 mg/dL, renal insufficiency and peripherovascular disease were markers for increased mortality. Patients that exhibited tachycardia, hypotension, heart failure, less than 35% ejection fraction, cardiogenic shock or that required inotropics and mechanical ventilation also experienced higher mortality. (Data not shown).The ones submitted to PCI and stenting of the culprit lesion had a lower mortality than those not exposed to those procedures (Figures 1, 2). Approximately two-thirds of the patients received prescriptions for appropriate medications for the secondary prevention of atherosclerosis upon discharge from the tertiary center (Table 3).

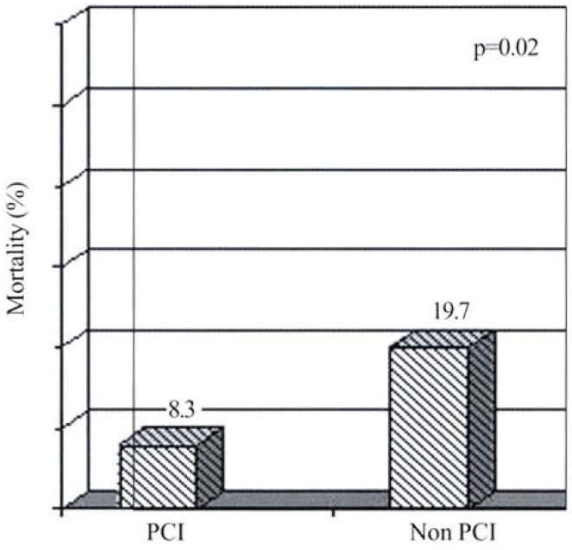

Figure 1. Performance of PCI and Mortality

Table 3. Hospital data at receiving center (n=184)

Characteristic	Number (%)	Characteristic	Number (%)
Anatomical Location of STEMI		**Type of PCI**	
Anterior	96 (52.2)	Primary PVI	25 (22)
Inferior	82 (44.6)	Rescue	32 (28)
New left bundle branch block	4 (2.2)	Late PCI	55 (48)
Coronary angiography	177 (97)	**Drug therapy during hospitalization**	
Multivessel disease	127 (71.7)	Aspirin	156(85)
Proximal LAD	46 (25)	ACE inhibitors	130(71)
Mid LAD	39 (21.2)	Beta Blockers	162(89)
Proximal circumflex	10 (5.4)	Clopidogrel	143(78)
Mid circumflex	18 (9.8)	Nitrates	152(83)
Distal circumflex	2 (1.1)	Glycoprotein IIb/	80(43)
Proximal RCA	18 (9.8)	IIIa inhibitors	
Mid RCA	19 (10.3)	Unfractionated	23(13)
Distal RCA	15 (8.7)	heparin	
Left ventricular function (%)		Low molecular	119(65)
31 (16.8)		weight heparin	>50%
35 – 50%	84 (45.6)	**Drug therapy upon discharge**	
<35%	51 (27.7)	Aspirin	132(72)
Percutaneous coronary		ACE inhibitors	112(61)
Interventions (PCI)	114 (62.3)	Beta blockers	126(68)
Without stenting	19 (16.6)	Clopidogrel	115(63)
With stenting	95 (83.3)	Statins	114(62)

Discussion

This retrospective review has provided relevant findings regarding the evaluation and care offered to a sample of patients with STEMI in our community and of the need for establishment of institution-specific, guideline-based protocols for triage and management of patients with this condition in our milieu. A significant number of the

Table 4. Complications during Hospitalization

Complication	Percent (%)
Death	12.6
Heart failure	16.0
Cardiogenic shock	11.0
Cardiac arrest	12.5
Mechanical ventilation	15.0
Bleeding	10.7
Arrhythmias	21.0
Infection	10.0
Cerebrovascular accidents	1.6
Renal failure	4.9
Stent thrombosis	3.9

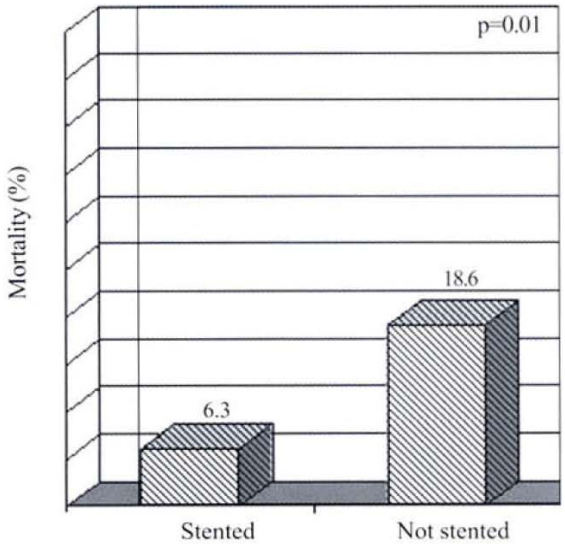

Figure 2. Stenting of Culprit Lesion and Mortality

analyzed referral notes showed that in spite of a high prevalence of CAD major risk factors present in the studied population, there was a less than recommended use in current practice guidelines of medications of proven benefit and efficacy for prevention and treatment of coronary artery disease, like aspirin, beta adrenergic blocking agents and statins. Moreover, a similar less than recommended utilization of medications of proven benefit for relief of ischemic pain, stabilization of the hemodynamic status and reduction of ischemia, occurred at the referral centers after a diagnosis of STEMI was confirmed. It is widely agreed, that in absence of absolute contraindications, antiplatelet therapy is beneficial and indicated in all patients with STEMI. Such statement is supported by the Antithrombotic Trialists' Collaboration review of antiplatelet treatment (mostly with aspirin use) in 15 trials of patients with this disorder (12). A similar recommendation of the current ACC/AHA guidelines is that beta-blocker therapy be administered universally to all patients with an acute STEMI in the absence of contraindications for their use. Those departures from the guiding principles point to a need for intensifying the education of physicians throughout the island regarding this matter. Additional observations of relevance in the study were that transfer and arrival of most patients to the tertiary care facility with the capability of performing primary PCI most often occurred more than 48 hours after the diagnosis of STEMI. Besides, less than one-third of such patients had received thrombolytic therapy prior to their referral. The described disparities with established guidelines are not unique to our environment and have also been addressed in publications from other centers (13-16). In fact, it has been published that in the United States, the median time to PCI after arrival at the hospital is 116 minutes and that exceeds two hours in 46 percent of the cases. The median delay in performing PCI among patients transferred is usually over three hours, with only 5% of patients transferred undergoing PCI within 90 minutes (17,18). The latter findings in our study also call for immediate attention and should serve to encourage the development of written protocols at referring institutions to assure a most expedite clinical assessment of patients, the enhancement of those institutions for utilizing fibrinolytic agents in suitable candidates and the timely referral to PCI-capable facilities of those patients that are still within the time frame for beneficial results from catheter-based reperfusion.

The finding that patients submitted to PCI, particularly those who received stents, derived the greatest survival benefit is in agreement with previously reported data in the literature. It has been similarly reported that early administration of anti-ischemic, cardioprotective and antiplatelet therapies in parallel with a prompt reperfusion intervention are of vital importance for better prognosis (19). A significant portion of the studied patients received platelet glycoprotein IIb/IIIa inhibitors in addition to clopidrogrel. Early utilization of those agents and of abciximab in particular, is considered a class IIa recommendation in the new STEMI guidelines (20). Intense antiplatelet therapy has been linked to excellent results in several randomized clinical trials, representing new trends and promising changes in the future management of this condition. The observation that approximately two-thirds of the patients in the study were discharged from the tertiary center on standard cardioprotective medications, like aspirin, beta blocking drugs, ACE inhibitors and statins, similarly entails a more vigorous educational effort

at institutional level. It is to be assured that in absence of contraindications, all patients with STEMI be prescribed at the time of their discharge those medications known to reduce the risk of future ischemic events, the need for subsequent revascularization procedures and mortality (21,22).

Limitations. The review is a retrospective evaluation mostly relied on the information provided by the admitting physician's history, physical examination, progress notes and the catheterization and percutaneous interventions reports. Data obtained from referral sources was frequently incomplete. No information was gathered from surviving patients or their relatives regarding their clinical status after discharge from the tertiary center.

Resumen

Este estudio revela hallazgos pertinentes sobre la atención médica recibida por pacientes con infarto de miocardio con elevación del segmento ST (STEMI, según conocido por sus siglas en inglés). Resalta el hecho de que a pesar del alto riesgo coronario y para complicaciones por enfermedad coronaria de la muestra de pacientes estudiada, un número significativo de éstos estaba recibiendo al momento de su referido al centro terciario, menos de lo esperado de aquellos medicamentos de reconocido beneficio para la prevención primaria y secundaria de esa condición. A base de los datos disponibles en las notas de referido la tasa de utilización de antiagregantes plaquetarios, bloqueadores beta adrenérgicos, inhibidores de la enzima convertidora de angiotensina (inhibidores de ECA) y estatinas ocurrió en una proporción menor a lo recomendado en las guías de práctica clínica vigentes. El análisis también evidenció un uso reducido de la terapia de reperfusión con agentes fibrinolíticos en los hospitales de referido. Se observó además, un retraso significativo en el traslado de los pacientes al centro terciario con capacidad para realizar intervenciones coronarias percutáneas. En la mayoría de los pacientes ese trámite ocurrió luego de pasadas 48 horas del diagnóstico de infarto. Llama la atención de igual manera, que alrededor de dos terceras partes de los pacientes en la muestra revisada, recibieron al momento de su alta hospitalaria, prescripciones para antiagregantes plaquetarios, bloqueadores beta adrenérgicos, inhibidores de ECA y estatinas. De los hallazgos del estudio puede razonablemente inferirse la existencia de espacio suficiente para mejorar la calidad de la atención médica que reciben los pacientes con STEMI en nuestro medio. Se considera evidente suponer que los hallazgos informados fomenten la revisión de los patrones de cuidado de los pacientes con STEMI en los centros hospitalarios del país, y una adherencia más plena a las recomendaciones de las guías de evaluación y cuidado recientemente actualizadas por el ACC/AHA. De igual forma se espera que los datos obtenidos deberán servir para estimular la realización de estudios de evaluación prospectivos que permitan determinar el curso de las deficiencias observadas, el nivel de cumplimiento futuro con las guías clínicas y el efecto de ese cumplimiento en el pronóstico de los pacientes.

References

1. Boersma E, Mercado N, Poldermans D, et al. Acute myocardial infarction. Lancet 2003; 361:847-58.
2. Van de Werf, F, Ardissino, D, Betriu, A, et al. Management of acute myocardial infarction in patients presenting with ST – segment elevation. The Task Force on the Management of Acute Myocardial Infarction of the European Society of Cardiology. Eur Heart J 2003; 24:28.
3. Ryan, TJ, Antman, EM, Brooks, NH, et al. 1999 update: ACC/AHA Guidelines for the Management of Patients with Acute Myocardial Infarction. Executive summary and recommendations A report of the American College of Cardiology/American Heart Association Task Force on Practical Guidelines (Committee on Management of Acute Myocardial Infarction) Circulation 1999; 100:1016.
4. Armstrong, PW, Cohen, D, Antman, E. Fibrinolysis for acute myocardial infarction: the future is here and now. Circulation 2003; 107-2533.
5. Keeley EC, Boura JA, Grines CL. Primary angioplasty versus intravenousthrombolytic therapy for acute myocardial infarction: a quantitative review of 23 randomised trials. Lancet 2003; 361:13-20.
6. Stone, GW, Grines, CL, Cox, DA, et al. Comparison of angioplasty with stenting, with or without abciximab, in acute myocardial infarction. N Engl J Med 2002; 346:957.
7. Juliard JM, Feldman U, Golmard JL, et al. Relation of mortality of primary angioplasty during acute myocardial infarction to door-to-Thrombolysis In Myocardial Infarction (TIMI) time. Am J Cardiol 2003; 91: 1401-5.
8. De Luca G, Suryapranata H, Zijlstra F, et al., for the ZWOLLE Myocardial Infarction Study Group. Symptom-onset-to-balloon time and mortality in patients with acute myocardial infarction treated by primary angioplasty. J Am Coll Cardiol 2003; 42:991-997.
9. Antman, EM, Anbe, DT, Armstrong, PW, et al. ACC/AHA guidelines for the management of patients with ST -elevation myocardial infarction-executive summary: a report of the American College of Cardiology/ American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1999 Guidelines for the Management of Patients With Acute Myocardial Infarction). Circulation 2004; 110:588.
10. Mehta RH, Montoye CK, Gallogly M, et al., for the GAP Steering Committee of the American College of Cardiology. Improving quality of care for acute myocardial infarction: The Guidelines Applied in Practice (GAP) Initiative. JAMA 2002; 287:1269-76.
11. Jencks SF, Huff ED, Cuerdon T. Change in the quality of care delivered to Medicare beneficiaries, 1998-1999 to 2000-2001. JAMA 2003; 289:305-12
12. Collaborative meta-analysis of randomised trials of antiplatelet therapy for prevention of death, myocardial infarction, and stroke in high risk patients. BMJ 2002; 324:71.

13. Dracup K, Alonzo AA, Atkins JM, et al. The physician's role in minimizing prehospital delay in patients at high risk for acute myocardial infarction: recommendations from the National Heart Attack Alert Program. Working Group on Educational Strategies to Prevent Pre-hospital Delay in Patients at High Risk for Acute Myocardial Infarction. Ann Intern Med 1997; 126:645-51
14. Rogers WJ, Canto JG, Lambrew CT, et al. Temporal trends in the treatment of over 1.5 million patients with myocardial infarction in the US from 1990 through 1999: the National Registry of Myocardial Infarction 1, 2 and 3. J Am Coll Cardiol 2000; 36:2056-63.
15. Eagle, KA, Goodman, SG, Avezum, A, et al. Practice variation and missed opportunities for reperfusion in ST-segment-elevation myocardial infarction: findings from the Global Registry of Acute Coronary Events (GRACE). Lancet 2002; 359:373.
16. Henry, TD, Unger, BT, Sharkey, SW, et al. Design of a standardized system for transfer of patients with ST -elevation myocardial infarction for percutaneous coronary intervention. Am Heart J 2005; 150:373
17. De Luca G, Suryapranata H, Ottervanger JP, et al. Time delay to treatment and mortality in primary angioplasty for acute myocardial infarction: every minute of delay counts. Circulation 2004; 109:1223-5.
18. McGinn, AP, Rosamond WD, Goff, DC Jr, et al. Trends in pre-hospital delay and use of emergency medical services for acute myocardial infarction: experience in 4 US communities from 1987-2000. Am Heart J 2005; 150:392
19. Gersh, BJZ, Stone, GW, White, HD, Holmes, DR Jr. Pharmacological facilitation of primary percutaneous coronary intervention for acute myocardial infarction is the slope of the curve the shape of the future? JAMA 2005; 293:979.
20. Kastrati A, Mehilli J, Dirschinger J, et al., for the Stent versus Thrombolysis for Occluded Coronary Arteries in Patients with Acute Myocardial Infarction (STOPAMI-2) Study. Myocardial salvage after coronary stenting plus abciximab versus fibrinolysis plus abciximab in patients with acute myocardial infarction: a randomised trial. Lancet 2002;359:920-5.
21. Eagle, KA, Kline-Rogers, E, Goodman, SG, et al. Adherence to evidence-based therapies after discharge for acute coronary syndromes: an ongoing prospective, observational study. Am J Med 2004; 117:73.
22. Burwen, DR, Galusha, DH, Lewis, JM, et al. National and state trends in quality of care for acute myocardial infarction between 1994-1995 and 1998-1999: the Medicare health care quality improvement program. Arch Intern Med 2003; 163:1430.