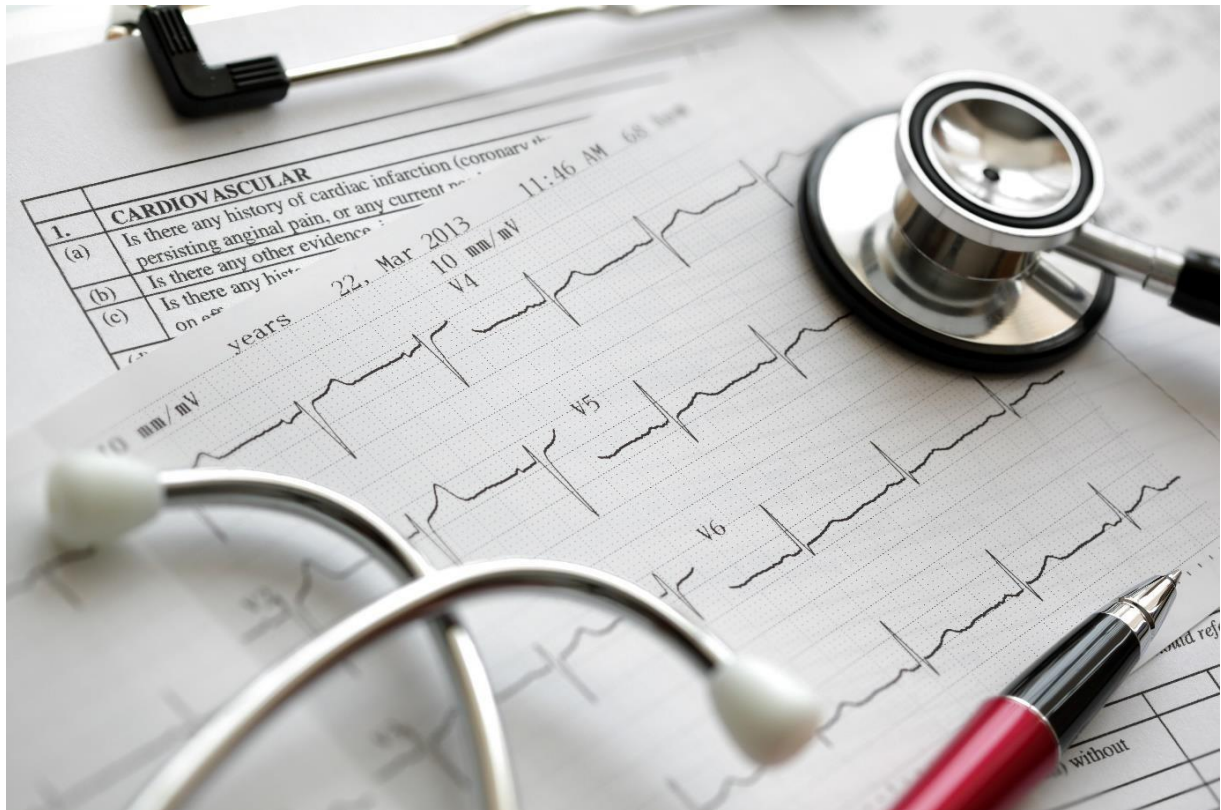


ECG Limb Lead Reversal: *Incidence & Impact on Insurance Underwriting*



1. CARDIOVASCULAR	
(a)	Is there any history of cardiac infarction (coronary artery disease) or any current or past persisting anginal pain, or any other evidence of atherosclerosis?
(b)	Is there any history of myocardial infarction?
(c)	Is there any history of congestive heart failure?

INCHES Healthcare
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Table of content

Background Statement	3
Introduction	3
Abstract.....	4
Case Study.....	4
Terminologies Used	5
ECG	5
Solution	16

Background Statement

- A Standard 12 lead ECG comprises of Six chest electrodes, Four limb Electrodes, which denote 6 limb leads viz. Leads I, II, III, aVr, aVI and aVf. Limb lead reversal is when these leads are incorrectly placed.
- The incidence of Limb lead reversal is 0.4% in Outpatient departments but increases significantly to 4% in Critical Care Units.
- When treating a patient of chest pain in an Emergency Room, an ECG is performed at once with high priority. There are good chances of electrodes being incorrectly placed leading to misdiagnosis.
- In the insurance sector, there are issues at multiple fronts.
- Misdiagnosis is common due to the reversal of electrodes.
- Repeating an ECG is a hassle, as patients come to a Diagnostic center for investigations, it is difficult to travel back to the same for a repeat ECG.
- Intentional limb lead reversal has a high fraud potential when used to mimic ischemia.

Introduction

- The incidence of limb lead reversal is 0.4% in an OPD setting and can go up to 4% in a Critical care setting. These numbers are staggering.
- There are no figures available for lead reversal incidence in Pre-Issuance examinations. Since professional fee paid for pre-issuance medicals is much lower than standard pricing, usually unskilled people take ECG which the Doctor later reports.
- Of over 120 thousand ECG's reviewed, by INCHES, for 7 Life insurance companies, the percentage of Limb lead reversal was 0.5%
- Why should we worry, one may ask? Limb lead reversal results in masking of ischemia or could mimic a chamber enlargement, a change in Axis, appear to be ischemia. These misinterpretations may either lead to loading/Denial of good proposals and accepting high Risk ones.

- INCHES ECG Lab initiated this project to understand all types of Lead reversal and their impact on interpretation. All the ECG's were reported by practicing doctors with 10 years of experience.

Abstract

- Limb lead reversal gives rise to patterns which can mimic Ischemia, Chamber enlargement, mask a preexisting ischemia.
- The ECG at a preliminary glance may look normal, but presence of inverted P waves in certain leads or a flat line, an upward going aVr gives a hint of Limb lead reversal. The ECG should be carefully analysed.
- A total of 24 limb lead reversals were performed which involved both, Single lead reversal (for e.g. LA with RA) and Dual limb lead reversals (LA with LL, RA with RL), clockwise rotation, anticlockwise rotation.
- All this data was compiled together and compared with baseline ECG with limb leads attached normally.

Case Study

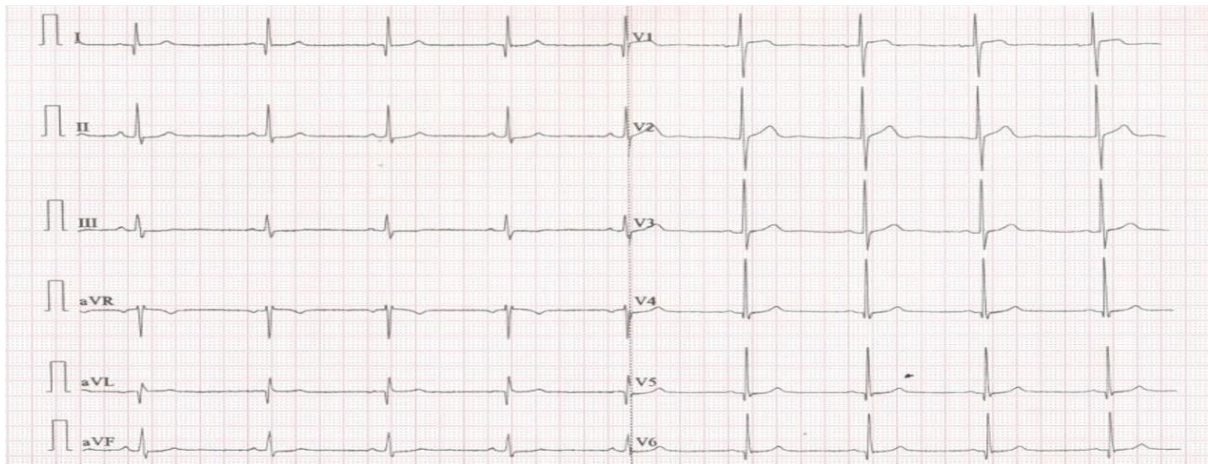
- 31 y/o male with no PED, who has a critical cover policy of 40 Lacs experiences chest pain.
- The patient is admitted to a hospital in Delhi where the ECG apparently shows Inferior wall Ischemia, and is admitted. 2D-Echo and CAG are normal. The discharge diagnosis was acute MI.
- The insurance company contacted INCHES for Expert Opinion.
- The ECG was of limb lead reversal, the ECG turns out to be WNL. There was no inferior wall Ischemia.
- This claim was repudiated.

Terminologies Used

- RA-Right Arm
- LA- Left Arm
- LL- Left Leg
- RL- Right Leg

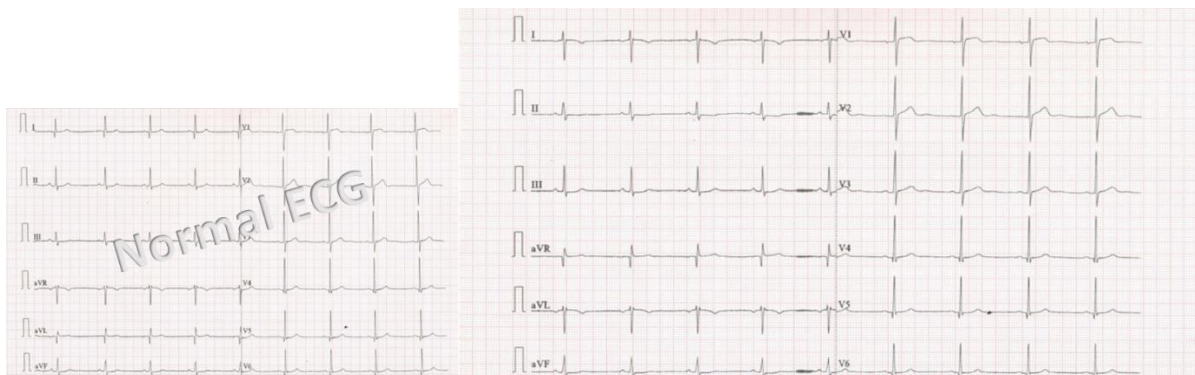
ECG

Normal Baseline ECG



- The normal baseline ECG which we will use for analysis.
- Normal Sinus Rhythm, with no ST-T changes, Normal Axis.

Left Arm- Right Arm reversal (LA-RA)

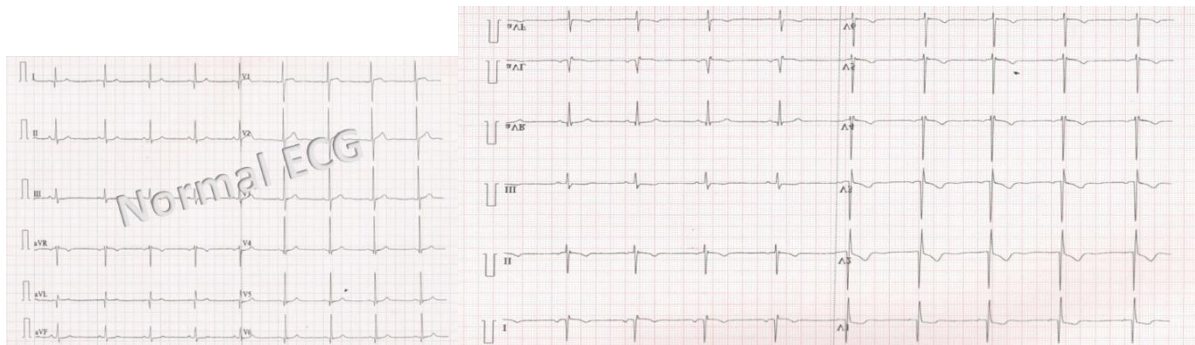


- Leads I and aVL show global negative complexes.
- Lead II and III change places.

- aVr and aVI change places.
- Right Axis deviation.

This mimics Dextrocardia, but unlike True dextrocardia, there is normal R wave progression through chest leads.

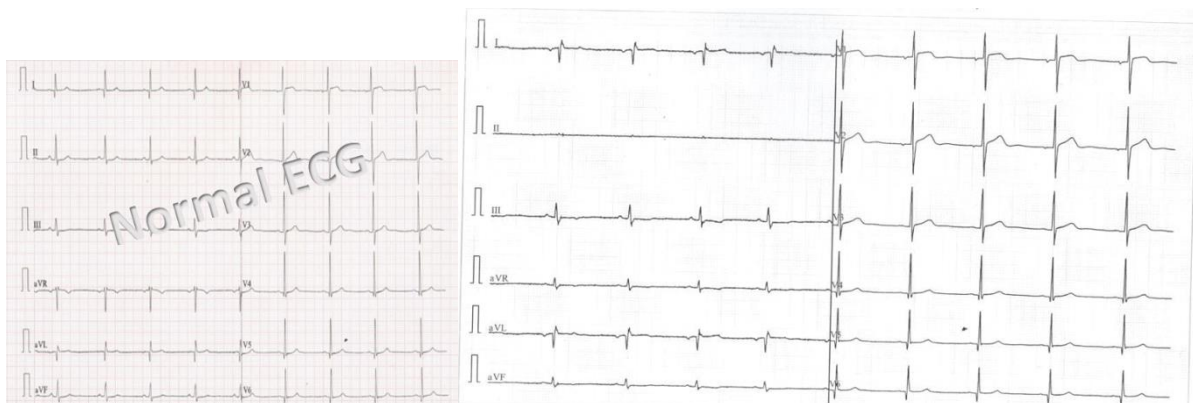
Left Arm- Right Arm reversal (LA-RA)



- In Left Arm- Left leg reversal, Lead III is inverted.
- Leads I and II switch places.
- aVI and aVf switch places.
- aVr remains unchanged.

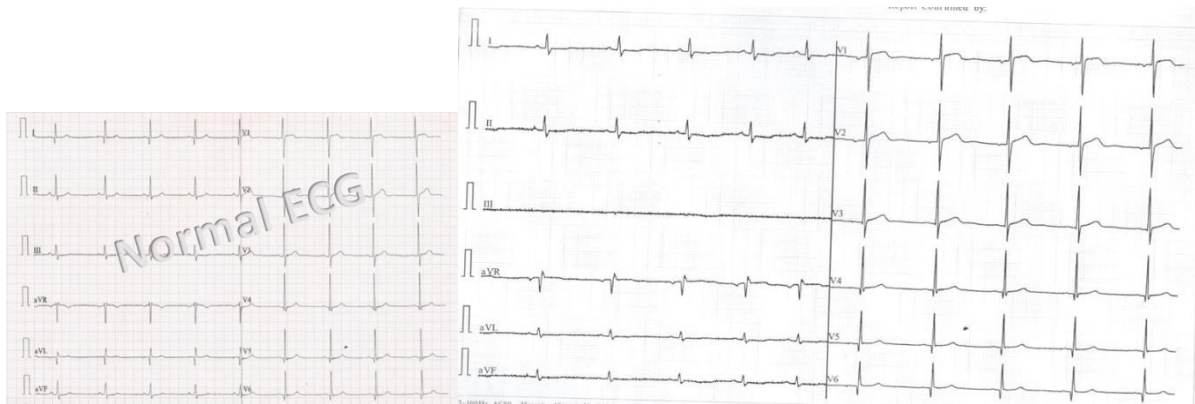
Hence, P wave of lead I in the reversed ECG is larger than in lead II, (Ideally P wave in lead II should be bigger than that in lead I).

RA- RL reversal



- Lead II is a flat line.
- Lead I is an inverted lead III.
- aVr and aVf are similar to each other.
- aVI is inverted lead III.

LA- RL reversal



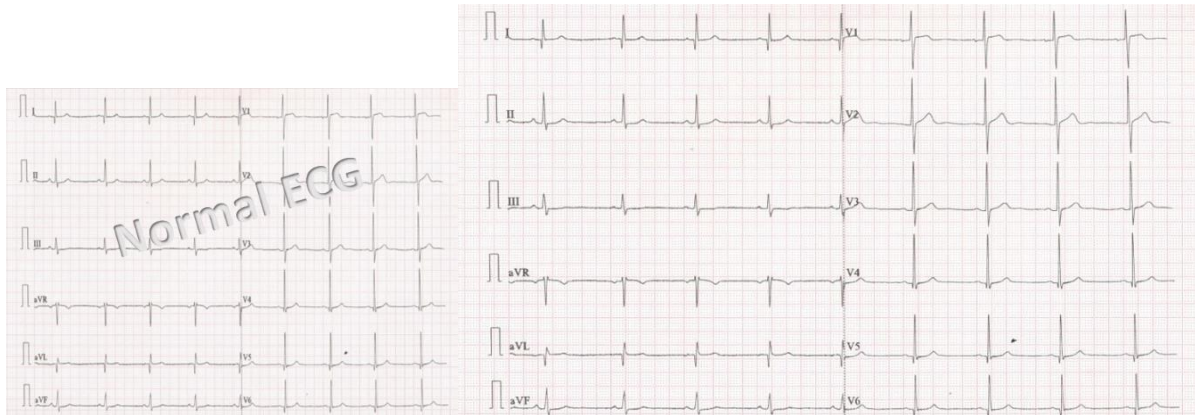
- Lead III is a Flat line.
- Lead I is similar to lead II.
- aVr is inverted lead II.
- aVl and aVf are similar.

LA- LL plus RA-RL



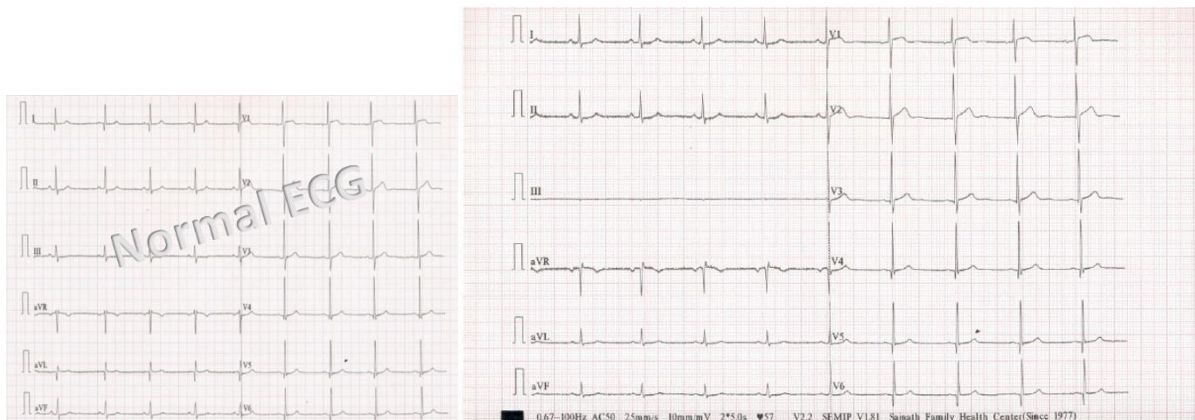
- Lead I is a flat line.
- Global negative complexes in leads II, III, aVf.
- aVr goes upright.
- Lead II, III and aVf are all inverted Lead III.
- aVr and aVl are similar.

LL RL reversal



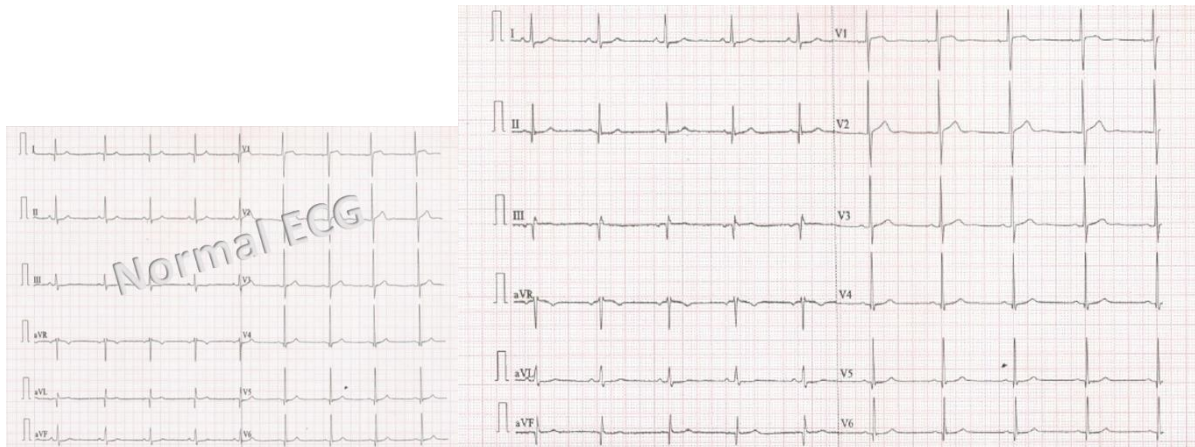
The ECG is essentially the same. Interchanging the RL and LL electrode did not bring about any change.

LA-RL, LL-LA, RL-LL



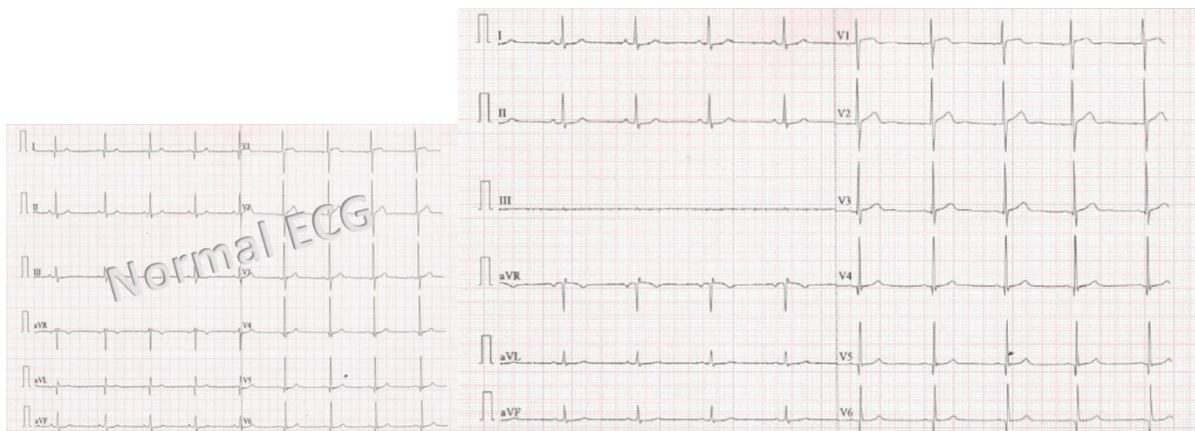
- Lead III is a flat line.
- Lead I and II resemble lead II.
- aVL and aVF resemble aVF.

LA-LL, LL-RL, RL-LA



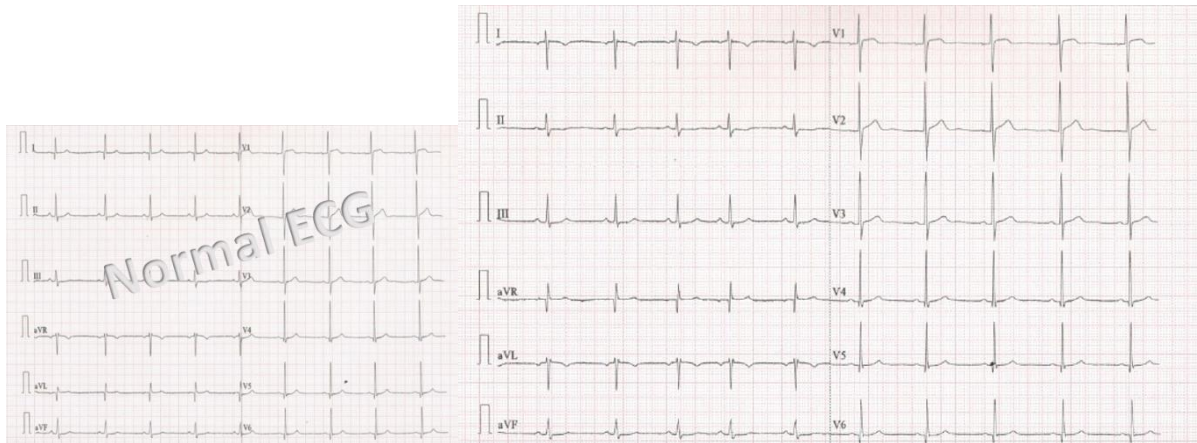
- Lead I and II change places.
- aVI and aVf change places.
- Lead III is inverted.

LA-RL, RL-LA reversal



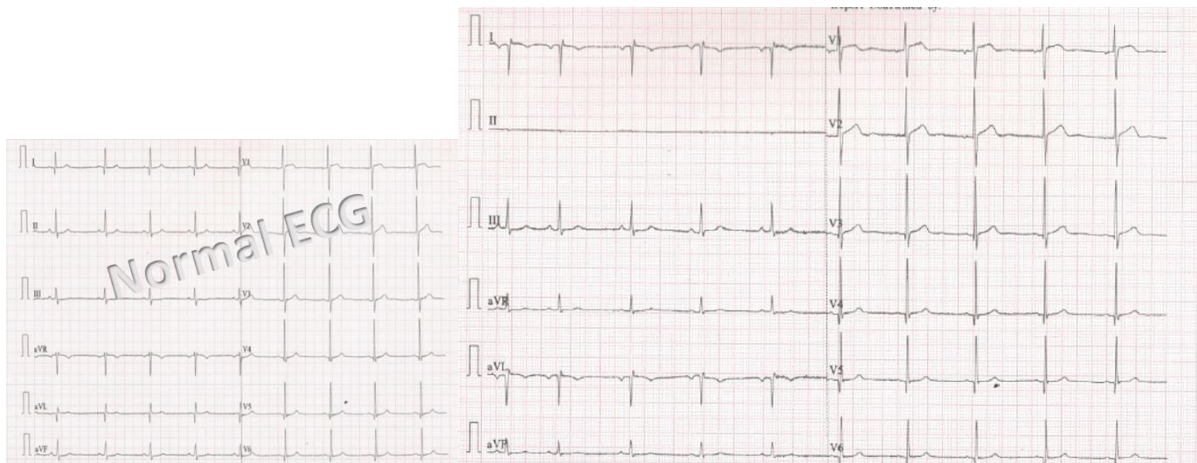
- Lead I and II resemble Lead II.
- Lead III is a flat line.

RA-LA, LA-RA, LL-RL, RL-LL reversal



- Lead II and Lead III are interchanged.
- Lead I is inverted.
- aVr and aVl are interchanged.

RA-LA, LA-RL, RL-LA reversal



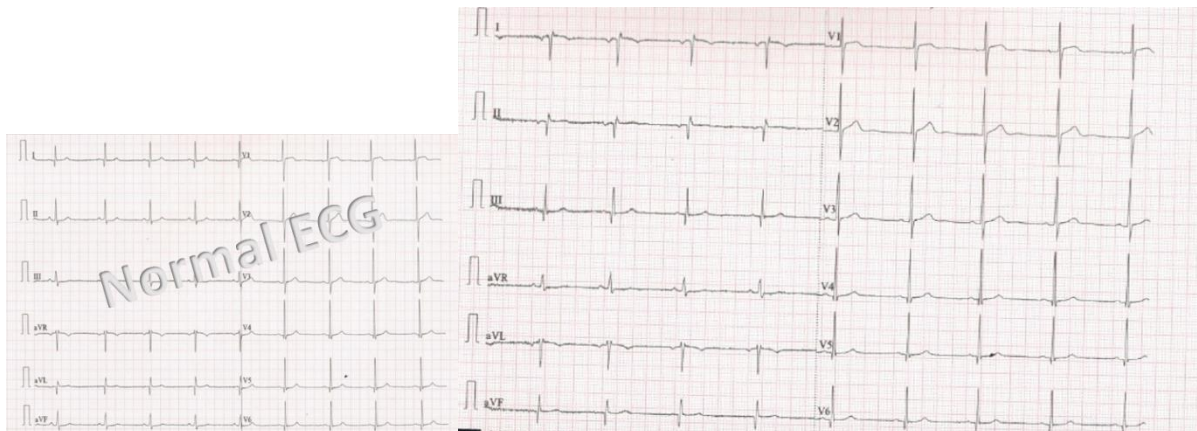
- Lead II is a flat Line.
- Lead III is lead II.
- Lead I and aVl is inverted Lead II.
- aVr and aVf are identical and are aVf.

RA-LA, LA-RL, RL-RA reversal



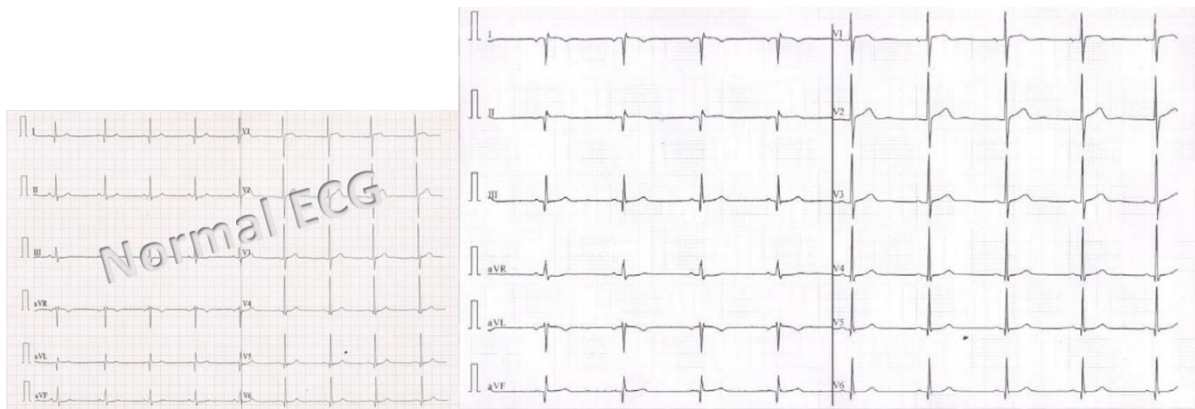
- Lead II is a flat line.
- Global negative complexes in leads I and aVL.

RA-LA, LA-LL, LL-RL, RL-RA reversal



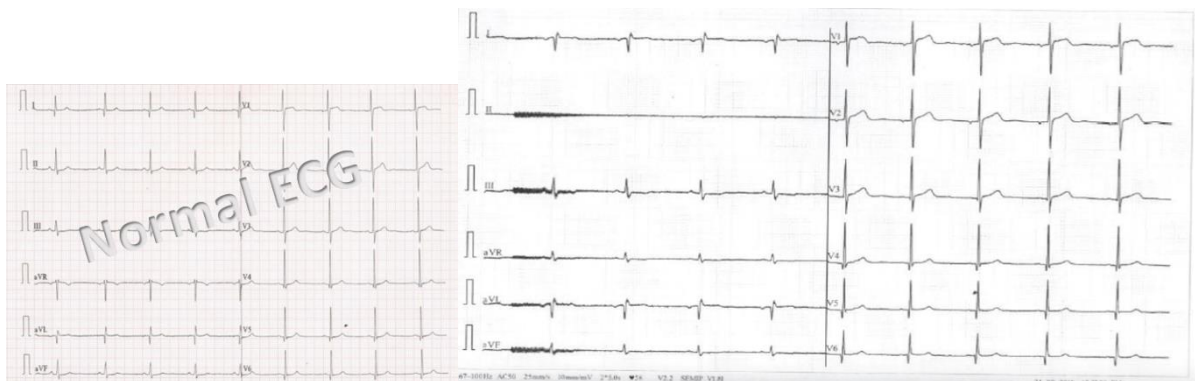
- Lead I is inverted Lead II.
- Lead II is inverted lead III.
- Lead III is Lead I.
- aVr is aVf.
- aVl is aVr.
- aVf is aVl.

RA-LA, LA-LL, LL-RA reversal



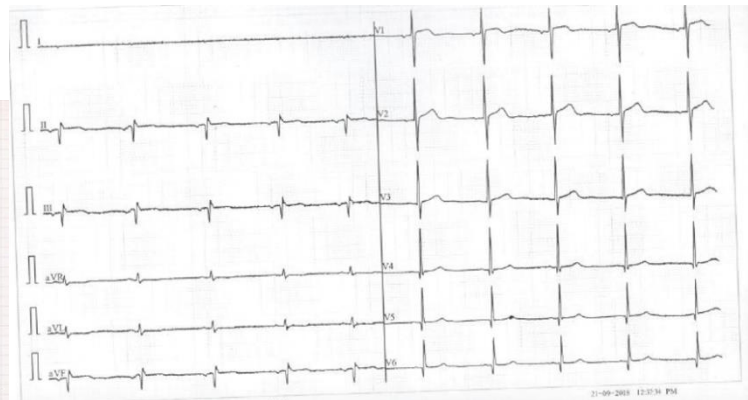
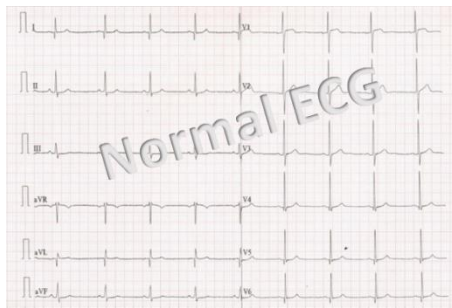
- Lead I is inverted Lead II.
- Lead II is inverted lead III.
- Lead III is lead I.
- aVI is aVr.
- aVf is aVI.
- aVr is lead III.

RA-RL, LL-RA, RL-LL reversal



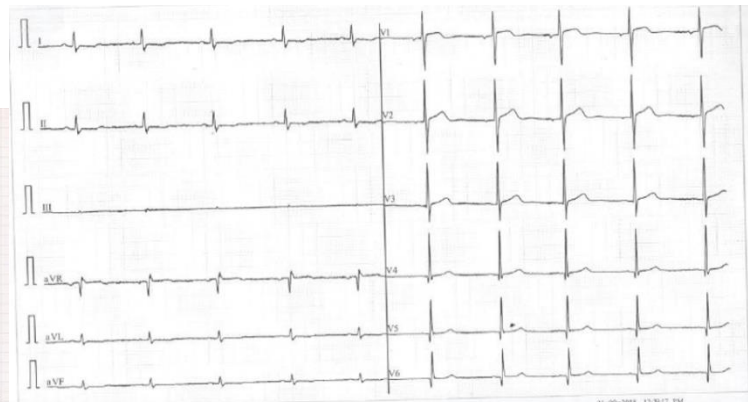
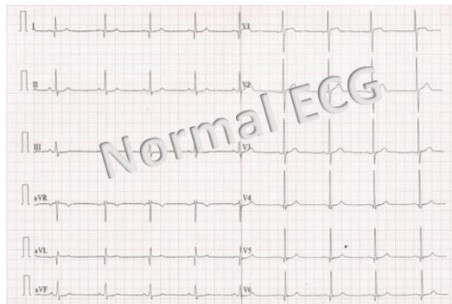
- Lead II is a flat line.
- Lead I and aVI are inverted III.
- aVr and aVf are similar.

RA-RL, LA-LL, LL-RA, RL-LA reversal



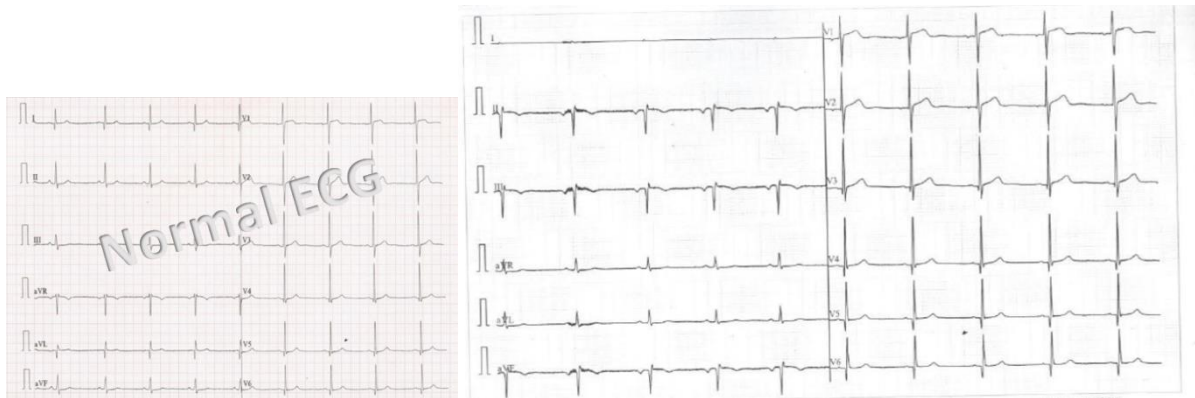
- Lead I is a flat line.
- Lead II, III and aVf are inverted lead III.
- aVr and aVl are similar.

RA-RL, LA-RA, RL-LA reversal



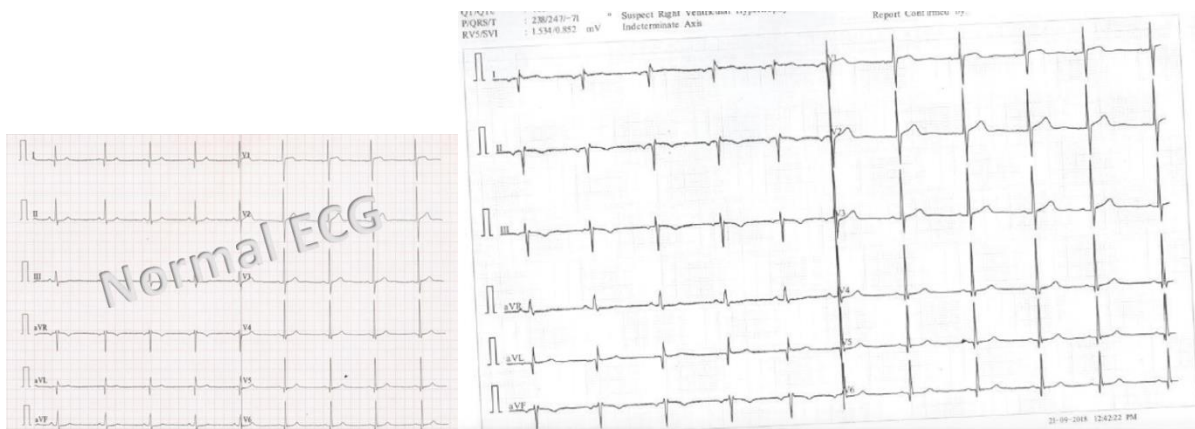
- Lead III is a flat line.
- Lead I and II are similar and are lead III.
- aVr is inverted Lead III.
- aVl and aVf are similar.

RA-LL, LA-RL, LL-LA and RL-RA



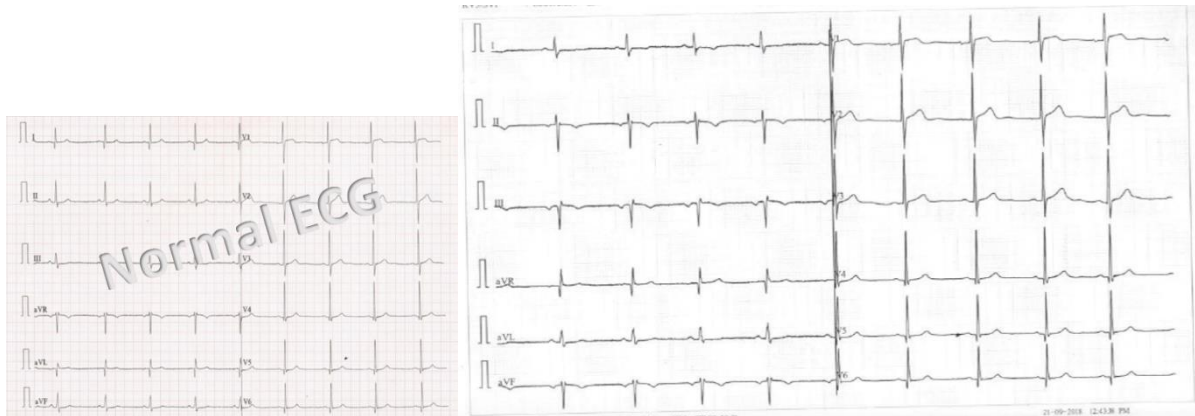
- Lead I is a flat line.
- Lead II, III aVf are similar and are inverted lead II.
- aVr and aVl are similar and both are aVf.

RA-LL, LL-RL and RL-RA reversal



- aVf is aVr.
- Lead II is inverted.
- Lead III is inverted Lead I.
- Lead I is inverted lead III.
- aVr is lead III.
- This ECG can mimic Inferior wall Ischemia.

RA-LL, LA-RA, LL-RL, RL-LA reversal



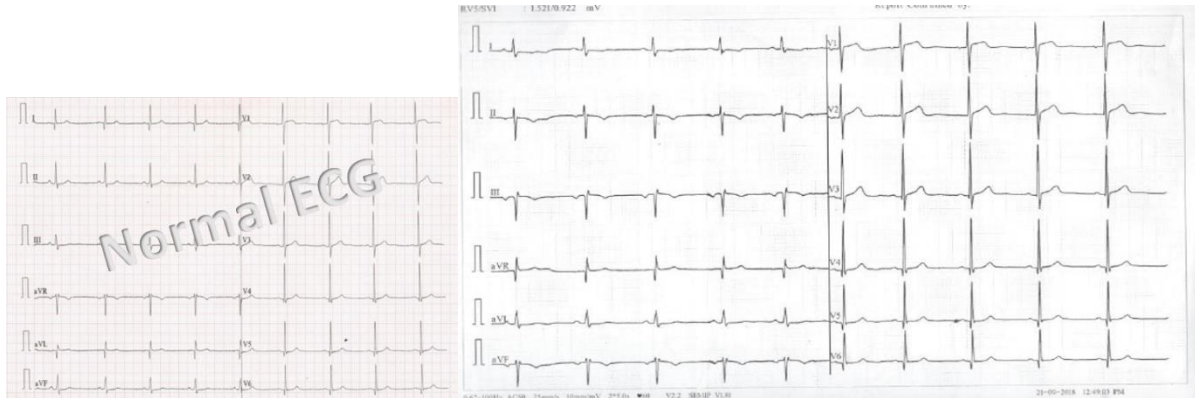
- Lead III is inverted lead II.
- aVr is aVl.
- aVf is aVr.
- Lead II is inverted Lead I.
- Lead I is lead III.
- aVl is aVf.
- The ECG can mimic Inferior wall Ischemia.

RA-LL, LA-RL, LL-RA and RL-LA reversal



- Lead I is a flat line.
- Lead II, III and aVf are similar, all are inverted lead II.
- aVr and aVl are similar.

RA-LL, LA-RA and LL-LA reversal



- Lead III is inverted Lead II.
- aVr is aVl.
- aVf is aVr.
- Lead I is Lead III.
- Lead II is inverted Lead I.
- aVl is aVf.

Solution

Limb lead reversals is a very common scenario and can create difficulties in decision for the insurer at underwriting as well as the claim stage. It is therefore, necessary to have a thorough knowledge of all possible limb lead reversals and identify every limb lead reversal effectively

This will help:

- Prevent misdiagnosis
- Prevent asking for repeat ECG's unless absolutely necessary thus ensuring a streamline smooth process
- Prevent fraud due to intentional reversal
- Risk management at an initial level
- Prevent high claim pay-outs

About INCHES Intelli-Claims Risk solutions

INCHES is a leader in providing risk solutions based on medical and medico legal insights that helps customers across all verticals of insurance industry to assess and manage risk. Integrating cutting-edge technology and insightful scoring analytics, we provide products and service that address evolving pain points specific to clients ensuring highest standards of security and TAT.

The services cover the entire spectrum of product design, UW & claim process, creating SOPs and requisite training.

With an explicit team of medicos and over 18 years of domain experience and 400 years of collective medical expertise, InCHES offers special solutions for pre-issuance medicals and helps in better risk management and loss mitigation.

Core team:

1. Padmashree Prof Dr Alaka Deshpande - *Director Clinical services*
2. Dr C H Asrani - *Chief visionary & CEO*
3. Dr Sushma Jaiswal - *Executive Director*
4. Dr Salma Rayani Khan - *AVP Legal services*
5. Dr Ashwin Shinde - *Sr Manager - Clinical Audit*
6. Dr Satish Kanojia - *AVP - Field services*
7. Dr Bhavini Shah - *Sr Clinical Associate*
8. Dr Dhanashree Mane - *Sr Clinical Associate*
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10. Dr Anisha Ramit - *AVP Business Development*
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