3 (2021) 100013

Contents lists available at ScienceDirect

American Heart Journal Plus: Cardiology Research and Practice

journal homepage: www.elsevier.com/locate/ahjo

The rare presentation of the de Winter's pattern: Case report and literature review

Rohan Madhu Prasad *, Abdullah Al-abcha, Ahmed Elshafie, Yasser Amr Radwan, Zulfiqar Qutrio Baloch, George S. Abela

Michigan State University - Sparrow Hospital, 1200 E Michigan Ave, Ste 510, Lansing, MI. 48912, United States of America

ARTICLE INFO

Article history:
Received 20 April 2021
Accepted 22 April 2021

ABSTRACT

Although not classified as a ST elevated myocardial infarction (STEMI), the patterns known as equivalents also require prompt recognition and treatment. A 50-year-old male with no pertinent history presented to the emergency department for chest pain that radiated to his left shoulder. An electrocardiogram (EKG) revealed findings consistent with the de Winter's pattern, which were greater than 1 mm upsloping ST depressions at the J point in leads V3-V6 (maximally in leads V3–V5), tall, peaked T waves in leads II, III, and V3–V5, ST elevations in lead aVR, and 1 mm ST elevation in V1 and V2. The physical exam, troponins, and other laboratory investigations were unrevealing. Urgent, diagnostic coronary angiography revealed complete occlusion of the proximal left anterior descending (LAD) artery, which was successfully treated with percutaneous coronary intervention (PCI) and two drug-eluting stents. After the stent placement, arterial blood flow was re-established and the ECG normalized. The patient was started on guideline based treatment and discharged home once medically stable. The de Winter's pattern on electrocardiogram indicates a significant coronary artery disease. This pattern requires urgent intervention, typically percutaneous stent placement.

1. Introduction

The electrocardiogram (ECG) is an imaging tool used in the initial diagnosis and management of patients presenting with symptoms consistent with acute coronary syndrome (ACS), such as chest pain. Obstructions in the coronary artery can cause ST elevations on ECG and eventually ST elevated myocardial infarction (STEMI). However, there are numerous high-risk ECG patterns that do not meet the STEMI criteria, but still suggests coronary artery blockage [1,2]. In 2008, an ECG pattern, named de Winter's pattern, was associated with significant stenosis of proximal left anterior descending (LAD) arterial [3]. This characteristic pattern is an upsloping ST segment at the J point in precordial leads that continues into tall, positive symmetrical T waves, but other findings can also be present [1,3–5]. This ECG pattern is as a STEMI equivalent; thus, these patients should be triaged for urgent intervention [6,7]. This case report describes a patient with this finding as well as conducting a review of the current literature.

2. Case presentation

A 50-year-old male with no pertinent past medical history presented to the emergency department for a two-day duration of chest pain, which radiated to his left shoulder and had a severity of 3/10. The patient was not on any medications prior to admission and had no risk factors for ACS. There were no previous ECG on file for comparison. On the physical exam, he was vitally stable and heart and lungs were within normal limits. The admission 12-lead ECG revealed greater than one millimeter (mm) upsloping ST depressions at the J point in leads V3-V6 (maximally in leads V3-V5), tall, peaked T waves in leads II, III, and V3-V5, ST elevations in lead aVR, and 1 mm ST elevation in V1 and V2. This did not meet the classic STEMI criteria, but it did represent the rare finding of de Winter's pattern. (Fig. 1) Initial troponins were 0.09 and 0.11 ng/mL (0–18 pg/mL). Urgent, diagnostic coronary angiography revealed complete occlusion of the proximal LAD artery, which was successfully treated with percutaneous coronary intervention (PCI) and two drug-eluting stents (2.5x32mm and 2.75x20mm). (Fig. 2) After the stent placement, arterial blood flow was re-established (Fig. 3) and the ECG returned to normal. (Fig. 4) The patient was started on aspirin, prasugrel, atorvastatin, lisinopril, and metoprolol. During the hospital stay, the patient was stable and asymptomatic two days later. Thus, he was discharged home and no medication regimen changes were needed at a one week follow up appointment.

Abbreviations: ACS, acute coronary syndrome; AHA, American Heart Association; ATP, Adenosine triphosphate; ECG, Electrocardiogram; LAD, left anterior descending artery; MI, myocardial infarction; mm, millimeter; PCI, primary coronary intervention; STEMI, ST elevation myocardial infarction.

* Corresponding author.
E-mail address: rohanmaprasad@gmail.com (R.M. Prasad).

http://dx.doi.org/10.1016/j.ahjo.2021.100013

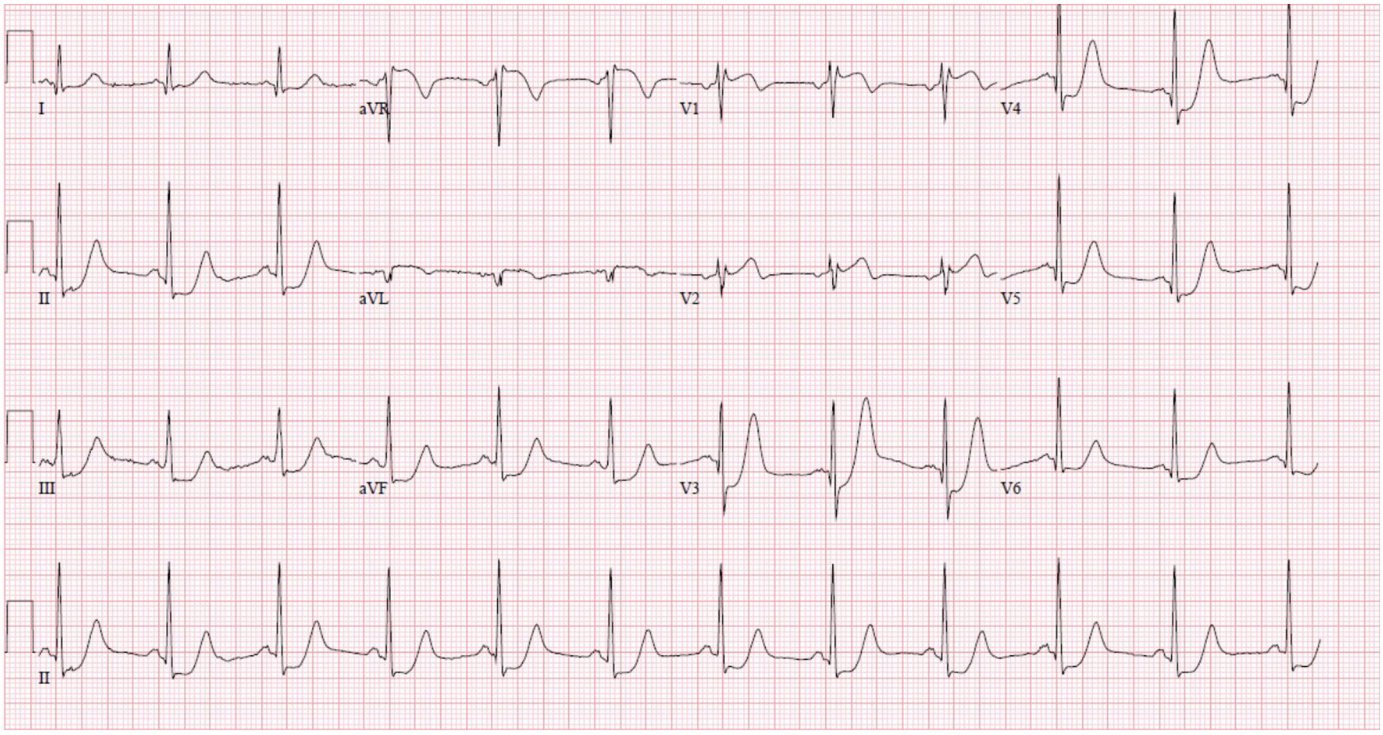

Fig. 1. Electrocardiogram on admission. Electrocardiogram, 12-lead, on admission demonstrating greater than 1 mm upsloping ST depressions at the J point in leads V3-V6 (maximally in leads V3-V5), tall, peaked T waves in leads II, III, and V3-V5, ST elevations in lead aVR, and 1 mm ST elevation in V1 and V2, which are findings consistent with the de Winter's pattern.

3. Discussion

The STEMI criteria includes new onset of greater than 1 mm of ST segment elevation in two or more consecutive limb leads and greater than 2 mm ST elevations in the precordial leads [8]. Additionally, tall symmetrical T waves can progress into the typical ST elevation in the precordial leads [3]. Over time, STEMI alternatives have been described that may mimic STEMI, but do not actually meet the criteria. Although none of these represent an active or impending MI, they are considered as STEMI equivalents [3,9]. These patterns include posterior myocardial infarction, de Winter's, Wellens, delayed activation wave, and T wave precordial instability [1,2]. In 2008, Dr. Robbert de Winter found that 2.0% (30/1532) of patients with anterior wall myocardial infarctions had an atypical ECG pattern and proximal LAD occlusions. The pattern, which he named the de Winter's ECG, was described as: a persistent 1–3 mm upsloping ST segment depression at the J point in the precordial leads that continued into tall, prominent, and symmetrically peaked T waves. Additionally, non-essential findings for diagnosis were 1–2 mm ST segment elevation in the aVR lead as well as the QRS complexes were not wide or mildly wide and had a loss of precordial R wave progression. The typical ECG findings are recorded 1.5 h after symptom onset [3].

It was later shown that the maximal upsloping ST depression (median amplitude of 0.3 mm and interquartile range of 0.2–4 mm) and maximal T wave (0.9 mV and 0.8–1.1 mV) was seen in the V3 lead. [4] In regards to the ST segment elevation in aVR, studies have reported 100% (35/35) and 50% (4/8) of patients having this finding [1,5]. In comparison to Dr. de Winter's initial proposal, cases have indicated that the aVR lead has a 1–2 mm ST elevation and mild depression of the ST segments in the inferior wall leads [10]. Furthermore, it has been shown that the de Winter's pattern is not persistent as they can change even before an intervention [11]. Some cases indicate that the de Winter's pattern can evolve into STEMI [12,13]

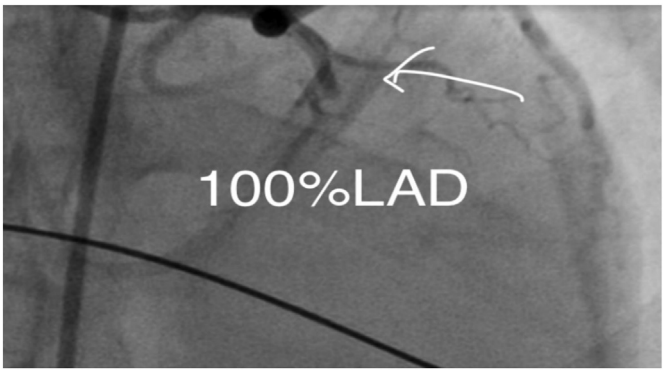

Fig. 2. Coronary angiography during cardiac catheterization. Coronary angiography during cardiac catheterization shows 100% occlusion of the left anterior descending artery.

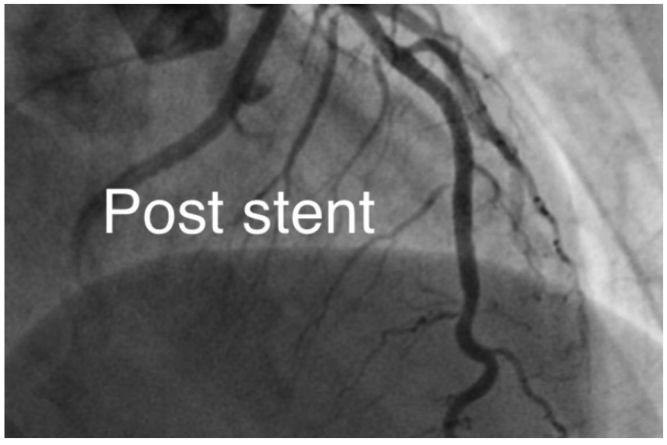

Fig. 3. Coronary angiography after percutaneous intervention. Coronary angiography after percutaneous intervention demonstrates coronary blood flow through the left anterior descending artery.

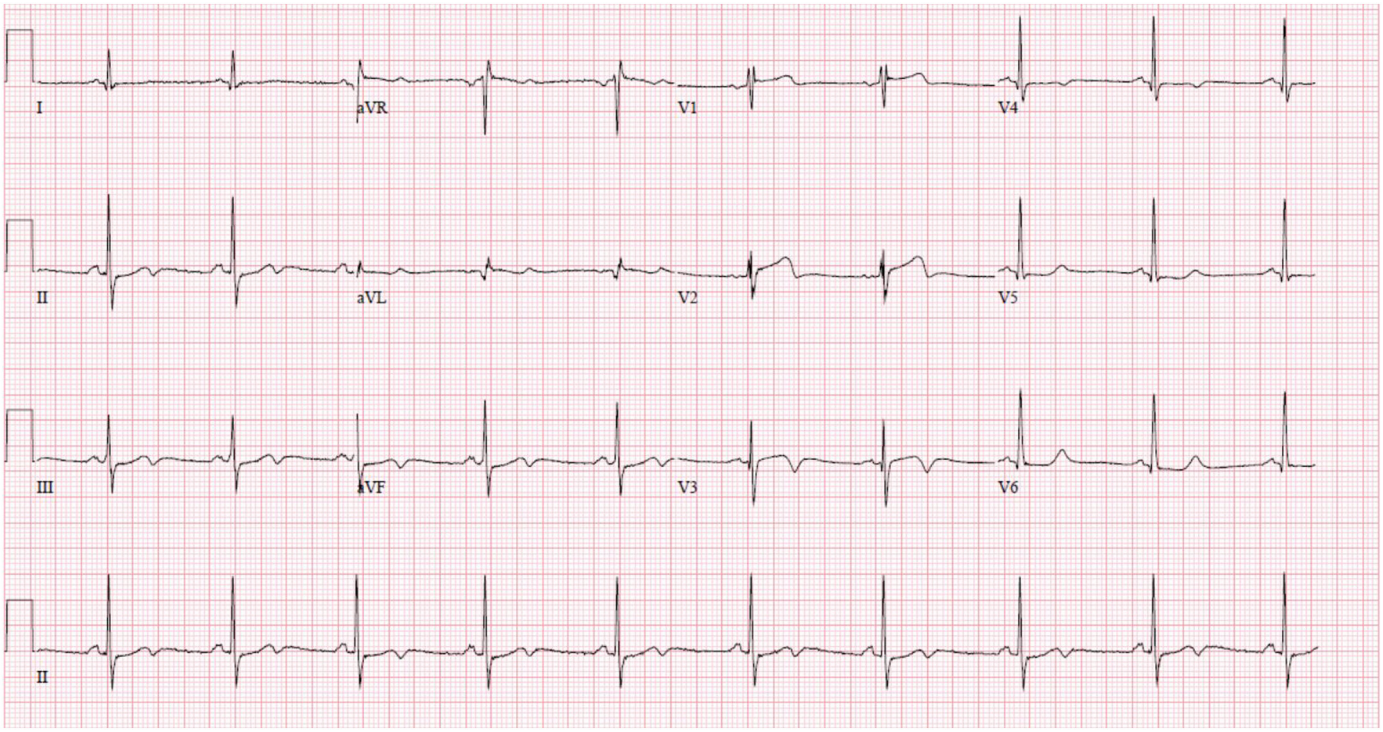

Fig. 4. Electrocardiogram after percutaneous intervention. Electrocardiogram 12 h after percutaneous intervention shows resolution of de Winter's pattern.

and that post-thrombolysis STEMI can evolve into de Winter's [14]. The common risk factors for this pattern includes males, mean age of 52 years, and history of smoking, hypercholesteremia, uncontrolled hypertension, and family history of myocardial infarction [5,7,15].

Dr. de Winter's initially reported a prevalence of 2.0% (30/1532) of anterior wall myocardial infarctions having this ECG pattern. Since then subsequent studies have reported the following prevalences: 1.9% (35/1890) of patients with PCI of the LAD artery [5], 3.4% (15/441) of patient with anterior myocardial infarction [7], 3.6% (7/206) of patients with STEMI and non-STEMI [1], 14% (7/44) of patients with non-STEMI [1], and 1.8% (6/330) of patients with non-STEMI [16]. It is widely thought that the de Winter's pattern is associated with proximal LAD occlusion; however, some reports do not support this. Two small studies have indicated that the vessels involved were: left circumflex (37.5% and 2/6), LAD (25% and 3/6), right coronary artery (25% and not reported), obtuse marginal (12.5% and not reported), and three vessel disease (not reported and 1/6), respectively [1,16]. Furthermore, three diagnostic studies have evaluated the positive predictive value of the de Winter's pattern to be 100% (with a 95% confidence interval of 69.2–100.0%) [5], 95.2% (76.2–99.9%) [11], and 100% (51.7–100%) [16]. The positive predictive value of the pattern with an LAD occlusion is: 62.1% (42.3–79.3%) [5], 85.7% (63.7–97.0%) [11], and 50% (13.9–86.1%) [16].

The current pathogenesis behind the de Winter's pattern has not been determined. One hypothesis is that the ischemic depletion of adenosine triphosphate (ATP) and subsequently the lack of action of sarcolemmal ATP-sensitive potassium channels causes the lack of typical ST elevations [3,17]. It is important to note that the upsloping ST segment depression is not a specific marker of ischemia, as it can also be found in patients with tachycardia and myocarditis. Moreover, the presence of q/Q wave and poor R wave progression was significantly more common in patients with upsloping ST depressions [14]. Loss of collateral blood flow may allow myocardial transmural ischemia and supports the fact that patients may progress from a de Winter's pattern to a STEMI [18]. Another theory is that a large area of transmural ischemia directs the injury current towards lead aVR and away from the precordial leads, however, it does not explain the de Winter's patter evolving into a STEMI [5]. Since the different layers of the cardiac wall have varying sensitivities to ischemia, severe regional hypoxia to mid-myocardium and subendocardial may cause these ECG findings [7,14]. The de Winter's pattern has been linked with significant occlusion of the proximal LAD and in some cases total occlusion, as in our case. [3,10,14] If complete occlusion occurs proximally to the septal perforator artery, the first branch of the LAD, then the basal septum is affected and ST elevation will arise in the aVR lead [3,4].

Despite the consequences of this severe ECG pattern, the current guidelines by the 2017 European Society of Cardiology (ESC) and 2013 American College of Cardiology Foundation (ACCF) / American Heart Association (AHA) do not specifically address the optimal management of patients with de Winter's [6,19]. However, the ESC suggests the PCI strategy when there is a clinical concern of ongoing myocardial ischemia with STEMI criteria or atypical ECG patterns [6]. In one study, the patients unfortunately experienced a delay between symptom onset and catheterization; however, it did show that almost all of the patients with de Winter's pattern eventually developed a STEMI [7]. Moreover, after a PCI procedure, the patient's symptom and pattern typically resolves, as in our case [6,7]. Despite prompt recognition and treatment, however, the patients can have a considerable loss of myocardium and systolic function [5,7,20]. Since the current guidelines recommend against thrombolysis in non-STEMI and are not clear in patients with de Winter's, the usage of thrombolytic agents is a controversial topic. Some cases report favorable outcomes after thrombolysis [13,21]. On the other hand, one study reported two patients failing thrombolysis and one patient developing re-occlusion after a successful thrombolysis [7].

The limitations of this study, as with other case reports, is that proposed correlations cannot be assumed as causations and the caution to generalize the concepts provided here to the general population. This patient had a although rare presentation of an EKG and was treated as per the guideline-based recommendations. Therefore, a strength of this study shows the effectiveness of guideline-based treatment in patients with de Winter's EKG.

4. Conclusion

The de Winter's pattern indicates significant stenosis of the proximal LAD. Therefore, prompt recognition of this rare finding is essential for early diagnosis and urgent reperfusion therapy. Appropriate recognition

leads to urgent treatment, reduces the amount of myocardial damage, and subsequently improves the prognosis, morbidity, and mortality of these patients. Guidelines are still controversial, but PCI is generally accepted and there are possible benefits to the thrombolytics.

Funding

No funding source was used in the writing or submission of this manuscript.

Consent to participate/publication

Consent for the case report was obtained from the patient.

Submission declaration/verification

We confirm that this case report has not been submitted to other journals.

Author contributions

Prasad: Wrote the case presentation and discussion, conducted literature review, obtained consent, edited final draft.

Al-abcha: Wrote the abstract and introduction, assisted in writing the discussion, conducted literature review, edited final draft.

Elshafie: Wrote the conclusion and works cited, obtained and formatted figures, edited final draft.

Radwan: Wrote the introduction, assisted in writing the discussion, conducted literature review, edited the final draft.

Baloch: Assisted in writing the discussion, conducted literature review, edited the final draft.

Abela: Assisted in writing the full case and guided on literature review.

Declaration of competing interest

The authors have no conflicts of interest to disclose.

References

[1] J. Wall, L.D. White, A. Lee, Novel ECG changes in acute coronary syndromes. Would improvement in the recognition of 'STEMI-equivalents' affect time until reperfusion? Intern. Emerg. Med. 13 (2018) 243–249.

[2] I.C. Rokos, W.J. French, A. Mattu, et al., Appropriate cardiac cath lab activation: optimizing electrocardiogram interpretation and clinical decision-making for acute ST-elevation myocardial infarction, Am. Heart J. 160 (6) (2010) 995–1003 (e1001-1008).

[3] R.J. de Winter, N.J. Verouden, H.J. Wellens, A.A. Wilde, A new ECG sign of proximal LAD occlusion, N. Engl. J. Med. 359 (2008) 2071–2073.

[4] N.P. Morris, R. Body, The De Winter ECG Pattern: morphology and accuracy for diagnosing acute coronary occlusion: systematic review, Eur J Emerg Med 24 (2017) 236–242.

[5] N.J. Verouden, K.T. Koch, R.J. Peters, et al., Persistent precordial "hyperacute" T-waves signify proximal left anterior descending artery occlusion, Heart 95 (20) (2009) 1701–1706.

[6] P.T. O'Gara, F.G. Kushner, D.D. Ascheim, et al., 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, Circulation 127 (4) (2013) (e362-425).

[7] J. Xu, A. Wang, L. Liu, Z. Chen, The de winter electrocardiogram pattern is a transient electrocardiographic phenomenon that presents at the early stage of ST- segment elevation myocardial infarction, Clin. Cardiol. 41 (2018) 1177–1184.

[8] Vedat Aytekin, Update on ACC/ESC criteria for acute ST-elevation myocardial infarction, Anatolian J. Cardiol. 7 (1) (2007) 14 [Anadolu Kardiyoloji Dergisi].

[9] K.K. Goyal, S. Rajasekharan, K. Muneer, C.G. Sajeev, de winter sign: a masquerading electrocardiogram in ST-el- evation myocardial infarction, Heart India 5 (1) (2017) 48–50.

[10] E. Garcia-Izquierdo, C. Parra-Esteban, J. Mirelis, et al., The de Winter ECG pattern in the absence of acute coronary artery occlusion, Can. J. Cardiol. 34 (2018) 209.e1–209.e3.

[11] S. Sclarovsky, E. Rechavia, B. Strasberg, et al., Unstable angina: ST segment depression with positive versus negative T wave deflections - clinical course, ECG evolution, and angiographic correlation, Am. Heart J. 116 (1988) 933–941.

[12] H. Wang, X.C. Dai, Y.T. Zhao, X.H. Cheng, Evolutionary de Winter pattern: from de Winters to STEMI-A case report, BMC Cardiovasc. Disord. 20 (2020) 324, https://doi.org/10.1186/s12872-020-01611-0.

[13] T.J. John, A. Pecoraro, H. Weich, L. Joubert, B. Griffiths, P. Herbst, The de Winter's pattern revisited: a case series, Euro. Heart J. Case Rep. (2020)https://doi.org/10.1093/ehjcr/ytaa402 ytaa402.

[14] Z.Q. Zhan, Y. Li, L.H. Han, et al., The de Winter ECG pattern: distribution and morphology of ST depression, Ann. Noninvasive Electrocardiol. 25 (2020)https://doi.org/10.1111/anec.12783 312783.

[15] J.M. Raja, A. Nanda, I. Pour-Ghaz, R.N. Khouzam, Is early invasive management as ST elevation myocardial infarction warranted in de Winter's sign - a "peak" into the widow-maker, Ann. Transl. Med. 7 (17) (2019) 412, https://doi.org/10.21037/atm.2019.07.19.

[16] N. Misumida, A. Kobayashi, P. Schweitzer, et al., Prevalence and clinical significance of up-sloping ST-segment depression in patients with non-ST-segment elevation myocardial infarction, Cardiol. Res. 6 (2015) 306–310.

[17] R.A. Li, M. Leppo, T. Miki, S. Seino, E. Marba, Molecular basis of electrocardiographic ST-segment elevation, Circ. Res. 87 (2000) 837–839.

[18] Y. Birnbaum, J.M. Wilson, M. Fiol, A.B. De Luna, M. Eskola, K. Nikus, ECG diagnosis and classification of acute coronary syndromes, Ann. Noninvasive Electrocardiol. 19 (2014) 4–14.

[19] B. Ibanez, S. James, The 2017 ESC STEMI Guidelines, Eur. Heart J. 39 (2018) 119–177.

[20] D. Yaranov, V. Kairouz, P. Patel, et al., "To Cath or not to Cath..." Rare electrocardiographic presentation of acute myocardial infarction, J. Am. Coll. Cardiol. (2018) https://doi.org/10.1016/s0735-1097(18)32736-0.

[21] M.Y. Rao, Y.L. Wang, G.R. Zhang, et al., Thrombolytic therapy to the patients with de Winter electrocardiographic pattern, is it right? QJM 111 (2018) 125–127.