BRIEF REPORT

Implementation of the New Diagnostic Criteria for Myocardial Infarction

Ramón López-Palop, María J. Antolinos, Eduardo Pinar, Daniel Saura, Juan A. Ruipérez, and Mariano Valdés

Servicio de Cardiología. Hospital Universitario Virgen de la Arrixaca. El Palmar. Murcia. Spain.

The extent of implementation in daily clinical practice of the new definition of myocardial infarction is unknown. The purpose of the present study was to describe the use of the new definition in patients discharged from a cardiology department.

We analyzed the clinical records of 277 patients admitted because of acute coronary syndromes and discharged from the cardiology department between 1 March 2001 and 31 August 2001. The final clinical diagnosis based on the presence of classical or only new diagnostic criteria was studied. 127 patients (46%) satisfied the new definition (61% classical criteria and 39% only new criteria). Only 98 (77%) of the patients with myocardial infarction according to the new definition were discharged with this diagnosis (96% of the group that satisfied classical criteria and 48% of the group that satisfied only new criteria). The diagnosis of myocardial infarction is still based predominantly on classical criteria; the new criteria have been only partially implemented.

Key words: *Myocardial infarction. Diagnosis. Troponin.*

Full English text available at: www.revespcardiol.org

Utilización de los nuevos criterios diagnósticos de infarto de miocardio

La nueva definición del infarto de miocardio tiene implicaciones en múltiples campos de la cardiología. Su grado real de aplicación es actualmente desconocido. Este trabajo se propone conocer la utilización de la nueva definición en los pacientes dados de alta de un servicio de cardiología.

Analizamos el historial clínico de los 277 pacientes dados de alta de un servicio de cardiología entre el 1 de marzo y el 31 de agosto de 2001 tras ingresar por un síndrome coronario agudo. Estudiamos el juicio diagnóstico final atendiendo al cumplimiento de los criterios clásicos o actuales de infarto. Cumplieron la nueva definición 127 pacientes (46%), 61% con criterios clásicos y 39% sin ellos. Sólo 98 (77%) de los pacientes con infarto según la nueva definición recibieron este diagnóstico en el momento del alta hospitalaria (el 48% si no existían criterios clásicos de infarto). Los criterios clásicos siguen siendo determinantes para el diagnóstico del infarto de miocardio. Los nuevos criterios se aplican sólo parcialmente.

Palabras clave: *Infarto de miocardio. Diagnosis. Troponina.*

INTRODUCTION

The Joint European Society of Cardiology/American College of Cardiology Committee's (ESC/ACC) new definition of myocardial infarction (NDMI)[1] has important clinical, epidemiologic, legal and scientific implications.[2] Moreover, it has been seriously questioned since its publication in 2000.[3,4] In Spain, the survey carried out by the Working Group on Ischemic Heart Disease and Coronary Care Units of the Spanish Society of Cardiology showed that 42% of Spanish cardiologists rarely or never applied the NDMI.[5] Currently, we do not know how widely the NDMI is used. However, the variety of ways in which the NDMI is interpreted must mean that neither population studies nor healthcare plans reflect the realities of myocardial infarction (MI). This may well lead to incorrect conclusions and misguided patient management strategies.

In this study we describe the extent to which the NDMI is used in daily clinical practice.

PATIENTS AND METHOD

Cross-sectional, observational study of patients discharged from the cardiology department of a

Part of this report was presented at the XXXVIII Congreso de Enfermedades Cardiovasculares (XXXVIII Conference on Cardiovascular Diseases), Madrid, October 2002.

Correspondence: Dr. R.F. López Palop.
Ricardo Gil, 20, 3° dcha. 30002 Murcia. España.
E-mail: mlopezs@meditex.es

Received 23 January 2003.
Accepted for publication 29 May 2003.

TABLE 1. **New definition of myocardial infarction (ESC/ACC)**

Criteria for acute, evolving or recent MI

Either of the following criteria is diagnostic for acute, evolving or recent MI:

1. Typical increase and decrease in biochemical markers of myocardial necrosis (cardiac troponins and CPK-MB), with at least one of the following:
   - Typical symptoms of myocardial ischemia
   - Development of new Q waves on the ECG
   - ECG changes indicative of myocardial ischemia
   - Coronary artery intervention (percutaneous or surgical)
2. Pathologic findings of an acute MI

Criteria for established MI

Any one of the following criteria:

1. Development of new Q waves on serial ECG. The patient may or may not remember previous symptoms. Biochemical markers of myocardial necrosis may have normalized, depending on the time that has passed since the infarction developed
2. Pathologic signs of a healed or healing MI

ESC indicates European Society of Cardiology; ACC, American College of Cardiology.

university hospital in Murcia, sSoutheastern Spain.

Patients

Between March 1 and August 31 2001, 277 patients, diagnosed on admission with suspected acute coronary syndrome (ACS), were discharged. We reviewed their clinical records and excluded 150 patients who did not satisfy the NDMI (Table 1). The final sample consisted of 127 patients.

Definitions and variables

We divided our sample into two groups: group A patients met both traditional MI diagnostic criteria (Table 2) and the NDMI; group B patients met only NDMI criteria.

We considered increases in the following enzymes as significant when accompanied by a characteristic rise and fall typical of MI: CPK≥300 ng/dL; CPK-MB mass≥5 ng/dL; cardiac troponin T≥0.1 ng/dL.

We included patients in the sample when the diagnosis on admission either used the term MI explicitly or included a term synonymous with myocardial necrosis.

TABLE 2. **Classical definition of myocardial infarction (WHO)**

Presence of at least two of the following criteria:

1. Typical symptoms of myocardial ischemia
2. Enzyme increase characteristic of myocardial necrosis
3. ECG changes typical of development of new Q waves

WHO indicates World Health Organization.

TABLE 3. **Clinical histories and baseline characteristics for MI diagnosis groups. Group A: diagnosis according to classical criteria. Group B: diagnosis according to new criteria**

	Group A N=77 n (%)	Group B N=50 n (%)	*P*
Age, years*	66±11	67±11	.69
Women	26 (34%)	13 (26%)	.35
Cardiovascular risk factors			
Smoking	27 (35%)	16 (32%)	.7
Hypertension	40 (52%)	34 (68%)	.07
Hypercholesterolemia	35 (46%)	25 (54%)	.3
Diabetes	24 (31%)	20 (40%)	.31
Family history	9 (12%)	8 (6%)	.5
History of previous heart disease			
Myocardial Infarction	13 (17%)	20 (40%)	.004
Angina	20 (26%)	23 (46%)	.03
Coronary revascularization			
Percutaneous	6 (7%)	13 (26%)	.002
Surgical	3 (4%)	2 (4%)	.98
Congestive heart failure	4 (5%)	5 (10%)	.3
Intermittent claudication	5 (7%)	7 (14%)	.2
Cerebrovascular accident	3 (4%)	8 (4%)	.3
Chronic bronchial disease	11 (14%)	2 (4%)	.06

*Mean±SD.

Statistical analysis

Quantitative variables are expressed as the mean and SD. We constructed a logistical regression model to identify variables independently associated with a hospital discharge diagnosis of MI. We analyzed data with SPSS 11.0 for Windows.

RESULTS

Of the 127 patients discharged during the period of our study after MI as defined by the NMDI, 77 also met classical criteria for MI (61%, group A). The remaining 50 patients (39%) presented isolated elevated levels of the new markers, cardiac troponins or MB mass (group B). Baseline characteristics of groups A and B appear in Table 3. Table 4 shows clinical characteristics of MI presentation. Group A showed significantly greater ischemic abnormalities in the ECG, peak CPK and duration of symptoms. Table 5 shows the patients' hospital course and diagnostic and therapeutic tests on admission. We found no differences between diagnostic tests except for a significantly greater use of coronary angiography in Group A. Group A patients showed significantly greater use of reperfusion

TABLE 4. **Characteristics of presentation of infarction by MI diagnosis group. Group A: diagnosis according to classical criteria. Group B: diagnosis according to new criteria**

	Group A N=77 n (%)	Group B N=50 n (%)	*P*
Admission for chest pain[a]	71 (92.2%)	45 (90%)	.7
Duration of symptoms of MI[b]	120 (50-180)	60 (30-90)	<.0005
MI following coronary angioplasty	4 (5.2%)	4 (8.0%)	.5
ECG changes indicating acute ischemia			
None	11 (14.3%)	18 (36.0%)	.004[c]
T Wave	12 (15.6%)	7 (14.0%)	
ST segment depression	7 (9.1%)	16 (32.0%)	
ST segment elevation	47 (61.0%)	9 (18.0%)	
Appearance of Q wave	59 (76.6%)	0 (0.0%)	
Peak CPK[b]	681 (398-1421)	165 (67-246)	<.0005
Peak MB[b]	91 (36-166)	8 (4.2-27.4)	<.0005
Peak cardiac troponin T[b,d]	—	0.3 (0.1-1)	
Peak cardiac troponin I[b,d]	—	3.2 (1.3-9.2)	

[a]Chest pain versus all other criteria. [b]Median (25th-75th percentiles). [c]None versus any ischemic change observed on the ECG. [c]Cardiac troponins were not found in patients with ST segment elevation (the majority of patients in group A).

TABLE 5. **Hospital couse and MI management by MI diagnosis group. Group A: diagnosis according to classical criteria. Group B: diagnosis according to new criteria**

	Group A N=77 n (%)	Group B N=50 n (%)	*P*
Diagnostic tests			
Echocardiogram	74 (96.1%)	46 (92.0%)	.3
Isotopic test	6 (7.8%)	2 (4.0%)	.4
Coronary angiogram	64 (83.1%)	33 (66.0%)	.047
Confirmation of coronary heart disease[a]	62 (80.5%)	31 (62.0%)	.069
Number of diseased vessels[b]	1.6 (0.7%)	1.8 (1%)	.3
0	1 (1.6%)	2 (6.1%)	
1	33 (51.6%)	14 (42.4%)	
>1	30 (56.8%)	17 (51.5%)	
Percutaneous coronary revascularization	59 (76.6%)	27 (54.0%)	.008
Reperfusion therapy	33 (42.9%)	2 (4.0%)	<.0005
Thrombolysis	4 (12.2%)	1 (50.0%)	.4
Primary angioplasty	29 (87.8%)	1 (50.0%)	<.0005
Average length of hospitalization in days[c]	9 (7-13)	7 (5-10)	.003
MI diagnosis imaging	70 (90.9%)	30 (60.0%)	<.0005
Maximum Killip Class >1	16 (20.8%)	6 (12.0%)	.2
Reinfarction	1 (1.2%)	0 (0.0%)	.4

[a]Percent diameter stenosis ≥75%. [b]In patients who underwent coronary angiography. [c]Median (25th-75th percentiles).

treatment, greater frequency of percutaneous revascularization, and longer average hospital stay. The diagnosis of MI by imaging techniques was successful significantly more frequently in group A than group B (91% vs 60%; *P*<.0005). The diagnosis of MI at discharge was recorded for 98 patients (77% of the sample); 74 (96%) of them were from group A and 24 (48%) from group B (Figure 1). Eight patients showed increased enzyme levels after coronary angioplasty but only 3 (37.5%) of them of were diagnosed as having MI after the procedure. All three belonged to group A.

Diagnoses in the 29 patients not classified as suffering from MI appear in Figure 2.

According to the multivariate analysis, belonging to group A, confirmation of MI by imaging techniques, and acute ischemic abnormalities in the ECG were associated independently with a greater likelihood that the specialist would classify events as MI (Table 6). We developed a model that accounted for 92% (CI 95%, 88%-97%) of the clinical diagnoses of MI (area below the [ROC] curve).

DISCUSSION

Our results show how little the NDMI has influenced the criteria for diagnosis at discharge from the cardiology department of our university hospital. Of 127 patients who satisfied the NDMI, 77% were diagnosed accordingly at discharge versus only 48% of patients added by applying the new definition.

The prevalence of MI among patients discharged after admission for ACS was 35% in our sample. This is 24% less that it would have been (46%) if the NDMI had been rigorously applied. The ESC/ACC committee predicted an increase in the number of infarctions diagnosed by applying NDMI criteria1

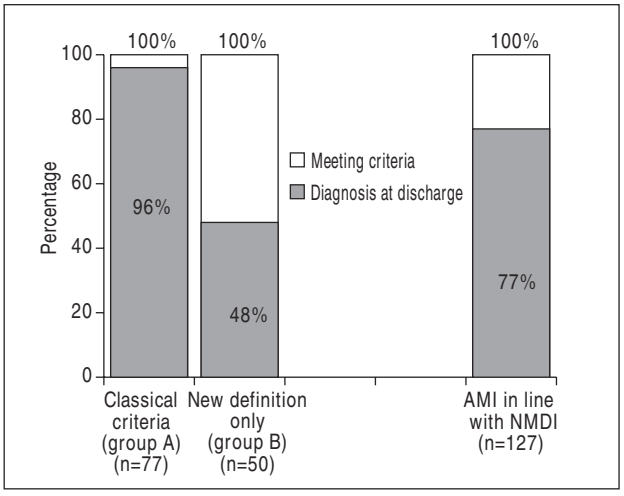

Fig. 1. Distribution of final clinical diagnoses in discharge reports for group A, group B and groups A and B together.

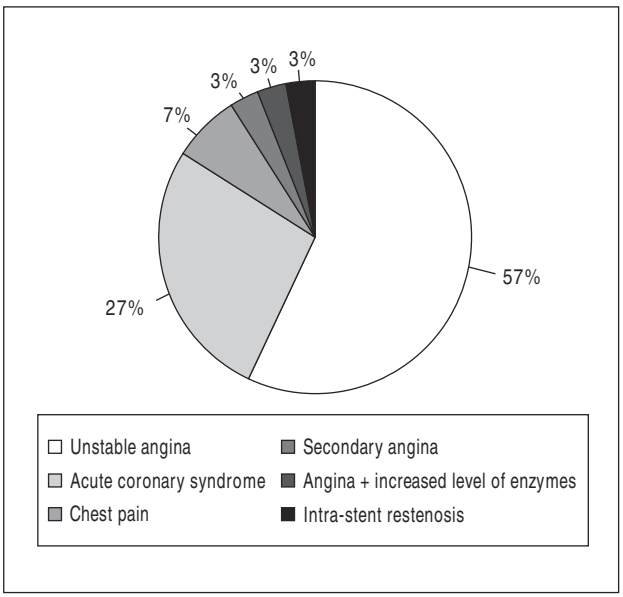

Fig. 2. Final clinical diagnoses in discharge reports of patients not diagnosed as having myocardial infarction even though they met the criteria in the new definition

TABLE 6. **Results of multivariate analysis (logistic regression) of variables associated with diagnosis of acute myocardial infarction at discharge**

	Odds ratio	95% CI	*P*
Age, by year	0.95	0.89-1.00	.062
Women	0.80	0.20-3.20	NS
MI by imaging technique	6.15	1.73-21.84	.005
Classical criteria (group A)	22.48	5.04-100.29	<.0005
ECG changes indicating acute ischemia	6.16	1.75-21.73	.005
Confirmed coronary heart disease	0.43	0.11-1.64	NS
Length of hospitalization, days	1.04	0.95-1.15	NS

MI indicates acute myocardial infarction.
Area below the ROC curve of the model: 0.92 (0.88-0.97).

and highlighted this in subsequent research.[6,7] This confirms the impact of the NDMI on epidemiologic data, distribution of healthcare resources and patient management.

Our data, which reflect the actual level of implementation of the NDMI criteria, support the opinion of Spanish cardiologists expressed in a recent survey.[5] In our sample, patients who did not meet classical criteria for the diagnosis of MI had similar clinical antecedents, except for the significantly lower frequency of a history of ischemic heart disease, and fewer clinical symptoms (lower frequency of ECG changes, duration of symptoms, peak enzyme levels, length of hospitalization). In addition, hospital discharge diagnoses may have been more strongly conditioned by the smaller number of cases of infarction that were confirmed with imaging techniques. Essentially, we were dealing with smaller infarctions according to the generally accepted grading system of infarction size. Moreover, these myocardial infarctions were clinically less important in terms of hospital course. The multivariate model we constructed explained 92% of the decisions (ROC). In the model, the presence of ischemic abnormalities in the ECG, including those defined by criteria not contemplated by the ESC/ACC joint committee such as confirmation of MI with imaging techniques, were the main factors that conditioned the final diagnosis of MI in patients with increased enzyme levels but with none of the traditionally recognized symptoms of MI. We found that the presence of new markers of necrosis (cardiac troponins or CK-MB) together with symptoms of myocardial ischemia was not sufficient in the majority of patients for the specialist to establish a final diagnosis of MI at discharge.

Limitations

Our study is based on a single department, so the results may not be representative of other centers in Spain. The lack of prior agreement on the implementation of the NDMI within our hospital, where 5 or more specialists make diagnoses independently, suggests that NDMI use may be similar in other Spanish centers.

Our study covers a period of 6 months. With time, results might change, and use of the NDMI might increase or decrease. We do not believe this invalidates our results; rather, it reinforces one of our conclusions: the variety of ways in which the NDMI is implemented will not only make it more difficult to compare centers, but will also complicate comparisons within a single center at different periods of time.

CONCLUSIONS

Implementation of the NDMI for hospital discharge diagnoses is limited. This definition is used for fewer than 50% of patients who do not meet classical criteria for the diagnosis of MI. Ischemic abnormalities in the ECG and diagnosis with imaging techniques are the principal factors that lead to the presenting event being considered MI in patients who do not meet classical MI criteria.

REFERENCES

1. Myocardial infarction redefined: a consensus document of The Joint European Society of Cardiology/American College of Cardiology Committee for the redefinition of myocardial infarction. J Am Coll Cardiol 2000;36:959-69.
2. López-Sendón J, López de Sá E. Nuevos criterios de diagnóstico de infarto de miocardio: orden en el caos. Rev Esp Cardiol 2001; 54:669-74.
3. Tunstall-Pedoe H. Redefinition of myocardial infarction by a consensus dissenter. J Am Coll Cardiol 2001;37:1472-4.
4. Domínguez de Rozas J, Obrador Mayol D, Tomas Abadal L. La nueva definición del infarto de miocardio. Rev Esp Cardiol 2001; 54:1345-7.
5. Bardaji A, Bueno H, Fernández-Ortiz A, Heras M. Aplicabilidad de la nueva definición del infarto de miocardio y opinión de los cardiólogos españoles. Rev Esp Cardiol 2003;56:23-8.
6. Koukkunen H, Penttila K, Kemppainen A, Penttila I, Halinen MO, Rantanen T, et al. Differences in the diagnosis of myocardial infarction by troponin T compared with clinical and epidemiologic criteria. Am J Cardiol 2001;88:727-31.
7. Ferguson JL, Beckett GJ, Stoddart M, Walker SW, Fox KA. Myocardial infarction redefined: the new ACC/ESC definition, based on cardiac troponin, increases the apparent incidence of infarction. Heart 2002;88:343-7.
8. Nomenclature and criteria for diagnosis of ischemic heart disease. Report of the Joint International Society and Federation of Cardiology/World Health Organization Task Force on standardization of clinical nomenclature. Circulation 1979;59:607-9.