

Applicability of the Appropriate use Criteria for Myocardial Perfusion Scintigraphy

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Abstract

Background: Appropriateness Criteria for nuclear imaging exams were created by American College of Cardiology (ACC) e American Society of Nuclear Cardiology (ASNC) to allow the rational use of tests. Little is known whether these criteria have been followed in clinical practice.

Objective: To evaluate whether the medical applications of myocardial perfusion scintigraphy (MPS) in a private nuclear medicine service of a tertiary cardiology hospital were suitable to the criteria of indications proposed by the American medical societies in 2005 and 2009 and compare the level of indication of both.

Methods: We included records of 383 patients that underwent MPS, November 2008 up to February 2009. Demographic characteristics, patient's origin, coronary risk factors, time of medical graduation and appropriateness criteria of medical applications were studied. The criteria were evaluated by two independent physicians and, in doubtful cases, defined by a medical expert in MPS.

Results: Mean age was 65 ± 12 years. Of the 367 records reviewed, 236 (64.3%) studies were performed in men and 75 (20.4%) were internee. To ACC 2005, 255 (69.5%) were considered appropriate indication and 13 (3.5%) inappropriate. With ACC 2009, 249 (67.8%) were considered appropriate indications and 13 (5.2%) inappropriate.

Conclusions: We observed a high rate of adequacy of medical indications for MPS. Compared to the 2005 version, 2009 did not change the results. (Arq Bras Cardiol. 2014; 103(5):375-381)

Keywords: Myocardial/radionuclide imaging; Diagnostic Imaging; Myocardial Perfusion Imaging; Quality of Health Care.

Introduction

The advances in medical knowledge and technological development have increased the diagnostic capacity of medical tests. These improvements have led to a marked increase in the use of imaging tests and, consequently, in the associated costs. In the United States, a study with patients treated by Medicare, during 1993–2001, showed a mean annual increase of 6.1% in the number of cardiac stress imaging tests, whereas the increase in cardiac catheterization was 2% and percutaneous coronary interventions was less than 1%, for the total number of individuals with acute myocardial infarction¹. Four million myocardial perfusion scintigraphy (MPS) tests were performed in 1998; in 2008 this number was 8 million². This increase in the volume of diagnostic image procedures, higher than any other medical procedure in the United States, led to the need to create

instruments that suit the clinical practice with respect to the most recent scientific evidence³. For this purpose, the American College of Cardiology Foundation (ACC) and the American Society of Nuclear Cardiology (ASNC) published in 2005 the Appropriateness Criteria for Single-Photon Emission Computed Tomography (SPECT) Myocardial Perfusion Imaging⁴. In June 2009, a revised and updated version was published among other scientific communities. This revised edition was titled Appropriate Use Criteria for Cardiac Radionuclide Imaging⁵.

Studies worldwide have tested the application of these appropriateness criteria with the aim of assessing the quality of assistance and guiding strategies for improvement⁶. Gibbons e cols.¹ demonstrated that 14% of scintigraphy procedures and 18% of stress echocardiography tests performed in a university hospital were deemed inappropriate, according to this instrument, and emphasized the need to improve assistance to optimize resources and improve the efficiency of the North-American health system^{1,7}. Until now, no studies, such as the present study, have been conducted in Brazil. The aim of this study was to assess whether the medical use of MPS in a private nuclear medicine department of a tertiary cardiology hospital was appropriate, according to the criteria of indications proposed by the American medical associations in 2005 and 2009, and compare the degree of indication between both publications.

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Methods

This was a retrospective review of 383 medical records of consecutive patients subjected to resting and stress (physical or pharmacological) MPS scans, according to clinical indication, performed between November 2008 and February 2009. The analyzed variables included the following: demographic characteristics, patients' origin (outpatient or inpatient), coronary risk factors, physician's years of training (more than 10 years of training or not), and appropriateness of the use of the test according to the 2005 ACC/ASNC appropriateness criteria. Using the same medical records, we performed a reassessment of the ordered tests, according to the 2009 ACC/ASNC appropriateness criteria, and compared the degree of indication between 2005 and 2009.

Sixteen medical records were excluded from the study because data were incomplete, e.g., the resting or stress test was not performed, the scintigraphy report was absent, or data pertaining to the physician who ordered the test was nonexistent. Myocardial ischemia was deemed present in scintigraphic images when some of the 17 myocardial segments had reversible perfusion defect.

The appropriateness criteria are composed of scenarios or clinical indications that include most cases observed in nuclear medicine cardiac tests. Each of these scenarios is scored on a scale of 1 to 9: I) 7 to 9, classified as appropriate (the test is generally acceptable and consists in a reasonable approach to the scenario); II) 4 to 6, uncertain or possibly appropriate, may be acceptable, i.e., it is a reasonable approach to the indication, and uncertainty also implies the need for further investigation or data on patients to definitely categorize the procedure as appropriate or not and to update the criterion; III) 1 to 3, inappropriate, not a reasonable approach to the indication⁸. The appropriateness criteria were created by the American College of Cardiology together with several medical associations, according to the modified Delphi method used by the RAND Institute of the University of California in Los Angeles (RAND/UCLA)⁴, which includes the following four steps: (a) listing of the clinical indications for which the test can be used, (b) review of the clinical indications by a panel of interdisciplinary experts and rating of the indications, (c) meeting of the panel of experts with extensive discussion on the clinical indications and new rating, and (d) tabulation of the indications with their respective scores⁹.

As recommended by the appropriateness criteria⁵, patients were classified as symptomatic if the physician indicated the test due to thoracic pain syndrome, anginal equivalent, or electrocardiogram (ECG) findings indicative of ischemia. The following are examples of symptoms related with thoracic pain: feeling of chest tightness, heartburn, pain in the shoulder, palpitations, pain in the jaw, and new anomalies on ECG indicative of ischemic heart disease. Symptoms such as dyspnea or reduced tolerance to exertion, which are coherent with coronary artery disease (CAD), were also considered as anginal equivalent.

With regard to the variables under study, patients were considered hospitalized if they were in the emergency room or in any hospital unit. Age, sex, arterial hypertension, diabetes mellitus, smoking, family history of cardiovascular disease, obesity (body mass index ≥ 30 Kg/m²), menopause, sedentarism, peripheral vascular disease, cerebrovascular disease, renal failure, and thoracic pain syndrome (TPS) were the variables analyzed according to the information contained in the admission records for the test in the nuclear medicine sector. Patients who smoked till the day of the test or up to 5 years before were considered smokers. The reports of the tests considered as normal or not, according to the presence of ischemia, were also analyzed.

The appropriateness of the use of MPS was assessed by two independent physicians and indications were allocated to one of the 67 scenarios provided in the updated document of indications⁵ and classified as follows: (A) appropriate, (U) uncertain, and (I) inappropriate. If consensus between the two examiners was not reached, the opinion of a third physician, nuclear medicine physician or certified cardiologist with more than 10 years of experience in the field was used. The indications with incomplete information or those that were not included in the scenarios were deemed as nonclassifiable (NC)⁵.

The present study was approved by the Ethics Committee under number 324 in 11/25/2009.

The results of the variable age are presented as mean \pm standard deviation and the remaining results are expressed in percentages. Comparisons were performed using the Mann-Whitney test for age and the chi-squared and Fisher's exact tests for the remaining variables. Probability values < 0.05 were considered statistically significant. The statistical analyses were performed using the SPSS software, version 22.

Results

Of the 367 consecutive patients under study, 282 (79.6%) were outpatients and 75 (20.4%) were inpatients. The mean age was 64.6 ± 12.3 years. Male patients accounted for 64.3% (N = 236) of the tests. The most prevalent risk factor for coronary disease was arterial hypertension [223 (60.8%)], followed by dyslipidemia [184 cases (50.1%)], and thoracic pain [164 cases (44.7%)]. The demographic characteristics are described in Table 1.

Of the 183 referring physicians, 168 (91.8%) had more than 10 years of clinical practice. Eighteen (4.9%) tests were requested by physicians with less than 10 years of clinical practice and 349 (95.1%) tests were indicated by physicians with more than 10 years of clinical practice. As shown in Table 2, according to the 2005 criteria, of the 367 analyzed requests, 255 (69.5%) were classified as appropriate, 49 (13.4%) as uncertain, and 13 (3.5%) as inappropriate, whereas according to the 2009 criteria, 249 (67.8%) were classified as appropriate, 19 (5.2%) as uncertain, and 19 (5.2%) as inappropriate. Moreover, 50 (13.6%) and 80 (21.8%) of the indications according to the 2005 and 2009 ACC, respectively, were categorized as nonclassifiable because it was not possible to allocate them to any of the used criteria.

Table 1 – Demographic characteristics of the sample (N = 367)

Variables	N (%)
Age (mean ± sd)	65 ± 12
Sex	
Male	236 (64.3)
Origin	
Inpatient	75 (20.4)
Outpatient	282 (79.6)
Complaint of thoracic pain	164 (44.7)
Comorbidities	
Arterial hypertension	223 (60.8)
Dyslipidemia	184 (50.1)
Diabetes	98 (26.7)
Family history of cardiovascular disease	129 (35.1)
Smoking	63 (17.2)
Sedentarism	123 (33.5)
Menopause	84 (22.9)
Obesity (BMI ≥ 30 Kg/m ²)	74 (20.2)
Peripheral vascular disease	12 (3.3)
Cerebrovascular disease	7 (1.9)
Renal failure	3 (0.8)

SD: standard deviation; BMI: body mass index.

Table 2 – 2005 and 2009 ACC appropriateness criteria

Criterion	2005	2009
	N (%)	N (%)
Appropriate	255 (69.5)	249 (67.8)
Inappropriate	13 (3.5)	19 (5.2)
Uncertain	49 (13.6)	19 (5.2)
Nonclassifiable	50 (13.4)	80 (21.8)

Using the 2005 ACC, the four main indications classified as appropriate accounted for 56.4% of cases, whereas using the 2009 ACC this percentage was 55.9%. The main appropriate indications are described in Table 3. According to the 2005 ACC, the most frequent indication for MPS [67 cases (18.3%)] was thoracic pain with intermediate pretest probability, interpretable ECG, and ability to perform physical activity. According to the 2009 ACC, the most frequent classifiable indication was nonacute ischemic equivalent with intermediate pretest probability, interpretable ECG, and ability to perform physical activity [49 cases (19.7%)].

Of the indications categorized as inappropriate, the most frequent was in asymptomatic patients up to 1 year after revascularization, with previous symptoms of revascularization [5 patients (38.5%)] for 2005 ACC and

postrevascularization, asymptomatic, and less than 2 years after percutaneous coronary intervention [4 patients (21.1%)] for 2009 ACC. The inappropriate indications and their frequencies are shown in Table 4.

The comparison between appropriate and inappropriate referrals, using the 2005 ACC, showed a significant difference only with regard to obesity ($p = 0.022$). The same comparison performed according to the 2009 ACC showed a significant difference only for the variable SDT ($p = 0.026$). Tables 5 and 6 show the comparison between appropriate and inappropriate indications for MPS, according to the 2005 and 2009 ACC appropriateness criteria.

Discussion

The aim of this study was to assess a new instrument that promotes the improvement of clinical practices. The appropriateness criteria were developed by the ACC and ASNC with the purpose of assisting physicians and institutions, as well as reducing healthcare costs. In Brazil, until now, there have been no studies on indications for MPS based on these criteria.

In the present study, the clinical indications for MPS showed a high percentage of appropriateness (69.5% and 67.8% according to the 2005 and 2009 ACC, respectively) in a private cardiology hospital. The use of this instrument has expanded exponentially. A study on the appropriateness of transthoracic echocardiography requests according to the ACC appropriateness criteria for echocardiography¹⁰ was recently published. It compared the practices between a private cardiology hospital and a public university hospital. The results showed that approximately 25% of the tests were inappropriately requested¹¹. The use of the appropriateness criteria has proved to be very useful for the evaluation of the quality of requests for complementary tests¹². More recently, continuing education strategies, such as online dissemination of information regarding appropriate referral, have been proposed to improve clinical practices¹³. In the present study we assessed the requests for MPS, which is a test of difficult access and that involves radiation exposure.

Similarly to the study by Gibbons et al¹, the present study was one of the first evaluations of the use of the appropriateness criteria for test requests in a nuclear medicine department in Latin America, according to the ACC/ASNC appropriateness criteria for SPECT perfusion imaging². After excluding the cases categorized as nonclassifiable, the ACC/ASNC appropriateness criteria was applied to more than 87% and 78% of the clinical indications for MPS for the 2005 and 2009 ACC, respectively, in the department where the study was conducted. The inappropriate indications corresponded to 3.5% and 5.2% and the uncertain indications to 13.4% and 5.2%, for 2005 and 2009 ACC, respectively. These results highlight the need to improve the efficiency of our health system. In the outpatient context, the percentage of appropriate indications was lower (64.4% for 2005 and 2009 ACC) than that observed in the inpatient context (89.3% for 2005 and 81.3% for 2009 ACC). This analysis was not performed in the study by Gibbons et al¹ because the sample only included hospitalized patients. Better interaction between the referring physician and the team responsible for

Table 3 – Most common appropriate indications for myocardial scintigraphy according to the 2005 and 2009 ACC appropriateness criteria

2005		2009	
Indications	N (%)	Indications	N (%)
Thoracic pain with intermediate pretest probability, interpretable ECG, and able to perform physical activity	67 (18.3)	Nonclassifiable	86 (34.5)
Intermediate Duke e Framingham scores	51 (13.9)	Nonacute ischemic equivalent with intermediate pretest probability, interpretable ECG, and able to perform physical activity	49 (19.7)
With pain, after intervention or angioplasty	50 (13.6)	Intermediate Duke score	34 (13.7)
Thoracic pain with intermediate pretest probability, noninterpretable ECG, and unable to perform physical activity	39 (10.6)	Symptomatic postrevascularization	33 (13.3)
Thoracic pain with high pretest probability, interpretable ECG, and able to perform physical activity	16 (4.4)	Nonacute ischemic equivalent with intermediate pretest probability, noninterpretable ECG, or unable to perform physical activity	23 (9.2)

ECG: Electrocardiogram.

Table 4 – Inappropriate indications for myocardial scintigraphy, according to the ACC appropriateness criteria

2005		2009	
Indications	N (%)	Indications	N (%)
Asymptomatic until 1 year after revascularization, with previous symptoms	5 (38.5)	Nonclassifiable	6 (31.6)
Thoracic pain with low pretest probability, interpretable ECG, and able to perform physical activity	4 (30.8)	Postrevascularization, asymptomatic, and less than 2 years after percutaneous coronary intervention	4 (21.1)
Low risk preoperative	2 (15.4)	Pain or ischemic equivalent, low pretest probability, interpretable ECG, and able to perform physical activity	3 (15.8)
Asymptomatic or with previous study and high-risk Framingham and annual scintigraphy study	1 (7.7)	Low risk preoperative	2 (10.5)
Low intermediate preoperative, with tolerance to exertion ≥ 4 MET	1 (7.7)	Other*	1 (5.3)

MET: metabolic equivalent; (*) Four indications had the same frequency.

Table 5 – Comparison between appropriate and inappropriate indications for myocardial scintigraphy, according to the 2005 ACC appropriateness criteria

Variables	Appropriate N (%)	Inappropriate N (%)	p value
Sex			
Female	100 (97.1)	3 (2.9)	0.243
Male	155 (93.9)	10 (6.1)	
Origin			
Inpatient	67 (95.7)	3 (4.3)	0.798
Outpatient	188 (94.9)	10 (5.1)	
Dyslipidemia			
No	123 (93.9)	8 (6.1)	0.349
Yes	132 (96.4)	5 (3.6)	
Obesity			
No	205 (96.7)	7 (3.3)	0.022
Yes	50 (89.3)	6 (10.7)	

Table 6 – Comparison between appropriate and inappropriate indications for myocardial scintigraphy, according to the 2009 ACC appropriateness criteria

Variables	Appropriate N (%)	Inappropriate N (%)	p value
Sex			
Female	93 (94.9)	5 (5.1)	0.336
Male	156 (91.8)	14 (8.2)	
Origin			
Inpatient	61 (95.3)	3 (4.7)	0.391
Outpatient	188 (92.2)	16 (7.8)	
Dyslipidemia			
No	114 (91.2)	11 (8.8)	0.308
Yes	135 (94.4)	8 (5.6)	
Thoracic pain syndrome			
No	105 (89)	13 (11)	0.026
Yes	144 (96)	6 (4)	

performing the tests and the fact that hospitalized patients often have more serious diseases, for which the use of scintigraphy is more well established, probably contributed to higher rate of appropriate requests in the group of inpatients.

Another aspect observed in our study, which was emphasized by Hendel et al⁵, was the application of the appropriateness criteria to allow an institution, a group of physicians, and even a health manager to assess standards and practices and identify areas susceptible to improvement. In addition, the criteria are a useful instrument for training, awareness and development of standards of practice regarding the appropriate request of tests. The following are among the most frequent inappropriate indications for myocardial scintigraphy observed in the clinical practice: (1) scintigraphy in asymptomatic patients and (2) scintigraphy in asymptomatic patients with less than 2 years of revascularization and complaints of symptoms before angioplasty¹⁴. The findings that routine evaluation of patients in the first year after coronary angioplasty corresponded to 38.5 % of inappropriate indications for myocardial scintigraphy according to the 2005 ACC, and that 21.1% of inappropriate requests according to the 2009 ACC corresponded to the routine evaluation of patients in the first 2 years after coronary angioplasty suggest that these indications should be the focus of educational programs and other interventions aimed at the referring physicians. Gibbons et al¹⁵ implemented a program of quality improvement focusing on inappropriate requests for scintigraphy and, although they did not observe a significant improvement in the rate of appropriate referrals, they suggested that specific efforts should be made, based on the data obtained from appropriateness assessment. Saifi et al¹³ demonstrated that the online use of a continuing education instrument can promote the increase in the number of appropriate myocardial scintigraphy tests.

The appropriateness criteria are an instrument in progress and, with the publication of the new version, some authors observed a change in the rate of nonclassifiable tests and an increase in the rate of uncertain and inappropriate tests^{14,16,17}. In the sample analyzed in this study, the rate of appropriate tests remained unchanged, the rate of uncertain tests decreased, and the rate of nonclassifiable tests increased. These differences may be associated with local experience and the most common type of indication in a given region. Moreover, of the 182 clinicians that requested tests, 95% had more than 10 years of clinical practice. This finding indicates that the analyzed population consists of experienced physicians, which is not necessarily representative of the situation in most institutions.

The update of criteria and the conduction of more studies in other regions of Brazil are necessary for the inclusion of more indications. Although the criteria of 2009 were not available to cardiologists when the tests included in this study were requested, we believe the analyses are valid because there was no significant change in clinical practices between the 2005 and 2009 publications of the appropriateness criteria; these publications were an attempt to improve the instrument⁵. Despite the limitations of a retrospective study, the present analysis is valid because it gives an overview of this practice.

The rational use of complementary tests in cardiology is one of the major challenges experienced by clinical practitioners today¹⁸⁻²⁰. Although technology has allowed these methods to aggregate an increasing amount of valuable information, its indiscriminate use may not contribute in changing the outlined strategy, and may even add costs and risks inherent to the techniques, such as exposure to contrast media or radiation^{21,22}. The search for quality directly involves the refinement of clinical referrals as a way of selecting patients who are most likely to benefit from these tests^{23,24}. This study,

which is the first in the Brazilian literature to focus on the use of the appropriateness criteria for myocardial scintigraphy, showed that this instrument is indeed useful for this purpose and that new studies should be conducted in different contexts so as to contribute to better clinical practices.

Conclusions

In this study there was a high appropriateness of clinical indications for MPS in a cardiology hospital, according to the appropriateness criteria, in particular among hospitalized patients. Moreover, there was no significant difference between the percentages of appropriate and inappropriate tests when using the 2005 and 2009 criteria. Further prospective studies and studies involving more physicians with less than 10 years of clinical practice should be developed to confirm the results presented in this article.

Author contributions

Conception and design of the research, Analysis and interpretation of the data and Writing of the manuscript:

Oliveira A, Rezende MF, Corrêa R, Mousinho R, Azevedo JC, Miranda SM, Oliveira AR, Gutterres RF, Mesquita ET, Mesquita CT; Acquisition of data: Oliveira A, Rezende MF, Corrêa R, Mousinho R, Mesquita CT; Statistical analysis: Oliveira A, Mesquita CT; Critical revision of the manuscript for intellectual content: Oliveira A, Rezende MF, Azevedo JC, Miranda SM, Oliveira AR, Gutterres RF, Mesquita ET, Mesquita CT.

Potential Conflict of Interest

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

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