Treatment strategies and risk stratification in acute coronary syndromes
Damman, P.

Citation for published version (APA):

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: http://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.
PROGNOSTIC RELEVANCE OF PCI-RELATED MYOCARDIAL INFARCTION

Woudstra P, Grundeken MJ, van de Hoef TP, Wallentin L, Fox KA, de Winter RJ, Damman P

Nature reviews cardiology. 2013 Apr;10(4):231-6
ABSTRACT

Procedure-related myocardial infarction (pMI) is directly associated with a coronary revascularization procedure, such as percutaneous coronary intervention (PCI) or coronary artery bypass graft surgery. In contrast to spontaneous myocardial infarction (MI), the prognostic relevance of pMI is the subject of ongoing debate. Data from retrospective analyses of large, randomized clinical trials, and large, contemporary cohort studies have several shortcomings that limit their extrapolation towards clinical practice. In our opinion, the currently available evidence is insufficient to conclude that pMI during PCI per definition has important prognostic implications. Until further evidence is available, we recommend adopting the definition for MI given in the third universal definition of MI, which differentiates between pMI and spontaneous MI. This is important not only for clinical decision making, but also for the interpretation of pMI as a surrogate endpoint in clinical trials. Further studies are essential to understand the pathophysiology and consequences of pMI.
INTRODUCTION

Spontaneous myocardial infarction (MI) originates directly from a primary coronary event, such as an atherosclerotic plaque erosion or rupture. By contrast, a so-called procedure-related myocardial infarction (pMI) is directly associated with a coronary revascularization procedure, such as percutaneous coronary intervention (PCI) or coronary artery bypass graft surgery (CABG). Despite these differences in etiology between spontaneous MI and pMI Figure 1), the majority of clinical trials assign these diagnoses an equivalent prognostic weight. The pathophysiology of pMI is not completely understood, but several mechanisms are thought to contribute. In the setting of CABG, the use of cardiopulmonary bypass, and prolonged cardioplegia duration is associated with pMI. In the context of PCI, embolization of thrombus particles and plaque material, or occlusion of small side-branches after stent placement are associated with pMI. Moreover, abrupt closure of the treated vessel, or occlusion of large side branches in complex lesions are associated with overt large pMI after PCI. The reported incidence of pMI depends on the type of cardiac biomarker measured, the sensitivity of the marker for the diagnosis of pMI, the defined upper limit of normal (ULN) for the marker, and the additional clinical criteria requested to fulfil the definitions of spontaneous MI and pMI.

Historically, the WHO definition of pMI specifies an elevation in creatine kinase (CK) level of at least twice the ULN. The definitions of pMI in the consensus documents on the universal definition of MI by the European and American cardiology societies have changed significantly over time (Box 1); clinical symptoms have been added, and the thresholds for cardiac biomarker levels indicating pMI are consecutively raised. In the latest (third) consensus document on the universal definition of MI a pMI in the setting of PCI (type 4a MI) is defined as an increase in the troponin level to above five times the ULN, in combination with at least one of the following: (i) symptoms suggestive of myocardial ischaemia, (ii) new ischaemic ECG changes or new left bundle branch block (LBBB), (iii) angiographic loss of patency of a major coronary artery, or a side-branch, or persistent slow- or no-flow or embolization, or (iv) imaging demonstration of new loss of viable myocardium or new regional wall motion abnormality (Box 2). In the setting of CABG surgery (type 5 MI), a troponin level above 10 times the ULN is defined to indicate pMI in the presence of at least one of the following : (i) new Q-wave or LBBB on the electrocardiogram (ii) angiographic documented new graft or native coronary artery occlusion, or (iii) imaging evidence of new loss of viable myocardial or regional wall motion abnormality (Box 2).

Patients with ST-segment elevation myocardial infarction (STEMI) usually present with ongoing chest pain, fluctuating degrees of ST-segment elevation in combination with elevated cardiac biomarkers early in the course of the infarction. These symptoms, ECG changes and elevation of cardiac biomarkers may still be present during (primary) PCI, as a consequence of the earlier spontaneous MI. The manifestations of cardiac ischemia/necrosis and the ongoing release of cardiac biomarkers caused by the index event are difficult, or even impossible, to
### Box 1. Historical Joint Definitions ESC/ACC(AHA/WHF) PCI-related MI definitions.

<table>
<thead>
<tr>
<th>Definition</th>
<th>Year</th>
<th>Serial sampling</th>
<th>Biomarkers</th>
<th>Clinical symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>First&lt;sup&gt;13&lt;/sup&gt;</td>
<td>2000</td>
<td>6, 12 and 24 h after the procedure</td>
<td>Typical rise and gradual fall troponin or more rapid rise and fall for CK-MB above 99th percentile URL.</td>
<td>Non necessary</td>
</tr>
<tr>
<td>Second&lt;sup&gt;20&lt;/sup&gt;</td>
<td>2007</td>
<td>before or immediately after the procedure, and again at 6–12 and 18–24 h</td>
<td>Increase of biomarker (&gt;3 X 99th percentile URL) in patients with normal baseline values.</td>
<td>Non necessary</td>
</tr>
<tr>
<td>Third&lt;sup&gt;2&lt;/sup&gt;</td>
<td>2012</td>
<td>before the procedure, repeated 3–6 h later and, optionally, further re-measurement 12 h thereafter</td>
<td>Elevation of cTn values (&gt;5 X 99th percentile URL) in patients with normal baseline values (≤ 99th percentile URL) or a rise of cTn values &gt;20% if the baseline values are elevated and are stable or falling.</td>
<td>(i) evidence of prolonged ischemia (&gt;20 min) as demonstrated by prolonged chest pain, or (ii) ischemic ST changes or new pathological Q waves, or (iii) angiographic evidence of a flow limiting complication, such as of loss of patency of a side branch, persistent such as of loss of patency of a side branch, persistent slow-flow or no-reflow, embolization, or (iv) imaging evidence of new loss of viable myocardium or new regional wall motion abnormality</td>
</tr>
</tbody>
</table>

Abbreviations: ESC, European Society of Cardiology; ACC, American College of Cardiology; AHA, American Heart Association; cTn, cardiac troponin; h, hours; LBBB, left bundle branch block; MI, myocardial infarction; PCI, percutaneous coronary intervention; WHF, World Heart Federation.
Differentiate from any additional cardiac biomarker release caused by the procedure. As a result, the identification of pMI is virtually impossible in most patients with STEMI. In patients with non-ST-segment elevation acute coronary syndrome (NSTE-ACS) [this is of less importance, as recurrent chest pain or new electrocardiographic changes can be included in the identification of pMI, together with a change in the pattern of release of cardiac biomarkers.3 Because of the difficulty to distinguish pMI in the setting of primary PCI for STEMI, the current report focuses on studies involving NSTE-ACS and stable ischaemic heart disease only.

In contrast to spontaneous MI, which is consistently associated with adverse clinical outcomes, 4, 5 the prognostic relevance of pMI is the subject of ongoing debate, as abundant evidence exists both for and against its clinical importance.6

In this Perspectives article the aim is to describe the limitations of the current evidence regarding the prognostic relevance of PCI-related pMI in patients with NSTE-ACS or stable ischaemic heart disease. The studies cited in this article are the latest available meta-analyses on this issue, and publications of interest that followed these analyses.

Box 2. Third universal definition of myocardial infarction2.

| Type 1 | Spontaneous myocardial infarction |
| Type 2 | Myocardial infarction secondary to an ischaemic imbalance |
| Type 3 | Myocardial infarction resulting in death when biomarker values are unavailable |
| Type 4a | Myocardial infarction related to percutaneous coronary intervention (PCI):
1. Elevation of troponin levels > five times ULN in patients with normal baseline values
2. An increase in troponin levels by >20% if the baseline values are elevated and are stable or falling
AND
One of the following:
- Symptoms suggestive of myocardial ischaemia
- New ischaemic ECG changes or new left bundle branch block
- Angiographic loss of patency of a major coronary artery or a side-branch or persistent slow- or no-flow or embolization
- Imaging demonstration of new loss of viable myocardium or new regional wall motion abnormality |
| Type 4b | Myocardial infarction related to stent thrombosis |
| Type 5 | Myocardial infarction related to coronary artery bypass graft surgery:
Elevation of troponin levels to >10 times ULN in patients with normal baseline values
AND
One of the following:
- New pathological Q waves or new left bundle branch block
- New graft or new native coronary artery occlusion documented with angiography
- Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality |
META-ANALYSES

Several meta-analyses of contemporary trials have been undertaken to address the clinical impact of PCI-related pMIs. A meta-analysis of five large trials combining data from 5,538 patients undergoing PCI for various indications showed that 6-month mortality increases with increasing post-procedural levels of CK dimers consisting of one muscle-type subunit and one brain-type subunit (CK-MB). Nonetheless, absolute mortality was lower after pMI than after spontaneous MI.\(^7\)

A second meta-analysis, combining data from clinical coronary stent trials of 5,850 patients without pre-procedural MI (no baseline CK or CK-MB elevation or clinical evidence of acute MI), showed an association between pMI and increased all-cause mortality during the first year after stent placement in specific high-risk patient groups.\(^8\) Although overall mortality was numerically higher in patients with pMI, only patients with CK-MB levels above eight times the ULN or with Q-wave MI had a significantly higher risk of mortality compared with patients who did not have a pMI. Moreover, the mortality difference for any pMI was confined to patients with unsuccessful procedures, defined as suboptimal angiographic result, repeat revascularization or stent thrombosis within 24 hours, with no significant differences among patients who had otherwise successful procedures. pMI was not associated with mortality after adjustments for other known predictors of mortality.

In another meta-analysis, the prognostic value of elevated troponin levels after non-emergency PCI in 22,353 patients was evaluated.\(^9\) During a mean follow-up of approximately 1.5 years, mortality was significantly higher among patients with elevated troponin levels after the index PCI compared with those who did not have troponin elevation.

Individual NSTE-ACS clinical trials

In the ACUITY trial,\(^10\) patients with moderate-to-high risk NSTE-ACS were randomly assigned to receive heparin plus a glycoprotein Iib/Ilia inhibitor, bivalirudin plus a glycoprotein Iib/Ilia inhibitor, or bivalirudin monotherapy. Outcomes 1 year after a pMI or spontaneous MI were evaluated among patients in whom PCI was performed. pMI was defined as a new CK-MB elevation above three times the ULN, after an initially normalized or declining CK-MB level. If the CK-MB peak was not reached, several clinical characteristics were used to define new PCI-related myocardial damage. Out of a total of 7,773 patients who underwent PCI, 466 (6.0%) experienced a pMI, and 200 experienced a spontaneous MI (2.6%). Mortality at 1 year was significantly higher in patients who experienced a spontaneous MI than in patients who had a pMI, or patients without MI (16.0%, 6.0%, and 2.6% respectively, \(P <0.0001\)). After multivariable adjustment, spontaneous MI was associated with a significantly higher mortality risk (HR 7.49, 95% CI 4.95 to 11.33, \(P <0.0001\)), which was not seen for patients who had pMIs (HR 1.30, 95% CI 0.85 to 1.98, \(P = 0.22\)). The authors of the ACUITY report concluded that pMI is a marker of baseline risk, atherosclerosis burden, and procedural complexity but, in most cases, is not an independent prognostic indicator of mortality.\(^10\)
In the FIR collaboration, data were pooled at the patient level from the three independent trials—FRISC-II, ICTUS, and RITA-3. In these three trials, a routine invasive treatment strategy was compared with a selective invasive or conservative treatment strategy in patients with NSTE-ACS, with a 5 year follow-up after random allocation. One of the pre-specified analyses of the FIR collaboration focused on long-term cardiovascular mortality after the occurrence of either a spontaneous MI or a pMI within 6 months of the original random allocation. In the FIR analysis, the identification of pMI depended on the original trial definition, which differed between trials, with cardiac biomarker elevations above 1.5-fold, onefold, and twofold the ULN in the FRISC II study, ICTUS, and RITA-3 respectively. In these studies, timing of cardiac biomarker (troponin, CK-MB and/or CK) measurements was according to local clinical practice. Of the 5,467 patients in the FIR patient-pooled dataset, 212 experienced a pMI, and 236 had a spontaneous MI within 6 months of random allocation. Cumulative cardiovascular mortality was 5.2% in patients with a pMI, which was not significantly different from the mortality rate in patients without a pMI (HR 0.66, 95% CI 0.36-1.20, P = 0.17). In contrast, in patients who experienced a spontaneous MI within 6 months, cumulative cardiovascular mortality was 22.2%, which was significantly higher than mortality in patients without a spontaneous MI (HR 4.52, 95% CI 3.37-6.06 P <0.001). The hazard ratios did not substantially alter after adjustments for patient-related risk indicators in multivariable analyses. Although no adjustments were made for pre-procedural biomarker levels or the occurrence of spontaneous MI in either study, the pre-procedural biomarker levels did not alter the results in the FIR analysis.

In a substudy of TRITON-TIMI 38, the association between type of MI during follow-up and subsequent cardiovascular mortality was investigated. pMI was defined as a CK-MB level above three times the ULN on two samples within 48 h of PCI, or above five times the ULN on a single sample within the same time frame. The patients with NSTE-ACS who experienced a pMI had an increased risk of cardiovascular death at 6 months compared with patients who did not have a pMI. After adjustments for important clinical covariates the difference remained significant (non-STEMI group HR 2.4, 95% CI 1.3-4.4, P =0.004).

**Stable ischaemic heart disease trials**

In the BARI 2D trial, the clinical benefits of initial elective revascularization with aggressive medical therapy or aggressive medical therapy alone were investigated, as well as an insulin-providing or insulin-sensitizing strategy for glycaemic control. pMI was defined as a CK-MB increase above three times the ULN after PCI, and a tenfold increase after CABG surgery. Among 2,368 patients, 192 (8.1%) had a spontaneous MI and 51 (2.2%) had a pMI. Compared with 2.4% mortality in patients without a MI, increased 3-year cardiac mortality was observed for spontaneous MI (16.1%, HR 8.2, P <0.001) and for pMI (9.6%, HR 3.4, P <0.008).

The SPIRIT IV study is a prospective, randomized, multicenter trial of PCI comparing an everolimus-eluting stent (XIENCE V®, Abbott Cardiovascular Systems Inc., Santa Clara, CA, USA) with a paclitaxel-eluting stent (TAXUS
EXPRESS®, Boston Scientific, Natick, MA) in patients with stable coronary artery disease. Serial CK and CK-MB or troponin (I or T) measurements were obtained routinely before and after PCI. pMI was defined retrospectively as a biomarker elevation above three times the ULN within 48 h after PCI, in accordance with the consensus definition of MI in use at that time. Of 3,687 patients, pMI occurred in 287 (7.8%). Mortality at 2 years was low (2.3%) and did not increase with increasing elevations of CK-MB or troponin levels of up to 10 times the ULN.

A subanalysis of the EVENT registry\textsuperscript{21} focused on the clinical relevance of post-procedural elevation of either CK-MB or troponin levels in patients undergoing elective PCI with coronary stent placement. pMI was defined as an increase of greater than three times the ULN in the peak values of CK-MB and troponin (I or T) obtained 6–24 h after PCI. The primary end point for this subanalysis was mortality at 1 year. Among 4,623 patients, pMI occurred in 357 (7.7%) according to the CK-MB criteria, and in 1,198 (25.9%) according to the troponin criteria. The prognostic value for mortality was greater for CK-MB (adjusted HR 2.5, 95% CI 1.5–4.1) than for troponin (adjusted HR 1.7, 95% CI 1.1–2.5).

**DISCUSSION**

**Study Limitations**

The mentioned meta-analyses consistently show an association between pMI and subsequent adverse cardiovascular outcomes. However, in the individual studies in NSTE-ACS and stable ischaemia, conflicting results are found.

In our opinion, the conflicting data in the literature could have several explanations. First, in the few studies that showed an association between pMI and cardiovascular outcomes, routine measurement of cardiac biomarkers was not performed. Consequently, in these studies, the decision to obtain a biomarker measurement could have been driven by clinical symptoms or by ECG changes, which might have led to a selection bias. In clinical practice, cardiac biomarkers are often measured only after complicated procedures to resolve, for example, dissections, the no-reflow phenomenon, or acute closures of vessels. The selection of such high-risk patients for biomarker measurements influences both the reported event rates and the subsequent clinical outcomes.

Most of the studies in which pMI has been investigated are retrospective, with the limitations inherent in such studies, including the inability to adequately adjust for important confounders. One of the most important confounders is a pre-procedural elevation in biomarkers levels, which could indicate that the procedure might be performed during a developing spontaneous MI, independent of the procedure. Several studies have shown that pre-procedural rather than post-procedural biomarker levels provide the most prognostic information.\textsuperscript{22, 23} For patients whose biomarker measurements are not available before the procedure, post-procedural levels of biomarkers might actually be a surrogate for the pre-procedural ‘baseline’ levels. Interestingly, most studies that adequately correct for other predictors of outcome do not show a consistent association between pMI and outcomes.\textsuperscript{3, 14}
A wide variety of cardiac biomarker type, assay type and sensitivity, and thresholds were used to identify pMI in the studies. In the most recent third universal definition, the use of troponins is advised. Remarkably, in Spirit IV similar event frequency and mortality hazards were seen with troponin levels more than 20 times the ULN and CK-MB levels three times the ULN. These data indicate that a direct comparison of studies based on more modest cardiac biomarker elevations should be performed with caution. Additionally, the use of troponin as preferred cardiac biomarker for the identification of pMI is under debate. Contemporary high-sensitivity assays and the delay with which troponin levels peak after a coronary event, could both potentially dissipate the distinction between troponin increases caused by the initial event and those occurring during the procedure.

The studies regarding pMI are conducted over a decade of PCI practice in a broad spectrum of patient groups, limiting the generalizability of the results in contemporary practice. The incidence of pMI in the within and between studies are all different (e.g. stable patients versus ACS, routine sampling versus sampling in case of clinical symptoms, type of cardiac biomarker used, type of procedures performed). Universal definitions for pMI have been available for many years, however they were not consequently used, and were altered over time. As a consequence, there is a lack in uniformity in the definition for pMI between the mentioned studies. These differences between and within the studies

**Figure 1.** Difference between spontaneous and procedure related MI. A spontaneous myocardial infarction (MI) is caused by acute closure of a large coronary artery due to thrombus formation caused by plaque rupture or erosion. In contrast, a procedure related MI is not related with a prolonged closure of a main vessel, but with other causes for (short) limitation of blood flow and micro vascular dysfunction such as distal embolization or small side branch closure due to the invasive procedure. Abbreviations: MI, myocardial infarction; PCI, percutaneous coronary intervention.
limit the comparability and generalizability of the study outcomes. The clinical assessment of the prognostic value of pMI in different subgroups is therefore profoundly hampered. For example, patients with stable ischaemic heart disease are generally at low risk of cardiac events. Therefore, the possible prognostic implications of pMI as a result of complex PCI could help in future definition of the patient population benefiting from PCI in stable disease.

The etiology of larger peri-procedural infarcts may be different and its short-term prognostic implications may be related to pre-existing LV function (and in many studies, LV dysfunction was an exclusion criteria. Thus, stent thrombosis within 24 hours after ostial LAD stenting in a patient with an EF of 30% is prognostically relevant, whereas side-branch occlusion in a young patient with normal LV function showing the same amount of marker elevation will likely show uneventful follow up.

Lastly, it is important to note that the most recent definition of pMI for the first time involves clinical symptoms associated with prolonged vessel closure. This difference from the previous definitions might assure that the diagnosis pMI according to the new definition is more often associated with prolonged vessel closure. The prognostic value of pMI according the new definition could therefore be more significant. Yet, vessel closure post procedure may be silent, and clinical symptoms may be related to coronary spasm or adventitial haematoma after stent placement. The new definition has not been applied in clinical trials to date, and therefore data to support this assumption is absent.

**Potential explanations for pMI-related outcomes**

The difference in outcomes between spontaneous MI and pMI could be partially explained by the more-limited myocardial damage caused by most pMIs compared with spontaneous MIs. The explanation for this difference could be found in the different pathophysiological origins of these MIs. A spontaneous MI is usually preceded by a total occlusion of a coronary artery, causing extensive and permanent myocardial damage, whereas a pMI is related to the opening of a coronary artery, with only minor and potentially reversible myocardial damage. A study of a small group (32 patients) undergoing multivessel PCI showed that of the five patients who had a pMI (defined as a CK-MB level above three times the ULN), contrast-enhanced cardiac MRI imaging could confirm three of these. Therefore we can not rule out the possibility that very large pMIs have prognostic implications, especially if these are caused by a coronary artery dissection or a large side-branch occlusion.

Finally, pMI might be a surrogate marker for severity and complexity of coronary artery disease and, therefore, associate with poor outcomes. pMI might occur more frequently in patients with severe atherosclerotic disease, calcification, a high thrombus burden, and a high subsequent risk of distal thrombus embolization. Clearly, glycoprotein IIb/IIIa inhibitors reduce the incidence of pMI, thus demonstrating that pMI is, in part, related to platelet aggregation. For patients with distal embolization of small thrombus fragments or plaque components, but without angiographic evidence of distal embolization, and with a normal ECG and no symptoms, a small biomarker elevation is not likely to be associated with
clinical outcomes. Hence, such studies should be re-evaluated in this context. As mentioned above, occlusion of large side-branches, large spiral dissections, or abrupt vessel closure might be causally related to outcome if myocardial damage is extensive and systolic left or right ventricular function is substantially compromised.

The current evidence on the causes of pMI is limited, partly owing to the fact that important information such as angiographic and procedural data are frequently missing in studies. In order to further extend our understanding of pMI, the relationship between complicated procedures and the amount of peri-procedural damage should be investigated. As mentioned above, angiographic and procedural information might reveal a relationship between complicated procedures, the size of a pMI, and subsequent outcomes.

The rapidly increasing use of high-sensitivity troponin assays will raise additional questions about the diagnosis and consequences of pMI. High-sensitivity troponin measurements allow the identification of spontaneous MIs possible within a few hours of the onset of symptoms. Spontaneous MI identified by high-sensitivity troponin assay warrants full treatment, even in patients with very limited myocardial damage, provided that a substantial increase in troponin levels can be demonstrated. By contrast, the use of high-sensitivity troponin measurements to identify pMI in patients with STEMI or NSTEMI-ACS, where troponin levels are already elevated prior to the PCI procedure, will be inappropriate.

**IMPLICATIONS FOR TREATMENT**

The currently limited and conflicting evidence on pMI raises several practical questions—whether biomarker elevation has occurred in the presence or absence of clinical and ECG evidence; which biomarkers should be measured; what biomarker threshold should be used to define pMI; whether the pMI per se conveys adverse prognostic and therapeutic implications; and what impact a pMI might have on risks associated with daily activities, such as driving. The conflicting evidence on the prognosis of pMI also hinders decisions on the therapeutic approach. For example, the most striking effect of glycoprotein IIb/IIIa inhibition in patients with NSTEMI-ACS is the reduction in the incidence of pMI. However, without any clear prognostic implications for pMI, the total clinical beneficial effect of the glycoprotein IIb/IIIa inhibitors might be limited or even absent, and possibly only associated with an increased risk of bleeding. In addition to the implications for prognosis and therapy, the current uncertainty about the clinical relevance of pMI questions the necessity of performing routine post-procedural biomarker sampling. Unnecessary biomarker sampling might lead to unjustified consequences for patients and their care. These include barring the patient temporarily or permanently from some occupations, increased insurance premiums and implications for secondary prevention if the pMI were accepted as equivalent to a spontaneous MI. Unless performed for research purposes, we recommend avoiding routine biomarker sampling after PCI. In contrast, biomarker sampling is justified if prompted by a PCI complicated by new symptoms of ischemia, new ECG changes or angiographic evidence of a vessel occlusion.
CONCLUSIONS

The evidence for prognostic implications of pMI, based on randomized trials and large registries are inconsistent. In our opinion, the currently available evidence is not sufficient to state that, in general, the diagnosis of pMI has important prognostic implications. Although very large pMIs might be clinically relevant, further investigations are needed to resolve how large pMIs need to have prognostic significance. Until such information is available, we recommend adopting the new definitions for the identification of pMI given in the third universal definition of myocardial infarction. This definition of pMI requires five times the ULN of troponin level (I or T) for PCI and 10 times the ULN of troponin level (I or T) for CABG surgery and, in both settings, at least one additional piece of evidence to confirm myocardial ischemia/necrosis, myocardial dysfunction or coronary occlusion. It must be recognized that these definitions are arbitrary and still do not imply that pMI and spontaneous MI have the same prognostic significance. Thus evidence does not support apportioning equivalent prognostic importance to pMI and spontaneous MI in clinical trials or in clinical practice. We recommend reporting and interpretation of events according to the new MI typing system (Box 2). Further studies are essential to extend our understanding of the pathophysiology and consequences of pMI.

REFERENCE LIST


22. Miller WL, Garratt KN, Burritt MF, Lennon RJ, Reeder GS, Jaffe AS. Baseline troponin level: key to understanding the importance of post-PCI troponin elevations. Eur Heart J 2006;27(9):1061-1069.


