

# Electrocardiographic applications of lead aVR

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## Abstract

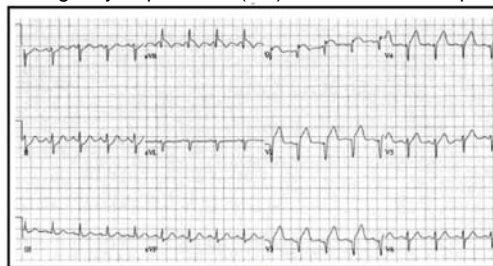
- lead aVR, an augmented unipolar limb lead placed on the lateral aspect of the right arm.
- Emergency physician commonly held belief that lead aVR rarely offers clinically useful information.
- lead aVR is often used only to ensure the correct placement of other 11 leads
- Authors believe that 4 specific findings in lead aVR are worthy of discussion.

## Findings in lead aVR that are potentially of value

- 1.ST-segment elevation in the patient with acute coronary syndrome suggestive of left main coronary artery occlusion
- 2.PR-segment elevation in the patient with acute pericarditis
- 3.Prominent R wave in the patient with significant tricyclic antidepressant poisoning.
- 4.ST-segment elevation in narrow complex tachycardia suggestive of Wolff-Parkinson-White syndrome

## Case 1

A 44-year-old man with a history of myocardial infarction, hypertension, and diabetes mellitus presented to the emergency department (ED) with left shoulder pain.



## Objective

- To recognize the importance of ST-segment elevation of lead aVR and influence physicians to initiate early invasive approach in the treatment of patients with this ominous ECG finding.

## What lead aVR indicates in this case

- ECG shows ST-segment elevation in leads V1 to V4 with reciprocal ST-segment depression in the inferior leads (II, III, and aVF); these findings are consistent with the finding of STEMI.
- The article points out the elevation of ST-segment in lead aVR which is suggestive of LMCA.

## result

- These findings were consistent with anterior wall ST-segment elevation AMI (STEMI).
- Because of the suspected left main lesion, the patient was transferred to a nearby hospital with interventional capability. The patient was taken to the catheterization laboratory where an LMCA occlusion with thrombus was noted. Urgent surgical consultation resulted in coronary artery bypass grafting (CABG).

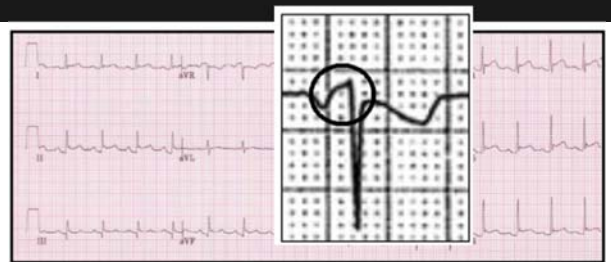
## Discussion

- A study was performed to identify early indicator of LMCA or or 3-vessel disease in patients presenting with ACS.
- The ECGs of 310 patients was analyzed.
- Sensitivity was 78%, Specificity was 86%
- The ECG findings determined ST-segment elevation greater than 0.5 mm in lead aVR to be the strongest predictor of LMCA or 3-vessel disease.

## Case 2

- A 39-year-old man without medical history presented to the ED with pain in the left side of the chest. The pain had appeared approximately 2 days before arrival in the ED and was worsened upon inspiration, assuming the supine position, and with upper extremity movement; no associated symptoms were noted. The patient had recently experienced an upper respiratory tract infection. The physical examination was normal; no chest wall tenderness was found. A 12-lead ECG (Fig. 2) revealed diffuse ST-segment elevation in leads V2 to V6, II, III, and aVF; PR-segment depression is also seen in anterior and inferior leads. PR-segment elevation is also seen in lead aVR.

### PR-segment elevation demonstration



## Objective

- To recognize the importance of PR-segment elevation in lead aVR as an indicator of acute pericarditis.

## Result

- The patient underwent echocardiographic examination, which revealed a small pericardial effusion. The patient was admitted to the Cardiology service for a 24-hour observation and discharged without incident.
- No etiology was discovered for the pericarditis; an infectious etiology was suspected based upon his recent upper respiratory tract infection symptoms.

## Discussion

- 50 patients with unequivocal clinical evidence of acute pericarditis was studied.
- Transient deviations of PR segments occurred in 82% of patients.
- Spodick noted that PR-segment elevation in lead aVR, likely representative of subepicardial atrial injury secondary to pericardial inflammation, is ubiquitous and characteristic of acute pericarditis.

## Case 3

- A 37-year-old female patient was transported to the ED by emergency medical services. The patient was last seen approximately 4 hours before presentation; she was found unresponsive in her bed.
- On arrival in the ED, the patient was lethargic; the examination revealed an anticholinergic toxidrome.
- The 12-lead ECG (Fig. 3) revealed sinus tachycardia with minimal QRS complex widening; a large RV wave is also seen in lead aVR.

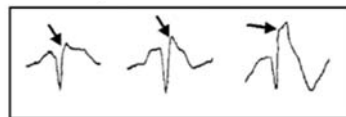
## ECG of the patient



## Objective

- Realizing the importance of prominent R wave that is indicative for TCA poisoning.

Large R` Wave in Lead aVr



## Result

- The patient was orotracheally intubated; she received intravenous sodium bicarbonate and charcoal via the orogastric tube.
- Upon further review, her medical history was remarkable for depression complicated by previous suicide attempts; she was managed with amitriptyline.
- The patient was discharged to a psychiatric facility with a diagnosis of TCA overdose.

## Discussion

- Early ECG findings in tricyclic overdose include sinus tachycardia, QRS complex widening greater than 100 milliseconds, right axis deviation, and characteristic R-wave changes in lead aVR.
- The R wave changes in lead aVR that are indicative of tricyclic poisoning include:
  - increased amplitude of the terminal R wave
  - increased R wave to S wave ratio.

## Discussion

- Liebelt published a study in 1995. The study was a prospective cohort series of 79 patients who presented within 24 hours of TCA overdose.
- Analysis demonstrated that R wave amplitude greater than 3 mm in lead aVR was the only electrocardiographic variable that could reliably be used to predict neurologic or cardiac toxicity.
- Average R wave in lead aVR is 4.4 mm in patients who experienced either seizure or arrhythmia
- Average of 1.8 mm in those patients who did not experience these adverse events.
- R wave to S wave ratio was 1.4 in significantly poisoned patients compared with those individuals without severe adverse effect with a ratio of 0.5.

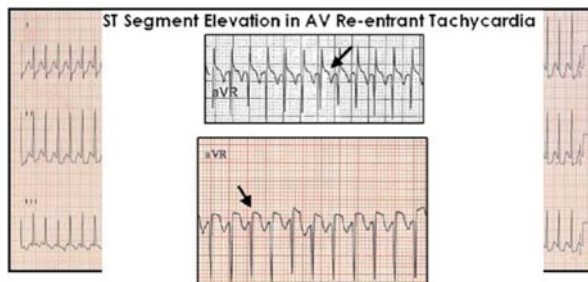
## Discussion

- The **sensitivity** of the R wave greater than 3 mm in lead aVR was **81%**.
- R/S wave ratio greater than 0.7 was **75%**, compared with an 82% sensitivity for QRS complex width greater than 100 milliseconds.
- The **positive predictive value** of the findings for significant toxicity in lead aVR was **43%** and **46%**, respectively, as opposed to 35% for a widened QRS complex.

## Case 4

- A 14-year-old adolescent boy presented to the ED with periods of dizziness. His medical history was unremarkable. Examination revealed a teenager in no apparent distress; cardiac examination demonstrated a rapid regular tachycardia. The 12-lead ECG revealed a narrow complex tachycardia with a rate of 280/min; ST-segment elevation in lead aVR suggested AVRT.

## ECG



## Objective

- Recognizing the ST-segment elevation in narrow complex tachycardia in lead aVR as an indication of Wolff- Parkinson-White syndrome (WPW) and be able to differentiate from other narrow complex tachycardias such as:
  - Sinus tachycardia
  - Sinus nodal re-entrant tachycardia
  - Atrial tachycardias
  - AV nodal re-entrant tachycardia (AVNRT)...etc

## Result

- Intravenous adenosine was administered with conversion to sinus tachycardia with a reduction in heart rate to approximately 120/min and evidence of ventricular preexcitation consistent with Wolff-Parkinson-White syndrome (WPW).

## Discussion

- 338 ECGs of patients presenting with narrow complex tachycardia, of which 71% were AVRT, 31% were AVNRT, and 16% were AT.
- Logistic regression analysis revealed that ST-segment elevation in lead aVR was the only factor that reliably could be used to differentiate among the various types of narrow complex tachycardia.
- Atrioventricular reciprocating tachycardia (WPW-related tachycardia) was differentiated from AVNRT and AT with a sensitivity of 71% and a specificity of 70%—ST-segment elevation in lead aVR was found to be strongly suggestive of WPW-related narrow complex tachycardia.

## Discussion cont

- Logistic regression analysis revealed that ST-segment elevation in lead aVR was the only factor that reliably could be used to differentiate among the various types of narrow complex tachycardia.
- Atrioventricular reciprocating tachycardia (WPW-related tachycardia) was differentiated from AVNRT and AT with a sensitivity of 71% and a specificity of 70%—ST-segment elevation in lead aVR was found to be strongly suggestive of WPW-related narrow complex tachycardia.

## Conclusion

1. The author believes that the importance of lead aVR should not be forgotten as it is in common fashion.
2. It provides essential diagnostic and prognostic information in a range of clinical presentations, as highlighted by the examples of:
  1. LMCA disease
  2. TCA poisoning
  3. Pericarditis
  4. WPW-related narrow complex tachycardia.