



Troponin Elevation Without Obstructive Coronary Disease: A Diagnostic Framework for the Acute Take

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Abstract

High-sensitivity troponin assays have made an elevated result a routine finding in acute medical practice, but only a small minority of elevated results represent a Type 1 myocardial infarction: in one large community cohort, 13.7% of unselected acute attendees had a troponin above the 99th percentile, yet only 1.6% met criteria for Type 1 myocardial infarction, a positive predictive value of just 11.8%. The Fourth Universal Definition of Myocardial Infarction distinguishes Type 1 (plaque rupture or thrombosis) from Type 2 (oxygen supply-demand mismatch without plaque disruption) and from myocardial injury (troponin elevation without ischemic symptoms or signs at all), a distinction with real prognostic weight: patients with Type 2 myocardial infarction and myocardial injury have substantially worse five-year mortality than those with Type 1 myocardial infarction, driven mainly by non-cardiovascular causes, despite carrying a lower burden of obstructive coronary disease. This review sets out a diagnostic framework for troponin elevation without obstructive coronary disease at the acute take, covering myocardial infarction with non-obstructive coronary arteries (MINOCA), takotsubo cardiomyopathy, myocarditis, and the non-cardiac causes, chiefly sepsis, pulmonary embolism and renal impairment, that collectively account for most elevated troponin results. It also sets out the honest complication at the center of this framework: there remains no randomized-trial evidence for how to treat Type 2 myocardial infarction once diagnosed, and the classification system underpinning this entire framework is itself being replaced, with a Fifth Universal Definition of Myocardial Infarction published in August 2026 abandoning the numbered Type 1-5 system altogether.

Keywords: Troponin; Myocardial infarction; Type 2 myocardial infarction; MINOCA; Takotsubo cardiomyopathy; Myocarditis

Introduction

A clinician on the acute medical take now encounters an elevated troponin routinely rather than rarely. High-sensitivity assays detect concentrations an order of magnitude lower than earlier generations of the test, and in one large community cohort, 13.7% of unselected acute medical attendees had a troponin above the sex-specific 99th percentile — yet only 1.6% of the same cohort ultimately met criteria for Type 1

myocardial infarction, a positive predictive value of just 11.8% [3]. Figure 1 sets out why these are not the same thing: an elevated troponin defines myocardial injury, a category far larger than myocardial infarction itself, and myocardial infarction in turn splits into Type 1 and Type 2, each with a different mechanism, evidence base and prognosis [1,2].

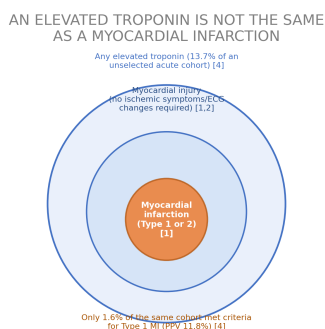


Figure 1: An elevated troponin is not the same as a myocardial infarction: myocardial injury is a broad category defined by troponin elevation alone, myocardial infarction (Type 1 or 2) is a narrower subset requiring ischemic symptoms or evidence, and only a small fraction of all troponin elevations meet Type 1 criteria specifically [1-4].

This review sets out a diagnostic framework for approaching an elevated troponin without obstructive coronary disease at the point of acute presentation: what the Fourth Universal Definition of Myocardial Infarction actually requires for each category, why the prognosis of Type 2 myocardial infarction and non-ischemic myocardial injury is worse than that of Type 1 despite less obstructive disease, and how myocardial infarction with non-obstructive coronary arteries (MINOCA), takotsubo cardiomyopathy, myocarditis and non-cardiac causes fit into that framework. It closes with two honest complications: the near-total absence of randomized-trial evidence for treating Type 2 myocardial infarction once diagnosed, and the fact that the classification framework this review describes has itself just been superseded.

Material and Methods

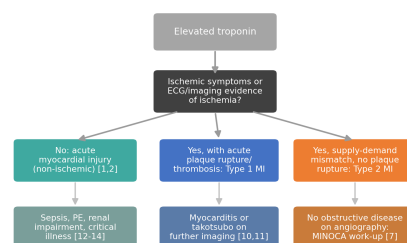
This is a narrative review, not a systematic review or a new meta-analysis. The literature was assembled by searching for studies of high-sensitivity troponin epidemiology, the Universal Definition of Myocardial Infarction and its 2026 successor, MINOCA, takotsubo cardiomyopathy and myocarditis, supplemented by the American Heart Association's MINOCA scientific statement and the current pulmonary embolism guideline for the non-cardiac-cause section [6,15].

Every percentage, hazard ratio and mortality figure reproduced here is taken directly from the cited source; none was recalculated by the present authors. Figure 2's decision tree is a simplified teaching schematic built to organize the categories discussed in this review, not a validated clinical algorithm, and is labelled accordingly; the same applies to Figure 3's funnel, which illustrates one community cohort's proportions rather than a universal constant.

Results

The Universal Definition: myocardial injury, and Type 1 versus Type 2 infarction

The Fourth Universal Definition of Myocardial Infarction separates three categories that are frequently conflated in practice. Myocardial injury is defined by a troponin concentration above the 99th percentile alone, with no requirement for ischemic symptoms, ECG changes or imaging evidence; it is, in the document's own words, "a prerequisite for the diagnosis" of infarction but "an entity in itself," and includes non-ischemic causes such as myocarditis and sepsis [1]. Myocardial infarction requires, in addition, clinical evidence of acute myocardial ischemia, and is then split by mechanism: Type 1 infarction is caused by atherothrombotic plaque rupture or erosion with thrombus formation, the mechanism targeted by the entire evidence base for antiplatelet therapy, statins and revascularization in acute coronary syndrome; Type 2 infarction results from oxygen supply-demand mismatch — tachyarrhythmia, severe anemia, hypotension or hypoxemia — superimposed on a coronary circulation that may have no atherothrombotic disease at all [1]. Figure 2 sets out how these categories are distinguished in practice and where each of the specific diagnoses discussed later in this review fits.



Management, evidence base and prognosis differ sharply between branches [5,6,9]

Figure 2: A diagnostic framework for elevated troponin without obstructive coronary disease, organized around the Fourth Universal Definition's distinction between myocardial injury, Type 1 and Type 2 myocardial infarction [1,2].

A single elevated value, on its own, is not sufficient for a diagnosis of infarction under any of these categories. The Fourth Universal Definition requires a dynamic pattern — a rise and/or fall in troponin, with at least one value above the 99th percentile — precisely to distinguish an acute process from a chronically elevated baseline, which is itself common in structural heart disease, chronic kidney disease and older age [1]. A chronically stable, non-rising troponin, however far above the 99th percentile, therefore falls outside the Universal Definition's criteria for infarction entirely, and is better framed to the patient and to colleagues as a chronic myocardial injury pattern than investigated repeatedly as if each admission represented a new acute event; serial measurement over hours, not a single value taken in isolation, is what actually separates the acute presentations this review is concerned with from that

chronic background [1].

Community and hospital cohorts assembled since high-sensitivity assays became routine confirm that myocardial injury and Type 2 infarction are common, and Type 1 infarction comparatively rare, among all elevated troponin results. Figure 3 sets out the proportions from one such cohort in full; a separate analysis of over 5,700 hospitalized patients with an abnormal high-sensitivity troponin found confirmed Type 1 infarction in only a minority, consistent with the same broad pattern [2,3].

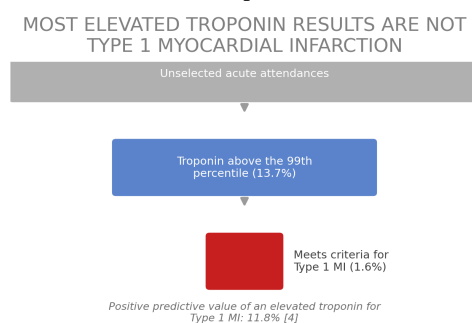


Figure 3: Of unselected acute attendees, 13.7% had a troponin above the 99th percentile, but only 1.6% met criteria for Type 1 myocardial infarction — a positive predictive value of 11.8% for an elevated troponin result alone [3].

Prognosis: Type 2 infarction and myocardial injury fare worse, not better

It would be reasonable to assume that Type 2 infarction and non-ischemic myocardial injury, lacking the acute plaque rupture that defines Type 1 infarction, carry a milder prognosis. The opposite is true. In a cohort of 2,122 patients followed for a median of 4.9 years, five-year all-cause mortality was 36.7% after Type 1 infarction, but 62.5% after Type 2 infarction and 72.4% after non-ischemic myocardial injury [5]. Figure 4 sets out this comparison in full. Critically, the excess mortality in the Type 2 and injury groups was driven predominantly by non-cardiovascular causes rather than recurrent cardiac events, reflecting the burden of the comorbidity — sepsis, malignancy, respiratory failure, renal impairment — that precipitated the troponin rise in the first place, and a related, larger analysis of the same cohort found Type 1 infarction carried the highest one-year rate of the combined cardiovascular death or reinfarction endpoint specifically, even as overall mortality favored Type 1 [5,7]. The practical implication is that an elevated troponin without obstructive disease is not a reassuring finding merely because it is not a classic heart attack; it frequently signals a sicker patient overall.

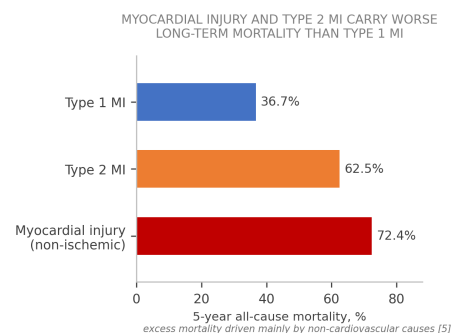


Figure 4: Five-year all-cause mortality by Universal Definition category: Type 2 myocardial infarction and non-ischemic myocardial injury carry higher mortality than Type 1 myocardial infarction, driven mainly by non-cardiovascular causes [5].

Category	Defining feature	Approx. share of elevated troponin	5-year mortality
Myocardial injury	Troponin elevated; no ischemic features	largest single category	72.4%
Type 2 MI	Supply-demand mismatch; no plaque rupture	substantial minority	62.5%
Type 1 MI	Plaque rupture/thrombosis	smallest category (~1.6%)	36.7%

Table 1: The Universal Definition's three categories for an elevated troponin, their approximate share of unselected results, and five-year all-cause mortality in each [1,3,5].

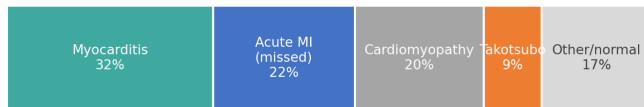
Specific diagnoses: MINOCA, takotsubo cardiomyopathy and myocarditis

When angiography shows no obstructive coronary disease in a patient who otherwise meets criteria for myocardial infarction, and no other specific cause is identified, the working diagnosis is myocardial infarction with non-obstructive coronary arteries (MINOCA). The American Heart Association's scientific statement defines MINOCA by three criteria together: infarction by the Universal Definition, no coronary stenosis of 50% or more in any major vessel, and no overt alternate cause for the presentation, and estimates MINOCA accounts for roughly 5% to 6% of all myocardial infarction referred for angiography, with a wider 5-15% range depending on the population studied [6]. MINOCA is explicitly framed as a working diagnosis pending further evaluation, not a final one, since the underlying cause, once actively sought, is frequently identifiable [6].

Cardiac MRI is the key investigation once MINOCA is suspected, and its findings illustrate how much a single angiogram can miss. Figure 5 sets out the breakdown from one cohort of patients with elevated troponin and a normal angiogram: myocarditis was the most common finding, ahead of an acute infarction the angiogram itself had not visualized, a non-ischemic cardiomyopathy, and takotsubo cardiomyopathy [10,11]. The updated Lake Louise criteria for cardiac MRI in

non-ischemic myocardial inflammation, incorporating T1 and T2 mapping alongside the older late-gadolinium-enhancement criteria, substantially improved diagnostic accuracy for myocarditis over the original 2009 criteria and now underpin this part of the work-up [9].

CARDIAC MRI FINDINGS IN TROPONIN-POSITIVE PATIENTS WITH NORMAL CORONARY ANGIOGRAPHY



single-center cohort; proportions vary by population studied [10,11]

Figure 5: Cardiac MRI findings in one cohort of patients with elevated troponin and a normal coronary angiogram: myocarditis was the single most common diagnosis, ahead of an acute infarction the angiogram had not visualized [10,11].

Takotsubo cardiomyopathy, a reversible left ventricular dysfunction typically affecting a region beyond a single coronary territory, is one of the specific diagnoses that MINOCA criteria and cardiac MRI can uncover. The International Takotsubo (InterTAK) Registry, covering 1,750 patients, found the great majority were women, and identified a physical trigger in 36.0% of cases, an emotional trigger in 27.7%, and no identifiable trigger at all in 28.5%, with the remainder reflecting a combination of triggers [8]. Figure 6 sets out this distribution. Serious in-hospital complications, including cardiogenic shock, occurred in a substantial minority, a rate comparable to or exceeding that seen in matched acute coronary syndrome, underscoring that "stress cardiomyopathy" is not a synonym for a benign condition [8].

TAKOTSUBO CARDIOMYOPATHY: TRIGGER TYPE AT PRESENTATION

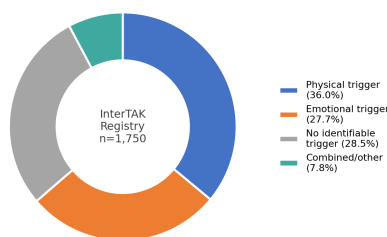


Figure 6: Takotsubo cardiomyopathy trigger type at presentation, International Takotsubo (InterTAK) Registry, n=1,750 [8].

Non-cardiac causes: sepsis, pulmonary embolism and renal impairment

A substantial share of elevated troponin results without obstructive coronary disease reflect a non-cardiac critical illness rather than any primary cardiac diagnosis. Troponin elevation is common in sepsis and is consistently associated with higher mortality across the pooled literature, a relationship a dedicated meta-analysis confirmed while cautioning that troponin's role is prognostic rather than diagnostic in this setting: it identifies a sicker patient rather than a specific cardiac lesion [12]. In acute pulmonary embolism, current European guidance uses troponin, combined with imaging evidence of right ventricular dysfunction, to classify normotensive patients as intermediate-high risk, while explicitly noting that troponin or natriuretic peptide elevation alone has low specificity and positive predictive value for early mortality when not combined with other findings [13]. Chronic kidney disease adds a further layer of interpretive difficulty: a systematic review and meta-analysis found troponin I and troponin T were each associated with significantly higher short-term cardiovascular event and mortality rates in patients with chronic kidney disease even without a suspected acute coronary syndrome, meaning a chronic, modestly elevated troponin in this population is prognostically meaningful but does not by itself imply an acute ischemic event [14]. A more recent systematic review and meta-analysis of troponin as a mortality prognosticator specifically in sepsis reached the same broad conclusion using a larger pooled dataset, reinforcing that the finding is not specific to one meta-analytic sample [20]. Table 2 summarizes these three non-cardiac settings side by side.

Setting	Role of troponin	Key evidence
Sepsis	Prognostic (higher mortality), not diagnostic	Meta-analyses in [12,20]
Acute pulmonary embolism	Component of risk stratification with imaging	2019 ESC PE guideline [13]
Chronic kidney disease	Chronic elevation is prognostic, not acute-MI-specific	Systematic review and meta-analysis [14]

Table 2: Non-cardiac settings in which an elevated troponin is common and prognostically meaningful without implying an acute coronary event [12,13,14,20].

Discussion

Two honest complications belong at the center of this framework rather than at its margins. The first is a treatment gap: despite Type 2 myocardial infarction's high prevalence and poor prognosis, "there have been no randomised trials of treatment for type 2 MI, in contrast to type 1 MI" — the entire evidence base for antiplatelet therapy, statins, beta-blockers and revascularization in acute coronary syndrome was generated in Type 1 populations and does not automatically transfer to a supply-demand mismatch with no plaque rupture to treat [16,17]. That gap is only just beginning to close: a pilot randomized controlled trial testing a structured investigation-and-treatment protocol for Type 2 myocardial infarction has now been published, though as a pilot study it establishes feasibility rather than a definitive treatment effect [18].

The second complication is more structural: the Type 1-5 numbered classification this review has used throughout was itself superseded while this review was being written. A Fifth Universal Definition of Myocardial Infarction, published jointly by the European Society of Cardiology, American College of Cardiology, American Heart Association and World Heart Federation in August 2026, abandons the numbered system entirely in favor of three categories — primary, secondary and procedure-related myocardial infarction — introduces sex-specific troponin thresholds, and explicitly reframes MINOCA as an intermediate working diagnosis rather than a final one, echoing language the AHA statement already used [19]. Because this update is only weeks old at the time of writing and the literature cited throughout this review, including its own reference list, is written in Type 1-5 terms, this review has deliberately kept that terminology throughout rather than mixing frameworks, while flagging for the reader that "Type 2 MI" and "myocardial injury" are now transitioning to "secondary MI" and a renamed injury category in the literature going forward.

Taken together, these two complications argue for the same clinical habit: an elevated troponin without obstructive coronary disease should prompt active characterization of mechanism, using the framework in Figure 2, rather than either reflexive treatment as if it were Type 1 disease or reflexive reassurance because it is not.

Study limitations

This is a narrative synthesis, not a systematic review, and the search followed no pre-registered protocol. Several of the underlying proportions, particularly the MRI findings in Figure 6 and the Type 1 MI proportion in Figures 1 and 3, come from individual cohorts and vary by population studied, care setting and troponin assay; they illustrate a pattern rather than a universal constant, as stated in each figure's caption. The Fifth Universal Definition was published only weeks before this review and its full text was consulted through post-publication summaries rather than years of accumulated secondary literature, which does not yet exist for a document this new.

Conclusion

Most elevated troponin results at the acute take are not Type 1 myocardial infarction, and the categories that make up the remainder — Type 2 infarction, non-ischemic myocardial injury, MINOCA, takotsubo cardiomyopathy, myocarditis, and non-cardiac critical illness — carry a mortality burden that is, if anything, higher rather than lower than Type 1 disease [3,5]. A structured diagnostic framework distinguishing these categories, rather than a reflexive "troponin positive, treat as acute coronary syndrome" reflex, is the accurate response to that evidence. That framework, however, currently rests on treating Type 2 myocardial infarction with an evidence base built for Type 1 disease, and on a classification system that has itself just been replaced — both of which the next several years of literature will need to resolve [16,19].

None of this is purely academic for the clinician standing at the bedside during an acute take. A patient with an elevated troponin and no obstructive disease on angiography is not an ambiguous case to be discharged with reassurance, nor a default Type 1 case to be treated with dual antiplatelet therapy by reflex; both responses are supported by evidence for a different population than the one actually in front of the clinician [3,6]. The practical task is to work through the framework in Figure 2 explicitly — ischemic symptoms or objective ischemia first, then the supply-demand precipitant if present, then the specific non-ischemic diagnosis if not — and to document that reasoning rather than defaulting to either extreme. That documentation matters beyond the individual encounter: because Type 2 myocardial infarction and myocardial injury are still frequently coded and audited as if they were Type 1 disease, registries and quality metrics built on coding data risk both under-recognizing the scale of the problem this review describes and over-crediting Type 1 pathways with outcomes that were never theirs to claim [5,7]. A clinician who takes the extra few minutes to characterize mechanism is not only making a better individual decision; they are also generating the accurate case-mix data that future trials of Type 2 myocardial infarction treatment, and any

eventual audit of the Fifth Universal Definition's real-world adoption, will depend on [17,19].

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