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ECG CHALLENGE
Coronary intervention

Look before you leap: the importance of ECG in management of out-of-hospital cardiac arrest

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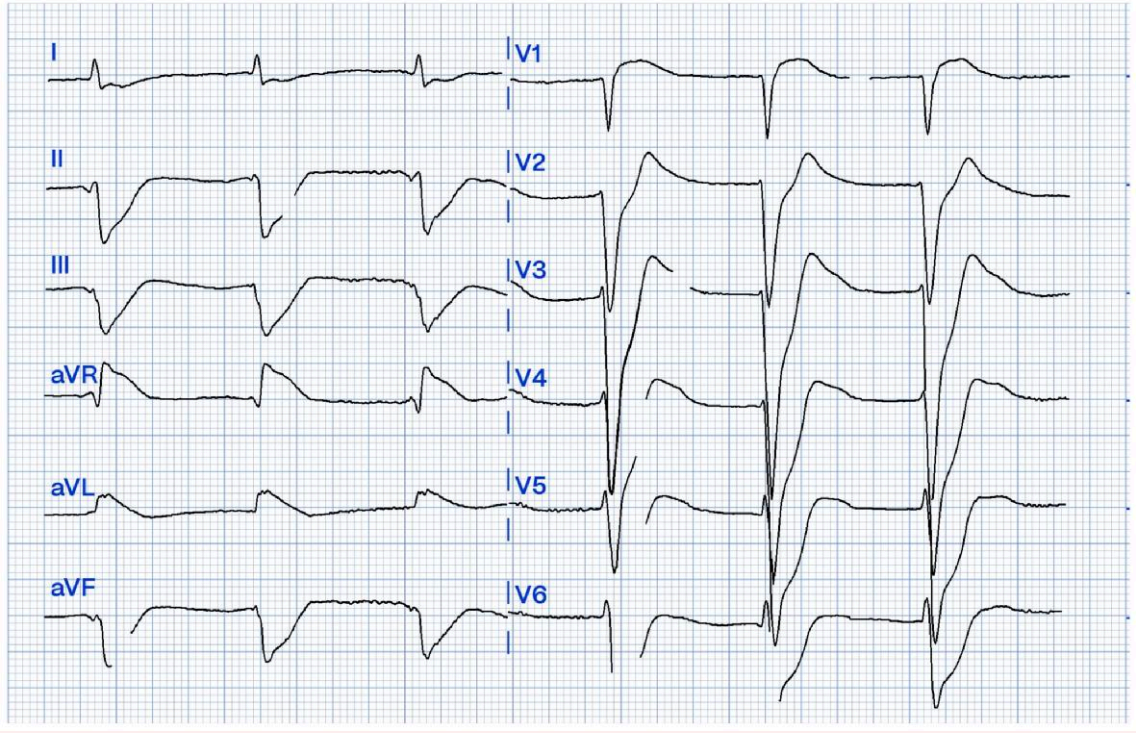
Graphical Abstract



Reconstructed pre-hospital ECG, 25 mm/s 10 mm/mV.

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Case

A 51-year-old man suffered witnessed out-of-hospital cardiac arrest (OHCA). Ventricular fibrillation was the initial rhythm. This was successfully terminated after three shocks and amiodarone administration but was followed by asystole requiring continuous cardiopulmonary resuscitation. Return of spontaneous circulation (ROSC) could be achieved after a cumulative low flow time of 45 min (assumed no flow time: 15 min). The ECG following ROSC (see *Graphical Abstract*) was interpreted by emergency medical service (EMS) and directed subsequent patient management. The patient was treated with aspirin and unfractionated heparin on scene. EMS decided against immediate transfer to catheterization laboratory.

At arrival at the emergency department (ED), the patient was intubated, sedated, and mechanically ventilated and required vasopressors (norepinephrine 1500 μg/h). EMS reported massive aspiration; the corresponding clinical sign was bilateral crackles. The in-hospital ECG showed regressed ST-segment depressions and elevations (see Supplementary material online, *Figure S1*). The patient's medical history was negative for chronic disease. Transthoracic echocardiography in ED primarily showed moderately reduced left ventricular ejection fraction and hypokinetic interventricular septum.

Question 1

What pathology is most closely represented in this ECG?

A. Intoxication with sodium channel blocker
B. Intoxication with tricyclic antidepressants
C. Diffuse subendocardial ischaemia following distributive shock
D. Acute coronary syndrome (ACS) with left main coronary artery (subtotal) occlusion
E. Acute coronary syndrome with proximal occlusion of the right coronary artery

Correct answers are C and D.

Discussion and explanation

The ECG showed accelerated idioventricular rhythm (67 bpm) and left axis deviation. Narrow QRS complexes were obviously seen in leads I and V1 (see Supplementary material online, *Figure S2*). ST-segment elevation (STE) was present in aVR, aVL, and V1. ST-segment depression was present in nine leads. The corrected QT duration was within the normal range (340 ms).

STE in lead aVR in combination with multi-lead depression might suggest occlusion of left main coronary artery/proximal left artery descending (LAD), or severe three-vessel disease.[1,2] Only the minority of patients with this ECG pattern have total coronary occlusion in real-world analysis.[1] Current guidelines on acute coronary syndrome without STE (NSTE-ACS) recommend to consider immediate coronary angiography in these patients with assumed ischaemia.[3] But in OHCA patients without evidence for ongoing ischaemia, recent evidence supports delayed angiography.[4]

The ECG reports and regression of ST segment abnormalities were discussed in ED for optimized patient management. Given the narrow QRS complex and as alterations quickly resolved without specific treatment, we rejected intoxication. Conditions (e.g. sepsis, anaphylaxis, and anaemia) causing supply–demand mismatch might lead to diffuse subendocardial ischaemia resulting in similar ECG findings. The dilemma of differentiation of underlying pathology of ischaemia could not be resolved with ECG interpretation. Prioritized assumptions were as follows:

- Occlusive acute myocardial infarction (AMI) with cardiogenic shock
- Diffuse subendocardial ischaemia following vasodilatory shock caused by either post-reanimation syndrome or sepsis following aspiration pneumonia

Answers C and D are valid options and further patient evaluation is required.

Question 2

A clinical exam and bed-side echocardiography are performed in ED. What sign or symptom is at least suggestive for ACS as underlying pathology in comatose OHCA patients?

A. History of acute chest pain
B. Shockable rhythm
C. Regional wall motion abnormality
D. Pulmonary oedema and shock requiring vasopressors
E. Swelling and oedema

The correct answer is E.

Discussion and explanation

Clinical decision-making is of utmost interest. Shockable rhythm and chest pain were previously described as an independent predictor for coronary occlusive disease in OHCA patients with NSTE-ACS in the literature.[5] Regional wall motion abnormality is consistent with territorial ischaemia and supports ACS as cause of OHCA rather than diffuse subendocardial ischaemia. Pulmonary oedema following cardiogenic shock is consistent with ACS and associated with worse prognosis. Swelling and oedema are less-specific signs of multiple causes but are mainly present in chronic diseases.

Question 3

What is the most appropriate next step in evaluating this patient?

A. Immediate transfer to coronary angiography
B. Measurement of high-sensitivity troponin
C. Blood gas analysis for measurement of serum lactate
D. ICU transfer
E. Cardiac computed tomography (CT)

The correct answer is A.

Discussion and explanation

All factors contributing to the risk of total coronary occlusion had weighed against diffuse subendocardial ischaemia. Aspiration pneumonia causing distributive shock was possible, but less likely. Decision-making was driven by history, haemodynamic instability, shockable rhythm, and regional wall motion abnormality. Finally, we supposed AMI-related cardiogenic shock. CT and troponin measurement might contribute to diagnosis of ACS but delay reperfusion. ACS with coronary artery occlusion requires prompt coronary angiography. Answer options B, C, D, and E are incorrect.

Clinical perspective and conclusion

Coronary angiography showed coronary one-vessel disease with thrombus in each the proximal LAD (TIMI 2 flow) and first diagonal branch 1 (see Supplementary material online, *Figure S3*). Percutaneous coronary intervention was successfully performed. High-sensitivity troponin values were 1.060 μg/L (reference: 0.014 μg/L) at arrival and 8.850 μg/L 3.5 h later; the corresponding values for creatine kinase were 953 U/L (reference: <145 U/L) and 4279 U/L.

Retrospectively, we assume thrombotic occlusion of the left main coronary artery or very proximal LAD with thrombolysis and recanalization following aspirin and heparin pre-treatment. This was consistent with the ECG pattern and clinical findings. Despite cardiovascular

stabilization, the patient suffered severe hypoxic brain injury and died following a recurrent episode of pneumonia. STE in lead aVR and V1 in combination with multi-lead depression is associated with coronary artery occlusion but remains non-specific.[1,2] The ECG contributes valuable information. In distinction to ST elevation myocardial infarction, additional finesse in clinical decision-making is required, but challenging in comatose patients.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports*.

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Consent: The patient reported in this case is deceased. Despite the best efforts of the authors, they have been unable to contact the patient's next of kin to obtain consent for publication. Every effort has been made to anonymize the case. This situation has been discussed with the editors.

Conflict of interest: None declared.

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Data availability

The data underlying this article will be shared upon reasonable request to the corresponding author.

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