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PEA (Pulseless Electrical Activity): The Heart's Last Call Before Silence

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1. Introduction (Key points)

- **In Pulse less Electrical Activity (PEA), the concerned person is unconscious without a palpable pulse and blood pressure, despite the heart's electrical system being intact.** In other words, the patient has cardiac electrical activity but without its mechanical translation to action, that's why this is also known as electromechanical dissociation (EMD). It is just to remind here that PEA is unshockable rhythm where cardiac defibrillator does not work at all.

- How to recognize PEA on the spot, the primary pointers include:
  - The presence of coordinated electrical activity on ECG
  - Assess responsiveness: Call the patient's name loudly or ask, 'Are you okay?' and provide a painful stimulus if there is no response to verbal stimuli (e.g, an sternal rub or pressing of the nail-bed) and / the responsiveness may also be judged by the clinician's acumen) → unconsciousness, suggestive of no effective perfusion to the brain.
  - Un recordable pulse and blood pressure (feel the pulse at the carotid artery for a period of 10 seconds) – it confirms that there is no mechanical cardiac output despite electrical activity on ECG.
  - No heartbeat is audible on the stethoscope. No respiratory movement is present.

  All these steps must be completed very quickly. It is a red signal alarming situation.
- The concept to f coordinated electrical activity on ECG.
  - PEA produces visible electrical activity on ECG but without mechanical support to cardiac contraction.
  - The cardiac electrical activity must have a logical pattern in an organized or semi-organized manner. This may include sinus rhythm, atrial fibrillation or even paced rhythms.
    The goal of identifying organized electrical activity in PEA is to determine whether the heart is generating electrical signals that would lead to coordinated contraction, the QRS complex whether normal or abnormal is the most reliable indicator for this. The P wave may precede QRS complex or may not be present there. T-waves might be abnormally widened in severe hyperkalemia.
  - Exclusion of Terminal Rhythms: PEA excludes conditions like ventricular fibrillation (VF) , Ventricular tachycardia (VT) or ventricular asystole. These are non-perfusing rhythms as de novo.
- Risk Factors and Frequency of Pulseless Electrical Activity
  - PEA is noticed in 30-38% of adults patients who suffer from cardiac arrest within their hospital-stay (such hospitalized patients are more at risk of experiencing the episodes of pulmonary embolism).
  - The administration of drugs like Beta-blockers and calcium channel blockers may make the concerned person more vulnerable to PEA.
  - Females are at higher risk of developing pulse less electrical activity compared to males.
  - The risk of having this condition increases more in persons over 70 years of age, particularly in females.

NB: **There exists a concept of pseudo-PEA, but a clinician should not struggle to establish this, otherwise the valuable time to save the life would be lost.**

2. Electro physiology in PEA

Now it is obvious that in case of PEA the myocardium may fail to respond to mechanical contraction despite organized electrical activity on ECG. Therefore, it becomes essential to understand how systolic events on ECG are being inscribed:

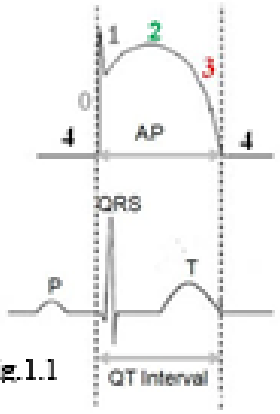
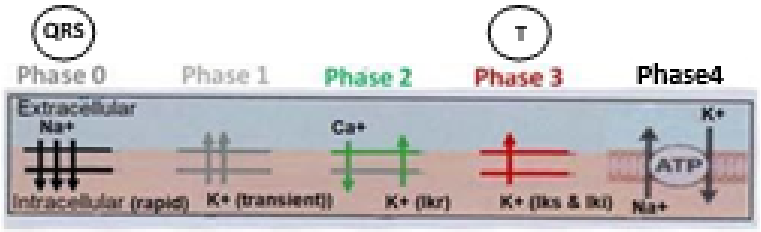


Fig.1.1



The mechanism of normal myocardial contraction:

- QRS, the wave of depolarization precedes the onset of ventricular myocardium contraction, initiated through rapidly acting Na+ conductance channels (**Phase0**).
- Opening of the L-type Ca2+ channels for the homogenous exchange in between Ca2+–K+ → the initiation of the excitation-contraction coupling leading to ventricular systole. This coupling occurs in cardiac myocytes lying underneath the isoelectric ST segment (**Phase 2**)
  (Phase 1 is not discussed here, which denotes a transient outward potassium current with a transient potassium efflux out of the cells giving rise to J-point on ECG)
- The closing of the L-type Ca2+ channels , followed by efflux of only potassium through K+ channels →T-wave (**Phase 3**)
- Restoration to the previous polarized state mainly by Na+ – K+ ATPase pump (**Phase 4**)

Some metabolic factors responsible for Myocardial Non-contractility in PEA

- Surplus potassium in extracellular compartment impairs rapidly acting sodium conductance channels and the process of depolarization thereby as well → this reduces myocardial excitability and contractibility both.
- Surplus calcium in extracellular compartment disrupts the exchange in between Ca2+ ions and K+ ions→ impairing the excitation- contraction coupling, essential for ventricular contraction.
- Low potassium and calcium ions also reduce the cardiac contractibility by impairing the exchange in between Ca2+ and K+ ions

- Severe metabolic acidosis: High concentrations of hydrogen ions reduce calcium sensitivity in cardiac myocytes impairing contractility.
- Hypoxia → less production of ATP molecules → impairment of Na+ - K+ ATPase pump → impaired regaining of polarized state. Cardiac myocytes cannot generate sufficient mechanical force for contraction
- Miscellaneous factors:
  - Mechanical constraints: Insufficient preload or excess pericardial fluid with precardial temponade by compressing the heart may prevent effective contraction despite the presence of electrical activity.
  - Tension pneumothorax, pulmonary embolism and even myocardial infarction may impair the cardiac contractility by inducing hypoxia and less volume return to the heart. MI may also cause the pump failure.

3. Etiology

The etiology of pulse less electrical activity is classified into primary i.e., cardiac, and secondary i.e., non cardiac causes.

Primary pulse less electrical activity is often caused by the depletion of myocardial energy reserves. It responds poorly to therapy

Its seems rather logical and essential to discuss the secondary causes of PEA first because the recognition of which is the main key to successful treatment.

Causes of secondary pulse less electrical activity are accessed on the basis of mneumonic "5 Hs and 5 Ts." These are as follows:

"Hs and Ts" of Pulse less Electrical Activity"

5Hs	5Ts
1. Hypovolemia	1. Thrombosis, coronary (myocardial infarction)
2. Hypoxia	2. Thromboembolism (pulmonary embolism)
3. Hydrogenion(acidosis)	3. Temponade (pericardial)
4. Hypo/hyperkalemia	4. Tension pneumothorax
5. Hypothermia	5. Tablets (drugs: calcium channel blockers, beta-blockers, Tricyclic antidepressant, certain antipsychotic drugs, digoxin in high doses, cocaine, etc.) / Toxins

4. Evaluation

- Investigations should include an electro cardiogram(ECG), arterial blood gas analysis, serum electrolytes, chest radiology, and echocardiogram
  (Venus blood gas analysis provides earlier results of pH bicarbonate, CO2 and K)

- Core body temperature should also be assessed (Body temperature drops below 95° F/35°C – hypothermia)

5. Managing PEA through ACLS (Advanced cardiac life support) protocol

- Start CPR: Perform high-quality chest compressions with an adequate rate and depth. Allow the chest to fully recoil between compressions. (100Compressions/minute, 10breathes/minute, 30:2ratioifunintubated)
- Establish IV or IO access: gain vascular access as possible to administer medications.
- Administer epinephrine: Give1 mg of epinephrine intravenously (IV) or intraosseously (IO) every 3–5 minutes.
- Looking for reversible causes and treat them accordingly (Essentiallyfocusingonthe"5Hsand5Ts" mnemonic to address potential underlying causes)
- Advanced air way management to ensure adequate ventilation 100% oxygen
- Monitor rhythm and pulse:
  Regularly check for a pulse and rhythm to access the effectiveness of intervention

✓**NB: Intraosseous (IO) access through bone marrow to administer drugs, fluid and blood products when IV route is not available.**

6. Prognosis

- The prognosis for Pulse less Electrical Activity (PEA) is often poor, even with the best emergency resuscitation efforts.
- In one study, only 23% of patients with PEA were able to be revived and lived until they reached the hospital, and even fewer (11%) were still alive when discharged from the hospital. PEA is often a fatal condition.
- Overall, prognosis of PEA is far less favorable than VF/VT, prognosis for out-of-hospital cardiac arrests (OOHCA) with initial asystole or pulse less electrical activity is <3% survival… though exceptions may include PEA with heart rate >60/min and 'pseudo-PEA''

In nutshell, PEA typically has a poor prognosis, with healthy survival is dependent on rapid intervention and the reversibility of the underlying cause, identifying the cause. Identifying the cause and providing effective CPR are critical for improving outcomes.

7. Illustration by ECG

History: 60 yrs male who had PPI implanted, was brought unconscious. On exam BP, PULSE unrecordable. No Respiration. No heart beats audible. Pupil B/L Dilated (ultimately the patient succumbed to death soon after the recording of ECG, he did not give time to act further). However no investigation other than ECG could be done.

ECG recorded at the presentation:

Source: Global Heart Rhythm Forum (14.01.2025) by Dr. R.K. Gupta,
Senior consultant physician, Yamuna nagar, Haryana

Findings on ECG

- PPI implanted (RV apical pacing, evident by unipolar spikes with LBBB morphology and negative complexes in inferior leads)
  Presence of pacemaker spikes indicate that the pacemaker is functioning (pacemaker spikes are appropriately followed by electrical activity)
- Electrical activity seen as the widened QRS complexes merging with T-waves. There is somewhat prolongation of second half of T (Peak to end T – proarrhythmic T).

Comments

- This is the case of pulse less electrical activity (PEA), the concerned person came in unconsious state without a palpiable pulse and BP but his ECG was showing the display of electrical activity , as evident by the presence of spikes induced wide QRS/T complexes.
- However, the non-contractile state of the myocardium as reflected by his unconscious with the absence of pulse and blood pressure might be attibuted to hypoxia, metabolic dearrangements (acidosis, hyperkalemia $\pm$) , etc.

- The patient came very late with dilated pupils, suggestive of prolonged cerebral perfusion. There is no time to act further and the patient succumbed to death.

8. Take Home Message

- In "Pulse less Electrical Activity (PEA)", the concerned person is unconscious without a palpable pulse and blood pressure, despite the heart's electrical system being intact.
- Have ECG to show the presence of coordinated electrical activity
  Assess his orientation to consciousness, see pulse and record blood pressure No heartbeat is audible on the stethoscope. No respiratory movement is present
- Risk factors:
  - The administration of drugs like Beta-blockers and calcium channel blockers may make the concerned person more vulnerable to PEA.
  - Females are at higher risk of developing pulse less electrical activity compared to males.
  - The risk of having this condition increases more in persons over 70 years of age, particularly in females.
- Assess the etiology as per mneumonic– "Hs and Ts" of, as discussed on page 4
- It is red-signal alarming situations adopt the ACLS protocol to save the life.
- The prognosis for Pulse less Electrical Activity (PEA) is often poor, even with the best emergency resuscitation efforts.

9. References

1. O'Brien, P. C. (Year). *Adult health nursing*. (Edition). Publisher.

For example: O'Brien, P. C. (2023). *Adult health nursing* (7th ed.). Elsevier.

8

1. Pulse less Electrical Activity Asystole
   https://nhcps.com/lesson/acls-cases-pulseless-electrical-activity-asystole/?srsltid=AfmBOoqDZ_pb_53Rn18nw562bYm6RTjFxAgdUteF8p1DDt9p2haHLb9r
2. Pulse less electrical activity in cardiac arrest: electro cardio graphic presentations and management considerations based on the electrocardiogram
   https://www.sciencedirect.com/science/article/abs/pii/S0735675710004092

2. O'Brien, Pamela C. *Adult Health Nursing*. 7th ed., Elsevier, 2023.

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