British Cardiovascular Society

'Promoting excellence in cardiovascular care'

Recognising the Critical Non-ST-Elevation Acute Coronary Syndrome

Ayisha Khan-Kheil, ST4 Cardiology Registrar, University Hospital Coventry & Warwickshire

Introduction:
'STEMI alert - Resus' is a phrase as cardiology trainees we are very familiar with. Recognising ST elevation in its various patterns, corresponding to occlusions in the respective coronary anatomy, is something that has been re-enforced since medical school. It is almost comforting in a way, when we attend such patients in the Emergency Department, confirm the history and ECG findings are consistent and whisk them to the catheter lab for primary percutaneous coronary intervention (PCI).

Take Home Messages

- Not all acute coronary artery occlusions present with ST elevation.
- Circumflex artery occlusions are more likely to present with a normal ECG.
- Echo is your friend – use it to exclude other causes of chest pain and to help confirm ACS.
- Recognise and educate others on less well known but recognised ECG patterns associated with coronary disease such as De Winters in LAD occlusion.

The diagnostic dilemma occurs when we are faced with the non-ST elevation acute coronary syndrome, (NSTE- ACS). Surely there should be some ECG changes? When do we consider an alternative diagnosis? When do we confidently call in the cardiac catheterisation lab team in the middle of the night? As a junior registrar, I often have such questions racing through my mind in these pressurised situations, simply because I have not yet had as much exposure and experience of acute coronary occlusions with ECG patterns other than ST elevation.

The aim of this editorial is to highlight awareness of these other patterns and the management of high risk NSTE-ACS, so that the time to coronary intervention is not delayed. Studies[1,2] show that these patients experience delayed intervention and revascularisation which in turn affects mortality and morbidity, all because the diagnosis from the ECG is not as obvious as an ST elevation MI. As cardiology trainees at the front door, we need to be aware of the guidelines and the additional diagnostic resources we can utilise, to reduce this risk as much as possible.

Definitions
According to the 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation,[3] the clinical spectrum of non-ST-elevation ACS, ranges from patients free of symptoms at presentation to individuals with ongoing ischaemia, electrical or haemodynamic instability or cardiac arrest. Due to the amount of myocardium in jeopardy and the risk of malignant ventricular arrhythmias, immediate coronary angiography and revascularisation are indicated in the high-risk cases.

Very High Risk Criteria	High Risk Criteria	Intermediate Risk Criteria
Haemodynamic Instability	Rise or fall in troponin compatible with MI	Diabetes Mellitus
Cardiogenic shock	Dynamic ST or T wave changes (symptomatic or silent)	eGFR<60mL/min
Ongoing chest pain refractory to medical therapy.	GRACE score >140	LVEF<40%
Life threatening arrhythmias/cardiac arrest		Early post-infarction angina
Mechanical complications of MI		Prior PCI
Acute heart failure		Prior CABG
Recurrent dynamic ST-T wave changes with intermittent ST elevation		Grace score 109 - 140

Table 1: Risk criteria warranting an invasive strategy in NSTE-ACS.

ECG patterns in NSTE-ACS[4]:

- May be normal in 1/3 of patients.
- ST depression ≥0.05 mV in two or more contiguous leads.
- Patients with ST depression have a worse prognosis than patients with a normal ECG.
- The number of leads showing ST depression and the magnitude of ST depression are indicative of the extent of ischaemia and correlate with prognosis and benefit from an invasive treatment strategy[5].
- ST depression combined with transient ST elevation identifies a high-risk subgroup.

A recent study of the Korean acute myocardial infarction registry demonstrated that a total occlusion of the left circumflex artery accounted for a longer door to balloon time – over 90 minutes, primarily because it did not present electrically as an ST elevation myocardial infarction[6]. In fact, patients presenting with such occlusions have ST elevation less than 50% of the time.[7]

The De Winter ECG pattern

Another acute coronary artery occlusion ECG to be aware of is the 'De Winter' ECG pattern, often considered an anterior STEMI equivalent that presents *without* obvious ST segment elevation. Essential diagnostic features include ST depression and peaked T waves in the precordial leads.[8]

Diagnostic Criteria

- Tall, prominent, symmetric T waves in the precordial leads
- Upsloping ST segment depression >1mm at the J-point in the precordial leads
- Absence of ST elevation in the precordial leads
- ST segment elevation (0.5mm-1mm) in aVR

This ECG pattern accounts for 2% of LAD occlusions but because it is not well recognised it may result in delays in re-perfusion and attendant increase in mortality and morbidity.[9]

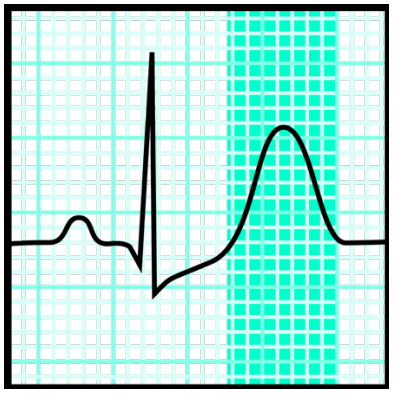

Figure 1: Typical De Winters ECG changes.[10]

So, what should we do if there are no significant ECG changes?

There is some evidence to suggest that there is reduced detection of LCx occlusions due to ECG insensitivity.[11] It may be useful in such cases to record ECG traces in additional leads – right sided and posterior leads looking for subtle ST changes.

However, the correlation of ECG changes with the culprit lesion is also affected by other factors such as: left coronary artery dominance, multivessel disease and distal location of the culprit lesion.

Echocardiography
Transthoracic echocardiography is essential to identify regional wall motion abnormalities which would suggest myocardial ischaemia in the infarcted territory. One study[12] which looked at echocardiography in a pre-hospital setting found that echocardiography to identify such abnormalities had a diagnostic sensitivity of 90.9% in NSTE-ACS.
In addition, echocardiography can help in excluding other differential diagnoses such as aortic dissection, pericardial effusion, aortic stenosis, hypertrophic cardiomyopathy and pulmonary embolism.

Angiography
According to the ESC guidelines, angiographic findings in NSTE-ACS are diverse, ranging from no lesion in 20% of cases to multi-vessel disease. Nearly one-quarter of NSTE-ACS patients present with an acutely occluded coronary artery and two-thirds of the occlusions are already collateralised at the time of angiographic examination.[13] Multiple meta- analyses[14] have been conducted investigating the outcomes of an early invasive strategy <24hours versus a delayed strategy in the management of high risk NSTEMIs.

The largest individual RCT to date is the 'Timing of Intervention in Acute Coronary Syndromes (TIMACS) trial.[15] This randomly assigned 3031 NSTE-ACS patients to an early (<24 h, median time 14 h) or delayed (median time 50 h) intervention. At 6 months, the primary endpoint of death, MI or stroke was not different between the early and delayed invasive strategy [9.6% vs. 11.3%; HR 0.85 (95% CI 0.68, 1.06), *P* = 0.15]. The secondary endpoint of death, MI, stroke or refractory ischaemia was reduced by 28% in favour of the early invasive strategy [9.5% vs. 12.9%; HR 0.72 (95% CI 0.58, 0.89), *P* = 0.003]. In a pre-specified analysis of high-risk patients (i.e. one-third of patients with a GRACE risk score >140), an early invasive strategy lowered the risk of death, MI or stroke [13.9% vs. 21.0%; HR 0.65 (95% CI 0.48, 0.89), *P* = 0.006], whereas the difference was not significant for patients with a GRACE risk score ≤140 [7.6% vs. 6.7%; HR 1.12 (95% CI 0.81, 1.56), *P* = 0.48; *P* = 0.01 for heterogeneity].

A further systematic review and meta-analysis looked at the outcome of 17,212 patients with non-ST segment elevation myocardial infarction who had an occluded culprit artery. These patients were more likely to have left circumflex artery as their culprit artery (odds ratio (OR) 1.65, 95% CI 1.15–2.37, *p* = 0.007), and this was associated with lower left ventricular ejection fraction, higher peak enzyme level and higher risk for cardiogenic shock compared with patients with a non-occlusive culprit artery.[16]
In light of this data, the importance of recognising a high risk non-ST elevation myocardial infarction is paramount. Such patients will require early percutaneous coronary intervention, and this is an issue that needs to be more widely understood, in order to enable better recognition, reduce delays and ensure less complications.

Conclusion

Patients presenting with NSTE-ACS will often present a diagnostic challenge. The art of determining whether your patient requires urgent primary coronary intervention is difficult to master and relies on you making the correct decision in the right time frame. It is worth bearing in mind the high-risk criteria for NSTE-ACS, in addition to the supplementary diagnostic tools discussed above. Despite some differences in practice across various centres, knowledge IS power. So, armed with this knowledge, let us go forth with confidence and revascularise the electrically silent infarcts, in order to improve mortality and morbidity.

---

[1] Terkelsen CJ, Lassen JF, Nørgaard BL, Gerdes JC, Jensen T, Gøtzsche LB, et al. Mortality rates in patients with ST-elevation vs. non-ST-elevation acute myocardial infarction: observations from an unselected cohort. Eur Heart J. 2005;26:18–26. doi: 10.1093/eurheartj/ehi002

[2] Milosevic A,Vasiljevic-Pokrajcic Z, Milasinovic D et al. Immediate Versus Delayed Invasive Intervention for Non-STEMI Patients. JACC: Cardiovascular Interventions Mar 2016, 9 (6) 541-549; DOI:10.1016/j.jcin.2015.11.018

[3] 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation https://academic.oup.com/eurheartj/article/37/3/267/2466099#108782025 Last accessed 20/11/12018

[4] Savonitto S, Ardissino D, Granger CB et al. Prognostic value of the admission electrocardiogram in acute coronary syndromes. JAMA 1999;281:707–713.

[5] Kaul P, Fu Y, Chang WC et al. Prognostic value of ST segment depression in acute coronary syndromes: insights from PARAGON-A applied to GUSTO-IIB. PARAGON-A and GUSTO IIB Investigators. Platelet IIB/IIIA antagonism for the reduction of acute global organization network. J Am Coll Cardiol 2001;38:64–71.

[6]Kang, MG, Kim, K, Park, HW et al. Door-to-balloon time and cardiac mortality in acute myocardial infarction by total occlusion of the left circumflex artery. Coronary Artery Disease: August 2018 - Volume 29 - Issue 5 - p 409–415.

[7] Stribling WK, Kontos MC, Abbate A et al. Left circumflex occlusion in acute myocardial infarction (from the National Cardiovascular Data Registry). Am J Cardiol. 2011 Oct 1;108(7):959-63. doi: 10.1016/j.amjcard.2011.05.027. Epub 2011 Aug 4.

[8] Life in the Fast Lane. https://litfl.com/de-winter-t-wave-ecg-library/ Last accessed 20/11/2018.

[9] de Winter RJ, Verouden NJ, Wellens HJ et al. A new ECG sign of proximal LAD occlusion.Interventional Cardiology Group of the Academic Medical Center. N Engl J Med. 2008 Nov 6; 359(19):2071-3.

[10] https://commons.wikimedia.org/wiki/File:De_Winter%27s_T_wave_(ECG).svg. Last accessed 27/11/2018

[11] Rasoul S, de Boer MJ, Suryapranata H, et al. Circumflex artery-related acute myocardial infarction: limited ECG abnormalities but poor outcome. Neth Heart J. 2007;15(9):286-90.

[12] Bergmann I, Büttner B, Teut E, et al. Pre-hospital transthoracic echocardiography for early identification of non-ST-elevation myocardial infarction in patients with acute coronary syndrome. *Crit Care*. 2018;22(1):29. Published 2018 Feb 7. doi:10.1186/s13054-017-1929-1

[13] Renu V, Allen PB, Andrew F et al. Pathology of the Vulnerable Plaque Journal of the American College of Cardiology Apr 2006, 47 (8 Supplement) C13-C18; DOI: 10.1016/j.jacc.2005.10.065

[14] Demosthenes G. Katritsis, George C.M. Siontis, Adnan Kastrati et al. Optimal timing of coronary angiography and potential intervention in non-ST-elevation acute coronary syndromes, *European Heart Journal*, Volume 32, Issue 1, 1 January 2011, Pages 32–40, https://doi.org/10.1093/eurheartj/ehq276

[15] Mehta SR, Granger CB, Boden WE et al. Early versus delayed invasive intervention in acute coronary syndromes. N Engl J Med 2009;360:2165–2175.

[16] Chi-Sheng H, Ying-Hsien C, Ching-Chang H et al. Prevalence and outcome of patients with non-ST segment elevation myocardial infarction with occluded "culprit" artery – a systemic review and meta-analysis. Crit Care. 2018; 22: 34.