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Letter to the Editor

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Alternative paradigm of the electrocardiogram in acute coronary syndrome

Paradigma alternativo del electrocardiograma en el síndrome coronario agudo

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To the Editor:

The 12-lead electrocardiogram (ECG), since its incorporation into clinical practice, has been a useful diagnostic tool in the evaluation of patients with acute coronary syndrome (ACS). The findings can be variable and include very high-risk elements, which the attending physician must master in order to make the most appropriate decisions.

According to Hajar[1], Heberden described angina pectoris for the first time in 1768 and Morgagni, "hardening of the arteries" in 1761; but Edward Jenner and Caleb Parry were the first to link both elements. However, it was after Virchow, the "father of pathology", defined the elements necessary for thrombus formation, that scientists began to seriously consider the implications for coronary artery disease. Nabel and Braunwald[2], on their part, reported that Ludvig Hektoen, also a pathologist, in 1879, concluded myocardial infarction was caused by coronary thrombosis secondary to sclerotic changes in the coronary arteries; and, in 1910, two Russian physicians described the clinical presentation of acute myocardial infarction in five patients, which was confirmed by autopsy. Two years later, James B. Herrick (1861-1954) incorporated, for the first time, the use of the ECG in the diagnosis of acute myocardial infarction[1-3].

The ECG should be recorded and interpreted within the first ten minutes of assessing a patient with suspected ACS. Based on the physiopathological mechanism, management and patients' prognosis, current guidelines recommend classifying ACS into two groups: with and without persistent ST-segment elevation[4-7].

Persistent ST-segment elevation has been associated with total or near-total (subtotal) occlusion of a coronary artery and with a proven benefit of reperfusion within 90–120 minutes of symptom onset. However, the absence of this persistent ST-segment elevation does not exclude the presence of acute coronary occlusion. There are other clinical, electrocardiographic, and laboratory elements that could suggest it, or portend a high risk of mortality, so in these cases, coronary angiography is also indicated, with the intention of performing percutaneous coronary intervention. For these reasons, it has been postulated to change the paradigm in ACS assessment to "occlusive" and "non-occlusive", instead of ACS with or without persistent ST-segment elevation, as currently being practiced[7,8].

This persistent ST-segment elevation in the clinical context of acute myocardial ischemia is classically defined as ST-segment elevation, above the isoelectric line, ≥1 mm (0.1 mV) in contiguous leads, except in V_2 and V_3 where the said elevation should be > 2.5 mm in men under 40 years of age, > 2 mm in men over

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40 years of age, or > 1.5 mm in women. The depression of the ST segment of V_1-V_4 requires the acquisition of posterior lead (V_7-V_9) tracings, to confirm or rule out a "posterior", now inferobasal infarction[5,7].

Aslanger *et al.*[9], have described an electrocardiographic pattern of elevation in lead III, without elevation in the other inferior leads, but in aVR and V_1, with a concomitant depression in V_4-V_6, or positive T-wave and ST-segment in $V_1 > V_2$. This pattern is associated with inferior myocardial infarction, associated with multivessel coronary artery disease[9].

The presence of cardiac pacemakers or complete left bundle branch block (LBBB) in patients with suspected acute myocardial ischemia can make ECG interpretation difficult. However, the Sgarbossa criteria[7,10], modified by Smith and validated by Meyers[10], can be applied with high sensitivity (80%) and specificity (99%), in those with LBBB. When these criteria are met, the ECG should be interpreted as an equivalent of ACS with ST-segment elevation. Complete right bundle branch block, apparently of new-onset, however, in patients with chest pain, should be considered to be of ischemic etiology, for which reason invasive coronary angiography should be performed, due to the high sensitivity, but not specificity of this electrocardiographic finding to diagnose occlusion of the anterior descending artery in its proximal segment[7,10].

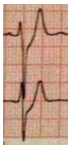
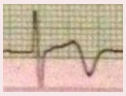
Diffuse ST-segment depression (>1 mm in 6 or more leads), together with ST-elevation in aVR/V1 and malignant arrhythmias, is associated with left main coronary disease and has a high incidence of serious complications (major cardiovascular events)[6].

In the group of patients with acute ischemic symptoms, who present an ECG without persistent ST-segment elevation (ST depression, T-wave abnormalities, transient ST-segment elevation, and even a normal electrocardiographic tracing), it is important to perform serial ECGs[6].

Patients with De Winter and Wellens electrocardiographic patterns (**Table**)[11,12] or with an inverted U wave, described by McHenry, are at high-risk for serious complications (major coronary events) and immediate invasive coronary angiography should be performed. Up to a quarter of these patients have total occlusion of a coronary artery[6,13,14].

Having identified several high and very-high-risk electrocardiographic elements for serious complications during ACS, it is clear that diagnostic and prognostic evaluation based solely on the ST-segment has limited specificity for total or subtotal occlusion of a coronary artery. Therefore, a new paradigm is suggested based on all the clinical, electrocardiographic, and laboratory elements evaluated patients with ACS according to the possibility of having an acute coronary occlusion[15]. However, there are limitations regarding the evidence in relation to this new classification paradigm (occlusive ACS, including subocclusive ACS or non-occlusive ACS), therefore randomized prospective studies are required for its validation; since it is evident that the current classification of ACS (with or without ST-segment elevation) does not identify an important group of patients who have an acute coronary occlusion, later demonstrated by coronary angiography, without manifesting the classic persistent elevation of the ST-segment.

Table. De Winter and Wellens' electrocardiographic patterns.

Pattern	Description	Electrocardiogram*
De Winter	> 1 mm upsloping ST-segment depression at the J point in precordial leads that continued into tall, positive symmetrical T waves. In most patients there was a > 0.5 mm ST-elevation in lead aVR.	
Wellens	Biphasic or deep inverted (symmetrical or asymmetrical) T waves in precordial leads, especially in V_2 and V_3, with a normal or minimally elevated ST segment. It usually appears during asymptomatic periods between episodes of ischemic-related chest pain.	

* Electrocardiographic fragments taken from figures in separate publications by de la Torre Fonseca *et al.*[11,12] in this journal.

CONFLICTS OF INTEREST

None.

REFERENCES

1. Hajar R. Coronary Heart Disease: From Mummies to 21st Century. Heart Views. 2017;18(2):68-74. [DOI]
2. Nabel EG, Braunwald E. A tale of coronary artery disease and myocardial infarction. N Engl J Med. 2012;366(1):54-63. [DOI]
3. Rodríguez León A, Moreno-Martínez FL, Hernández de la Rosa. James B. Herrick y su inolvidable legado. CorSalud [Internet] 2012 [cited Dic 10, 2022];4(4):232-5. Available at: http://www.corsalud.sld.cu/sumario/2012/v4n4a12/herrick.html
4. Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, *et al*. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: Executive Summary: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. J Am Coll Cardiol. 2021;78(22):2218-61. [DOI]
5. Thygesen K, Alpert JS, Jaffe AS, Chaitman BR, Bax JJ, Morrow DA, *et al*. Fourth Universal Definition of Myocardial Infarction (2018). Circulation. 2018; 138(20):e618-e651. [DOI]
6. Collet JP, Thiele H, Barbato E, Barthélémy O, Bauersachs J, Bhatt DL, *et al*. 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. Eur Heart J. 2021 Apr 7;42(14):1289-367. [DOI]
7. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, *et al*. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J. 2018;39(2):119-77. [DOI]
8. Pendell Meyers H, Bracey A, Lee D, Lichtenheld A, Li WJ, Singer DD, *et al*. Accuracy of OMI ECG findings versus STEMI criteria for diagnosis of acute coronary occlusion myocardial infarction. Int J Cardiol Heart Vasc [Internet]. 2021 [cited Dic 15, 2022];33:100767. Available at: https://doi.org/10.1016/j.ijcha.2021.100767
9. Aslanger E, Yıldırımtürk Ö, Şimşek B, Sungur A, Türer Cabbar A, Bozbeyoğlu E, *et al*. A new electrocardiographic pattern indicating inferior myocardial infarction. J Electrocardiol. 2020;61:41-6. [DOI]
10. Meyers HP, Limkakeng AT, Jaffa EJ, Patel A, Theiling BJ, Rezaie SR, *et al*. Validation of the modified Sgarbossa criteria for acute coronary occlusion in the setting of left bundle branch block: A retrospective case-control study. Am Heart J. 2015;170(6): 1255-64. [DOI]
11. de la Torre Fonseca LM, Pérez Fernández A, Echavarría Sifontes L, Mederos Hernández J, Rojas-Velázquez JM, Machín-Legón M, et al. Patrón de «de Winter» en paciente con síndrome coronario agudo sin elevación del segmento ST. CorSalud [Internet]. 2019 [cited Dic 15, 2022];11(4):332-6. Available at: https://revcorsalud.sld.cu/index.php/cors/article/view/409/1042
12. de la Torre Fonseca LM, Mederos Hernández J, Pérez Fernández A. Caracterización del síndrome de Wellens y su relación como predictor de obstrucción grave de la arteria descendente anterior. Unidad de Cuidados Coronarios Intensivos Hospital Manuel Fajardo 2016-2017. CorSalud [Internet]. 2019 [cited Dic 15, 2022];11(4):271-7. Available at: https://revcorsalud.sld.cu/index.php/cors/article/view/404/1034
13. de Winter RJ, Verouden NJ, Wellens HJ, Wilde AA; Interventional Cardiology Group of the Academic Medical Center. A new ECG sign of proximal LAD occlusion. N Engl J Med. 2008;359(19):2071-3. [DOI]
14. de Zwaan C, Bär FW, Wellens HJ. Characteristic electrocardiographic pattern indicating a critical stenosis high in left anterior descending coronary artery in patients admitted because of impending myocardial infarction. Am Heart J. 1982;103(4 Pt 2):730-6. [DOI]
15. Aslanger EK, Meyers PH, Smith SW. STEMI: A transitional fossil in MI classification? J Electrocardiol. 2021;65:163-9. [DOI]