

# **ECG Interpretation:**

## **How to obtain a good quality ECG**

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Lancashire and South Cumbria Cardiac Network Website at:  
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## HOW TO OBTAIN A GOOD QUALITY ECG

1. Ensure patient is comfortable
2. The patient should be supine (45 degree angle)
3. Remove any chest hair
4. Clean skin if necessary with prep pad or alcohol wipe
5. Apply appropriate adhesive electrodes
6. Attach ECG cables to tabs
7. Ensure patient is relaxed and still
8. Record ECG making sure paper speed is 25mm/sec and calibration is correct

## PROBLEMS AND TROUBLESHOOTING

- **AC Interference** –  
Switch off non-essential equipment at power source
- **Muscle Tremor** –  
Assist patient to relax, move limb electrodes to upper limbs if possible
- **Baseline Wander** –  
Caused by sweat, poor electrode contact. Dry the skin, wipe with alcohol wipe, and shave if hairy
- **Broken lead/cable** –  
Replace lead (use triangle diagram for assistance)
- **Flat line in one chest electrode** – check proper adhesion to the skin, replace electrode, check connection of cable to ECG module

## **SKIN PREPARATION**

Skin preparation is often required to help produce an artefact-free and accurate ECG. Various methods are available, all of which are designed to minimise the skin-to-electrode impedance.

For example,

- The removal of chest hair may be required to ensure adequate contact with the skin. Verbal consent should be obtained from the patient and a clean razor used which should be disposed of in a sharps bin immediately afterwards.
- Exfoliation may be required and should be undertaken with very light abrasion using either a paper towel, gauze swab or proprietary abrasive tape designed specifically for this purpose.
- On occasions the skin may require cleansing. A variety of methods exist ranging from washing with mild soap to cleaning with an alcohol wipe. **However, care must be taken in patients with sensitive or broken skin.**

## **ELECTRODE PLACEMENT**

**The following electrode sites should be correctly identified and the placement of the electrodes must conform to AHA recommendations.**

(NB. Each lead wire is generally colour coded to aid identification. However, the colour may vary depending on manufacturer. The colours listed are consistent with IEC (European) recommendations).

## **LIMB LEADS**

Evidence exists to demonstrate that moving the limb lead attachments away from the distal limbs alters the appearance of the ECG. This variation can invalidate the use of such recordings for many diagnostic purposes.

To ensure consistency between recordings it is recommended that the electrodes are attached to both arms and legs, slightly proximal to the wrist and ankle. It is imperative that recordings from other sites are labelled accordingly so that the results are not confused with those obtained from standard sites.

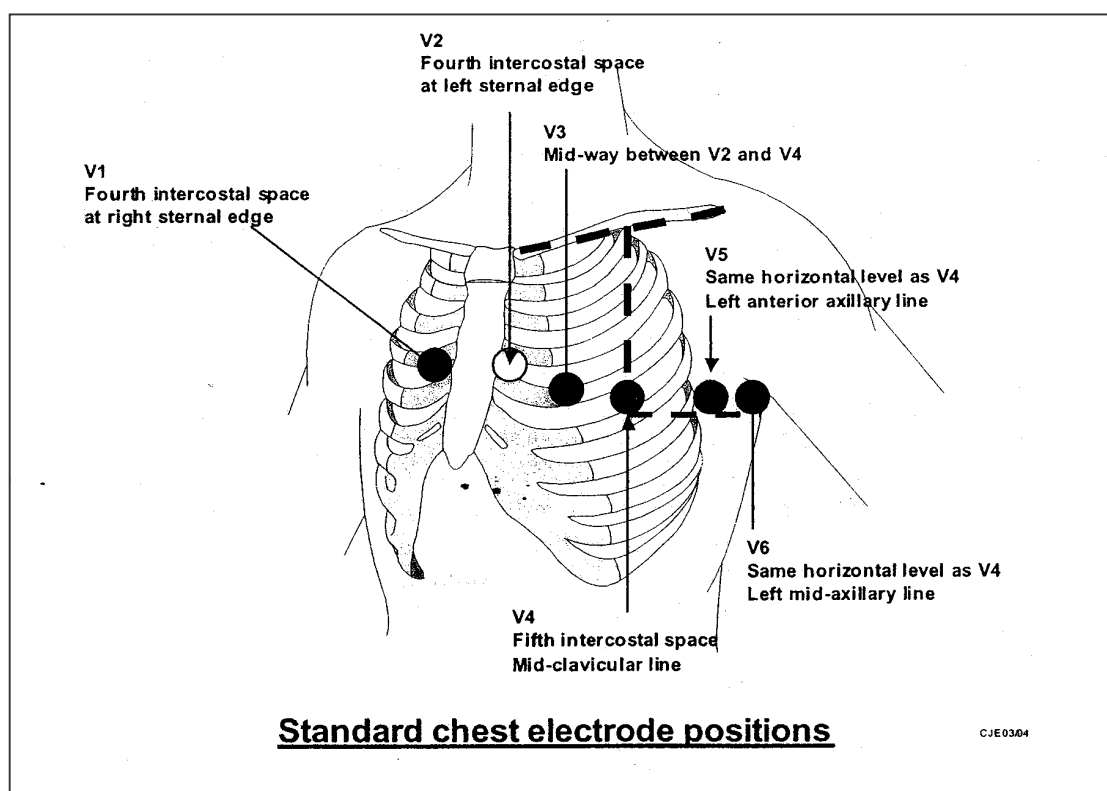
- Right arm limb lead (RA, red) – right forearm, proximal to wrist
- Left arm limb lead (LA, yellow) – left forearm, proximal to wrist
- Left leg limb lead (LL, green) – left lower leg, proximal to ankle
- Right leg limb lead (RL, black) – right lower leg, proximal to ankle

**PRECORDIAL (CHEST) LEADS**

Variation in the placement of the precordial electrodes produces diagnostically significant differences in the ECG. **Previous studies have demonstrated that V1 and V2 are frequently placed too high and the left lateral leads too low.**

The correct anatomical positions for placing the precordial leads have been defined and should always be used (see figure below). If any deviation from these positions is necessary then this must be clearly labelled on the printed ECG.

| Electrode | Position   |
|-----------|--|
| V1 (C1)   | Fourth intercostals space at the right sternal edge        |
| V2 (C2)   | Fourth intercostals space at the left sternal edge         |
| V3 (C3)   | Midway between V2 and V4                                   |
| V4 (C4)   | Fifth intercostals space in the mid-clavicular line        |
| V5 (C5)   | Left anterior axillary line at same horizontal level as V4 |
| V6 (C6)   | Left mid-axillary line at same horizontal level as V4 & V5 |



## LOCATING CHEST ELECTRODE POSITIONS

- Care should be taken when counting the intercostals spaces down from the clavicle that the small space between the clavicle and the first rib is not mistaken for the first intercostals space.
- In order to avoid this common error the sternal angle (angle of Louis) should be used as the main reference point. This anatomical landmark denotes the position of the sternal angle at the manubriosternal joint.

**To locate the sternal angle, a finger should be run down the sternum, from the sternal notch at the top until a bony horizontal ridge, the sternal angle, is met. With the finger on this ridge, sliding down and to the side will locate the second intercostals space. Then count down to the third and fourth space. Locate the very edge of the sternum and place V1 there. Repeat this procedure on the left side to correctly position V2.**

- Next the position for V4 should be located. This should be placed in the fifth intercostals space in line with the mid point of the clavicle.
- Once the V4 electrode has been correctly placed then the location for V3 can be identified, directly mid-way between V2 and V4.
- V5 and V6 are then positioned, taking care not to follow the line of the ribs, but to follow a horizontal line from V4. V5 is placed in line with the anterior axilla and V6 in line with the mid-axilla.
- When recording an ECG from female patients by convention the lateral chest electrodes (V4, V5 and V6) are placed beneath the left breast. Whilst it is acknowledged that there is emerging evidence to support the positioning of these electrodes over the breast without any attenuation of the signal there is insufficient published data to support alteration of the widely adopted technique of placing V4 to V6 under the left breast.

## RECORDING

- In order to record a good quality ECG the patient must be relaxed and comfortable. If these conditions are not satisfied the ECG will record somatic muscle potentials as well as cardiac activity. Such interference will make the ECG more difficult to interpret. Some patients cannot relax fully because of pain from arthritis or other conditions. Make them as comfortable as possible.
- On occasions it may be necessary to adapt the recommended ECG recording techniques. For example, wheelchair bound patients may need to remain in their chair during the recording process. **Any variations to standard recording techniques must be highlighted on the trace**, e.g. "ECG recorded whilst patient in wheelchair".
- Patient details (name and a second unique identifier such as hospital number or date of birth) should be entered into the ECG machine.
- Before recording the ECG, check the patient's limbs are still and appear relaxed. If the patient has clenched fists or stiff arms, or is moving his/her fingers, it will not be possible to obtain a high quality ECG.
- Press the appropriate button on the machine to initiate a recording (usually labelled 'start' or 'auto'). A 12-lead ECG and rhythm strip should be recorded at 25mm/s with a gain setting of 10mm/Mv.
- The filter button **should not** be selected for this initial recording.

If, despite efforts to relax the patient and make them comfortable, there is somatic muscle interference on the ECG, switch on the filter and repeat the recording. Use of the filter should be clearly identified on the final ECG.

NB. The filter will reduce the interference. However, as it will also distort the ECG it should only be used when absolutely necessary (after all attempts to eliminate the interference have failed).

- If the ECG complexes are of high voltage then the gain should be adjusted (5mm/mV) to enable them to be measured accurately. Similarly, the gain should be increased (20mm/mV) if the complexes are of low voltage. Any alteration in the gain settings should be clearly marked on the tracing.
- If the rhythm is not to be irregular then an additional rhythm strip should be recorded for a minimum of 10 seconds.
- Any changes on the ECG that might require urgent medical attention should be identified and advice sought from a senior member of staff if necessary. If the patient has any cardiac symptoms at the time of recording, such as chest pain or palpitations then this should be noted on the tracing.
- If the ECG is technically correct and of good quality, ensure that it is fully and correctly labelled (patient identification information, relevant clinical details) then remove all of the electrodes from the patient and dispose as clinical waste.