LBBB and the Paradigm Shift from STEMI to Occlusion MI

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Short Editorial related to the article: Accuracy of Left Bundle Branch Block Chronology and Electrocardiography Criteria for Acute Myocardial Infarction Diagnosis: A Systematic Review and Meta-analysis

The current paradigm for acute coronary syndrome (ACS) is based on ST elevation myocardial infarction (STEMI) electrocardiogram (ECG) criteria.[1] This is defined as ST elevation in the *absence* of left bundle branch block (LBBB). Nevertheless, this creates an obvious dilemma: what about patients *with* LBBB? In their systematic review and meta-analysis of 51 studies, Alencar et al. help resolve longstanding debates by comparing guidelines with evidence.[2] This not only clarifies how to address this specific diagnostic dilemma, but also how a paradigm shift from STEMI to Occlusion MI (OMI) could transform patient care.

As Alencar found, LBBB appeared in only 3.3% of ACS, but had higher mortality than acute MI without BBB. The current paradigm creates the twin dangers of unnecessary cath lab activation or even thrombolytics for LBBB without OMI, or delayed reperfusion for LBBB with OMI.[2]

The 2004 STEMI guidelines advocated emergent reperfusion for ACS with "new or presumably new LBBB", referencing thrombolytic trials and Sgarbossa criteria. However, thrombolytic trials assessed "BBB" regardless of timing, and Sgarbossa specifically identified criteria to help when a prior ECG was unavailable or the duration of LBBB was unknown.[3] To our knowledge, the idea of new vs. old LBBB has no source in data. While subsequent guidelines removed this recommendation, the concept persisted. De Alencar's study should put this debate to rest: a subset of 29 studies including 221,261 patients with LBBB found that the timing of LBBB is irrelevant.[2]

Thirteen years ago, Smith et al. refined the Sgarbossa criteria through the use of proportionality and by using the angiographic outcome of OMI rather than CK-MB.[4] As Alencar et al.[2] found, the Modified Sgarbossa Criteria (MSC) has the highest sensitivity of any method, with preserved specificity. Meyers et al. validated the MSC[5] at different proportionality cutoffs (compared with 25%, using 20% increased sensitivity from 80 to 84% but decreased specificity from 99 to 94%), which allows it to be used in a clinical context with different pre-test probabilities.[5] Dodd also validated the MSC for OMI in paced rhythms.[6]

Nevertheless, it is puzzling that the 2023 ESC guidelines continue to state that LBBB or paced rhythm "precludes an accurate assessment of the presence or absence of ST-segment elevation".[7] The 2025 ACC guidelines make no mention of any criteria for LBBB,[8] but the previous 2022 ACC expert consensus recognized both Sgarbossa and MSC.[9]

The Barcelona criteria have also been proposed,[10] but as Alencar et al.[2] discussed, they are not based on angiographic or troponin correlates of occlusion and have not been validated.[11] Instead, the Barcelona criteria were based on troponin values consistent with any type of MI, including non-OMI. The study also used a control group of patients without ACS symptoms, likely overestimating the specificity of the criteria. Furthermore, patients included in the study were identified by referral to primary percutaneous coronary intervention, causing a much higher pre-test probability in the study group than in the entire Emergency Department population of patients with ACS symptoms and LBBB.

De Alencar's study pairs well with another recent systematic review and meta-analysis by the same authors. In reviewing the only 3 studies to have compared STEMI criteria with the actual patient outcome of OMI, they found a sensitivity of only 43.6% and specificity of 96.5%.[12] Yet in patients with LBBB, Alencar et al. found the MSC had a sensitivity of 83.6% and specificity of 92.6%. In other words, the STEMI paradigm is based on ST elevation in the absence of LBBB, and so not only misses a majority of occlusions without diagnostic ST elevation, but does not even attempt to diagnose OMI in the setting of LBBB.[12]

In fact, the Smith Modified Sgarbossa criteria in LBBB are far more sensitive for OMI than are the STEMI criteria in normal conduction! This is because they use proportionality and because, contrary to conventional wisdom, LBBB does *not* hide transmural ischemia if you use proportions. This makes it particularly odd that the guidelines ignore the MSC.

Using proportionality and other evidence-based advances, artificial intelligence has been trained to identify OMI regardless of whether the ECG has normal conduction or LBBB. In a subgroup analysis of 246 patients with LBBB, including 64 with OMI, sensitivity and specificity were 60.9% and 93.4% – again superior to the 32.5% sensitivity of STEMI criteria in normal conduction.[13]

Keywords

Non-ST Elevated Myocardial Infarction; Myocardial Infarction; Electrocardiography

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Manuscript received July 13, 2025, revised manuscript July 30, 2025, accepted July 30, 2025

DOI: https://doi.org/10.36660/abc.20250497i

Despite improved sensitivity, applying the MSC clinically is challenging given the low prevalence of OMI.[14] Even with advanced ECG interpretation and expert-trained AI, the ECG is but one test for the underlying pathology of Occlusion MI. However, the OMI paradigm also shifts the focus from ECG to patient, including point of care ultrasound for regional wall motion abnormality (though echocardiography is suboptimal in LBBB due to dyssynchrony) and emergent reperfusion for refractory ischemic regardless of ECG findings. Alencar et al. have not only clarified how to improve care for patients with LBBB in the current paradigm, but also that a broader evidence-based paradigm shift is needed.[15]

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