Diagnosis and practical implications of ECG lead reversal: Anesthesiologist perspective

Dear Editor,

Most electrocardiographic (ECG) abnormalities during the perioperative period are diagnosed and managed appropriately by the anesthesiologist. Abnormal ECG owing to the reversal of limb lead could also happen either by manual error or faulty equipment. Here, we report a case of ECG lead reversal and discuss the important relevant points for practicing anesthesiologists.

A 24-year-old female patient was planned for puerperal sterilization. During preoperative evaluation by an experienced anesthesiologist, she was found to have a pulse rate of 116 bpm with regular rhythm and blood pressure of 124/82 mmHg. Other clinical examination including cardiovascular system was unremarkable. Her hemoglobin level was 10.2 g/dl. Considering the differential diagnosis of anxiety, hyperthyroidism, and cardiac abnormalities, an ECG was asked for further evaluation of tachycardia.

The ECG showed heart rate of 103 bpm, with right axis deviation, aVR uptake, ST depression in V3, V4, V5, V6, and T wave inversions in V1–V4 [Figure 1a]. Although the automatic ECG machine (MAC 1200ST series, GE medical systems) interpretation was “suspect arm lead reversal,” these findings were suggestive of non ST-elevation myocardial infarction (NSTEMI), which warrants further investigations. In addition, the clinical features were not correlating, and the ECG was repeated and found to be normal [Figure 1b]. Our case strongly emphasizes the fact that an ECG should always be correlated clinically.

If ECG findings of NSTEMI had been present with non-specific cardiac symptoms, any anesthesiologists would have asked for further cardiac evaluation. On the first look, we could not have diagnosed the lead reversal. Only after reading the ECG machine interpretation, we could diagnose the ECG limb lead reversal [Table 1]. This was simulated in the various anesthesia workstations, and we noticed that surprisingly none of the perioperative multiparametric monitor (equipped with arrhythmia analysis) used in the perioperative period gives alarm for limb lead reversal. On several occasions, the ECG monitoring is disconnected and reconnected especially during the change of position (eg., supine to prone) in operating room. In those situations, sudden change in the ECG is a serious cause of concern for anesthesiologist.

Therefore, we suggest the manufacturers to incorporate the lead reversal alarm in the arrhythmia analysis of ECG.

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**Table 1: Alterations observed in ECG caused by common leads misplacement in normal ECG**

| Leads reversed                          | ECG pattern observed                                                                 | Clinical misinterpretation                                                                 |
|----------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Right arm, Left arm                    | Inverted P waves in II, III, aVF; large q-wave in I, aVL; leads I and aVL appear as inverse of V5, 6 | Non sinus atrial rhythm; Old lateral wall myocardial infarction                             |
| Right arm, Left lower limb             | Inverted P waves II, III, aVF; large q waves II, III, aVF                             | Non sinus atrial rhythm; Old inferior wall myocardial infarction                           |
| Left arm, Left lower limb              | Insignificant q-waves in III                                                         | Nil                                                                                       |
| Right lower limb, Left lower limb      | No change                                                                             | Nil                                                                                       |
| Left arm, Right lower limb             | Low voltage lead III                                                                  |Nil                                                                                        |
| Right arm, Right lower limb            | Diffuse low voltage in all limb leads, especially lead II; non-sinus atrial or junctional rhythm | Conditions described by diffuse low voltage complexes                                      |
| Reversal of precordial leads           | Break in normal R-wave progression from V1, 6                                        | Mirror image dextrocardia or posterolateral infarction                                     |

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monitoring. In addition, every anesthesiologist should be aware of the diagnostic criteria for ECG limb lead reversal.

**Declaration of patient consent**
The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**
There are no conflicts of interest.

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