Out-of-Hospital Cardiac Arrest

An Underlying Reversible Cause

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ECG CHALLENGE

An 84-year-old man called the emergency service from his home because of recent chest pain associated with dyspnea. He had a long-standing history of coronary artery disease and chronic obstructive pulmonary disease. One minute after the basic life support team arrived, the patient went into cardiac arrest. The rescuers deployed their automated external defibrillator, and 1 electric shock was delivered. Thereafter, the patient received cardiopulmonary resuscitation. The prehospital emergency physician arrived at the scene 10 minutes later. At this time, the patient had pulseless electric activity (PEA). The ECG monitoring (lead 2) during cardiopulmonary resuscitation is shown in Figure 1. He received 1 mg adrenaline, continuous chest compressions, and orotracheal intubation. A few minutes later, the patient had recovered spontaneous circulation. Cardiac and pulmonary auscultations were normal. The patient was connected to a ventilator, which displayed normal pressure levels. He was then transported to the emergency department without any new clinical complications.

What abnormalities are present in the ECG, and might they relate to a particular cause of the cardiac arrest?

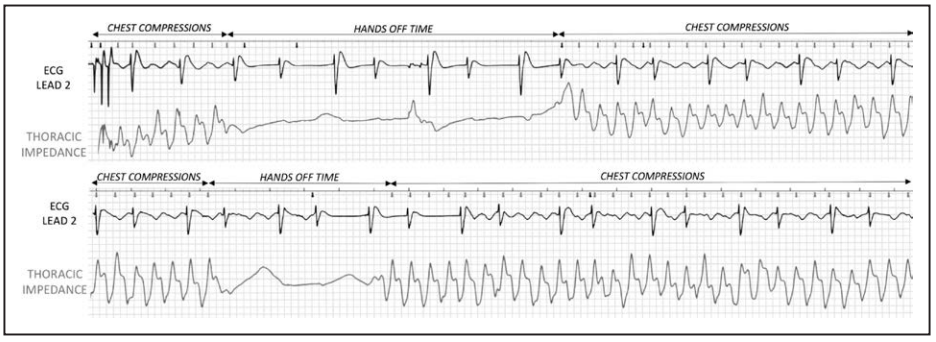

Figure 1. The 2 tracings represent the ECG and the thoracic impedance variation. The hands-off times reveal the presence of electric alternans of the ECG, which persisted during the chest compressions.

Please turn the page to read the diagnosis.

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RESPONSE TO ECG CHALLENGE

The ECG in Figure 1 shows 2 tracings; lead 2 of the cardiac ECG and the thoracic impedance variation display. The patient's thoracic impedance was measured with a continuous low electric current generated by the monitor via the defibrillation electrodes (LifePack15, Physio-Control, Seattle, WA). Its variation represents chest movement, especially when the patient receives chest compressions. Lead 2 can be best interpreted during periods without chest compressions (those with a flat impedance curve). The first hands-off time reveals PEA with a rhythm that is not strictly regular, without a visible P wave, and with a frequency of 60 bpm, a QRS interval of 150 milliseconds, and a QTc interval of 300 milliseconds. The most important observation is the presence of electric alternans. Electric alternans is a rarely observed cardiac phenomenon in which the ECG tracing shows alternation of the QRS complex amplitude, morphology, or axis, most often with a 1-in-2 periodicity. Although this electric phenomenon is not pathognomonic, it is usually attributable to pericardial effusion, hemothorax, or pneumothorax.[1]

Several mechanisms have been proposed to explain the phenomenon of electric alternans, including swinging of the heart, which causes the electric axis to change (as in pericardial effusion), and changes to the volume of the thoracic cavity during respiratory movements. At the hospital, the patient received a thoracic computed tomography scan that showed complete and compressive right pneumothorax (Figure 2). Exsufflation was immediately performed, followed by chest tube insertion, whereupon the electric alternans disappeared immediately. On the basis of the history of atraumatic emphysema, the rupture of an emphysema bleb was believed to be the most likely explanation for the pneumothorax. Three days later, the patient was discharged from the intensive care unit.

This is the first report of electric alternans observed during resuscitation for an out-of-hospital cardiac arrest. The current guidelines for advanced life support in patients with out-of-hospital cardiac arrest recommend 2-minute cardiopulmonary resuscitation cycles, which are usually punctuated by analysis of the rhythm and classification as shockable or nonshockable. PEA is the most common nonshockable rhythm associated with a correctable cause.[2] PEA can be associated with several different causes, each which may have a specific manifestation on the ECG such as electric alternans in cases of tamponade and pneumothorax, Osborn (J) wave in hypothermia, or widening QRS in tricyclic antidepressant intoxication.[3] Each specific type of PEA requires a specific treatment.[3]

In this case, if electric alternans had been recognized earlier by the emergency physician, the patient could have received a prehospital pulmonary and cardiac ultrasound examination and potentially could have been diagnosed and treated promptly in the field. Of note, there was neither ipsilateral nor contralateral decreased air entry on auscultation. The normality of auscultation was unexpected, but the literature shows normal auscultation in up to 42% of cases of pneumothorax.

In summary, this is a case of electric alternans observed during resuscitation for out-of-hospital cardiac arrest in a subject with a history of emphysema. The recognition of a correctable causes on ECG has the potential of improving prognosis in some patients who experience out-of-hospital cardiac arrest.

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Figure 2. Computed tomography scan revealing a complete right pneumothorax (asterisk).

DISCLOSURES

None.

AFFILIATIONS

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FOOTNOTES

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