Module 1: Basic ECG recording and interpretation

Introduction

12-Lead electrocardiogram (ECG) was developed as a teaching and learning tool for Victorian clinical educators. The information contained in each module was developed using evidence-based resources and examples of best practice. Where expert opinion varies, a discussion section is included. However, it is not within the scope of *12-lead ECG* to address the full spectrum of local variations. Variations can occur in several areas, including practices relating to types of equipment used, infection control processes, practice guidelines and so on. Therefore, educators should, where appropriate, adapt content to reflect their local policies, procedures and protocols. This will ensure the relevancy of the package content to your learners.

The modules are designed to be discrete courses in their own right. They are timetabled so they can be completed in a 1–2 hour timeframe. This timeframe was chosen after we received feedback from clinical educators requesting shorter courses, because health professionals often have limited time to educate away from patients. However, the packages may also be combined into a one- or two-day course.

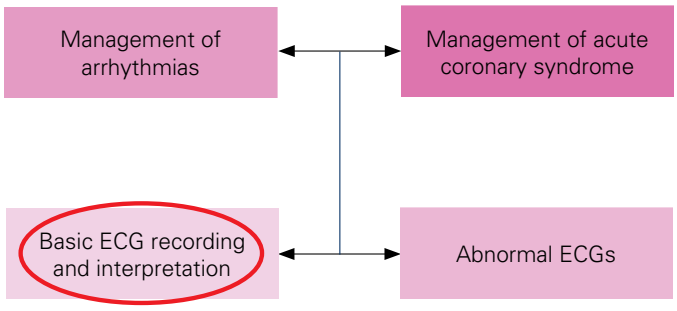
12-lead ECG should be used as an educational tool to assist in the teaching of clinical skills. It is structured as a guide to assist clinical educators, and uses many concepts taught in the *Clinical Skills in Hospitals Project* (Train-the-Trainer courses). Educators are encouraged to build on this resource by adding their own scenarios which incorporate hospital/health service protocols, policies and other resources. Each module is designed as a lesson plan to incorporate the simulations into the teaching of clinical skills.

Aims

12-lead ECG aims to make participants confident in their recording and interpretation of electrocardiogram (ECG) tracings on adult patients, and when they initiate appropriate therapeutic interventions for patients with common clinical conditions that lead to ECG abnormalities. It is not intended to be a comprehensive textbook on ECG interpretation. In contrast to adult patients, the need to perform an ECG on a paediatric patient is a rare occurrence outside of specialist paediatric cardiology services. This module does not address the issue of ECGs in children.

Package structure

12-lead ECG contains four modules which provide learning opportunities for health professionals at all levels of experience and from all health disciplines. Modules 1 and 2 are regarded as fundamental. Modules 3 and 4 are more difficult, and are regarded as intermediate.

Level of complexity	Package structure
Complex For participants with more than 4 years experience or who have completed Modules 1–4	
Intermediate For participants in postgraduate years 3–4 or who have completed Modules 1 and 2	
Fundamental For participants in postgraduate years 1–2	

12-lead ECG was designed to develop participants' knowledge, skills and behaviours in ECG interpretation, and to expose them to increasingly complex scenarios aimed at testing their ability to combine these skills, work as a team and problem solve in more difficult situations.

Educators delivering these modules should be aware of participants' level of experience and choose appropriate modules. Modules presume an increasing level of knowledge as they progress, ranging from a fundamental knowledge of anatomy and physiology for the fundamental modules, up to detailed knowledge of arrhythmia and acute coronary syndrome management for the more complex modules. Novice participants (such as first-year graduates) are expected to start with the fundamental modules, and only move onto intermediate and more complex modules as they demonstrate proficiency. More experienced participants may start at the intermediate level if the educator is satisfied that they have the prior knowledge and skills. Individual educators are responsible for assessing each participant's baseline knowledge and determining which modules they need to complete. While the intermediate modules contain considerable medical detail, non-medical participants can still gain valuable experience from these modules by focusing on their roles and expectations in these scenarios. If the group contains no medical staff, facilitators may need to play the medical roles. More specific descriptions of presumed knowledge are outlined in each module.

The design of these packages presumes that the clinical educators using them have knowledge and expertise in current best practice regarding the teaching of clinical skills and conducting facilitated discussions. Knowledge and expertise are presumed commensurate with the Department of Human Services' basic and advanced Train-the-Trainer Programs. Clinical educators are encouraged to refer to Department of Human Services' *Clinical Skills Facilitators Manual* for theory on:

1. Peyton's model for teaching clinical skills
2. leading small group discussions
3. giving feedback
4. crisis resource management skills.

Module 1: Basic ECG recording and interpretation

Authors: Dr Stuart Dilley, Ms Debbie Paltridge

Aims

The purpose of *12-lead ECG—Module 1: Basic ECG recording and interpretation* is to teach, and/or consolidate participants' knowledge of, clinical skills required for acquiring and interpreting a normal electrocardiogram (ECG).

Presumed knowledge

This module is targeted to health professionals with little or no experience in ECG acquisition and interpretation. However, they are expected to have a basic knowledge of:

1. cardiac anatomy: cardiac chambers
2. cardiac electrophysiology: conduction system
3. basic principles of the 12-lead ECG.

Objectives

By the end of this module, participants should have:

1. reviewed the electrophysiology of the heart as it relates to the ECG
2. identified the characteristics of a normal ECG
3. practised recording an ECG using an appropriate human volunteer
4. practised interpreting and communicating the appearance of normal ECGs
5. identified common errors in ECG recording.

Background information for educators

An electrocardiogram (ECG) is the graphical record produced by an electrocardiograph, a machine that records the electrical activity of the heart over time. The ECG allows health professionals to diagnose and monitor various cardiac conditions, including arrhythmias (irregularities of cardiac rhythm) and myocardial damage (such as myocardial infarction).

Electrophysiology

The contraction of any muscle, including the heart, is associated with electrical changes called 'depolarisation'. The electrical discharge for the normal heart usually follows a standard pathway[1, 2]:

1. Electrical discharge starts in the right atrium at the sino-atrial (SA) node, the heart's 'natural pacemaker'. The SA node discharges 60–80 times per minute, resulting in a heart rate of 60–80 beats per minute (bpm).
2. Depolarisation spreads throughout the atrial muscle fibres.

3. The wave of depolarisation reaches the atrio-ventricular (AV) node, where its conduction to the ventricles is briefly delayed.
4. Conduction then occurs rapidly down the 'bundle of His' and its two branches, the left and right bundle branches. The left bundle further divides into anterior and posterior fascicles.
5. Conduction then occurs more slowly through specialised Purkinje fibres, resulting in ventricular muscle depolarisation.
6. Atrial repolarisation (return to resting electrical status) occurs during ventricular depolarisation.
7. Ventricular repolarisation occurs following ventricular depolarisation and before the next SA discharge.

Abnormalities in this conduction system may occur with cardiac disease, and are subsequently reflected in the ECG pattern. Indications for performing an ECG include:

1. irregular heart rate or palpitations
2. chest pain
3. fast heart rates (> 100 bpm)
4. slow heart rates (< 50 bpm)
5. collapse or syncope (collapse with spontaneous return of consciousness)
6. chest trauma where cardiac injury is suspected, for example, blunt trauma to the chest (as might occur when a pedestrian is struck by car)
7. pre-operative assessment of at-risk patients, for example, the elderly.

Normal ECG

All ECG machines run at a standard rate (25 mm per second) and use paper with standard-sized squares. Each small square (1 mm) represents 40 ms (0.04 seconds), while each large square (5 mm) represents 200 ms (0.2 seconds). On the y axis, each small square represents 0.1 mV.

ECGs may be recorded as a standard '12-lead ECG', individual 'rhythm strips' or as specialised ECGs that look at different parts of the heart. In all cases, a standard ECG complex is produced, which consists of:

1. A P wave, representing atrial depolarisation. The presence of P waves indicates 'sinus rhythm', the heart's normal rhythm.
2. A PR interval, representing conduction through the AV node and the bundle of His. This should be between 120–200 ms, or less than 5 mm on the ECG paper.

3. The QRS complex, representing depolarisation of the ventricles. A Q wave is any negative deflection at the beginning of a QRS complex. Small Q waves in some leads may be normal. Large Q waves (> 2 mm) may be abnormal. An R wave is the first positive deflection, and an S wave is the negative deflection immediately following an R wave. The QRS complex should be less than 120 ms (3 mm).
4. The ST segment, between the end of the S wave and start of the T wave. The ST segment should be 'isoelectric', that is, at the same level as the part between the T wave and the next P wave.
5. A T wave, representing repolarisation of the ventricles.

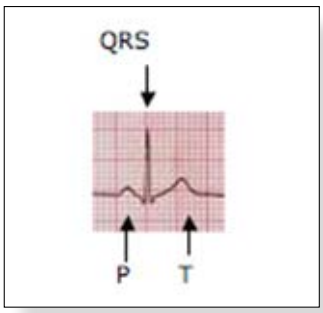


Figure 1: QRS

A standard 12-lead ECG records these PQRST complexes in real time from different locations around the heart. Hence, every lead appears slightly different, while still containing a PQRST complex.

Of the 12 leads, six are referred to as 'limb leads'. The limb leads are leads I, II, III, aVR, aVL and aVF. The other six are referred to as 'chest' or 'precordial' leads. These leads are V1, V2, V3, V4, V5 and V6.

The limb leads record the electrical activity in the heart in the vertical plane. The chest leads record the electrical activity of the heart in the horizontal plane. Thus, different leads can be grouped together when looking for consistency of ECG appearances (normal or abnormal) for different parts of the heart.

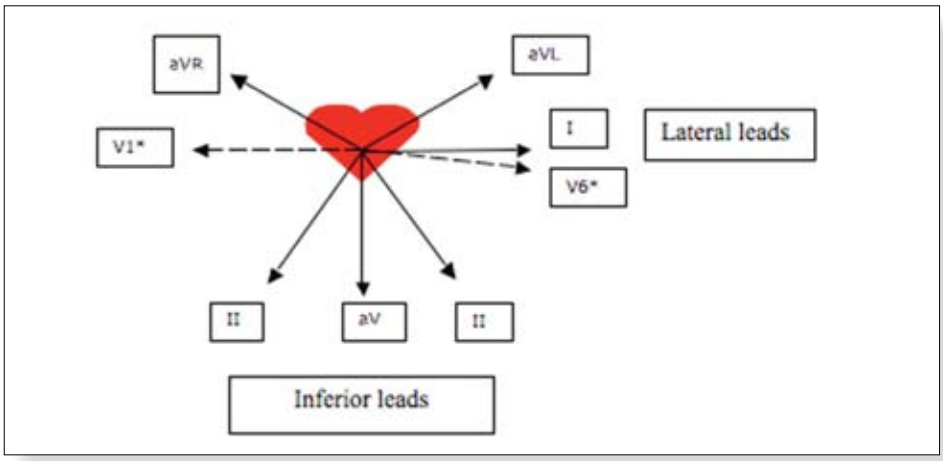


Figure 2: ECG appearances for different parts of the heart

**Chest leads V1–V6 are projected anteriorly out of the diagram from V1 at the right to V6 at the left of the heart.*

1. inferior surface: II, III, aVF
2. left lateral surface: I, II, aVL
3. right lateral surface: aVR, V1, V2
4. anterior and septal: V3, V4
5. anterior and lateral: V5, V6.

The wave of depolarisation ('axis') travels from the upper right to the lower left of the heart. As depolarisation travels towards an ECG electrode, the ECG records an upward deflection. Conversely, depolarisation spreading away from the electrode records a downward deflection. In most leads, the P waves and T waves are positive deflections (apart from aVR), and the QRS complexes are predominantly positive (apart from aVR, and sometimes V1, V2 and lead III).

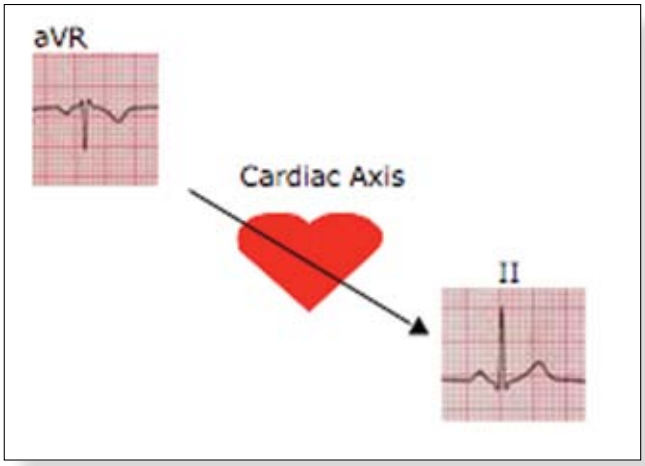


Figure 3: Wave of depolarisation

ECG recording

Obtaining an ECG from a patient is a relatively simple procedure. However, practitioners must follow all steps and take all possible measures to avoid error and minimise interference and artefact. This should include these steps:

1. Confirm the identity of the patient requiring an ECG.
2. Explain the procedure to the patient.
3. Offer the patient privacy.
4. Remove the patient's clothing to allow ECG recording while minimising exposure and maintaining warmth.
5. Position the patient in the supine position if possible. Patients with severe respiratory compromise will not be able to lie in this position and may need to have an ECG performed while sitting or semi-recumbent.

6. Place the ECG electrodes ('dots' or 'tabs') in the correct position on the patient's chest and limbs (see below). This may require removal of body hair or drying of the skin.
7. Connect the labelled ECG leads to their corresponding electrodes.
8. Turn on the ECG machine.
9. Press the 'filter' switch to 'on'.
10. Enter patient details.
11. Advise the patient to relax and lie still.
12. Press the appropriate button on the machine to initiate recording, usually 'start' or 'auto'.
13. Review the printed ECG to confirm adequacy of the tracing and to identify immediate life-threatening abnormalities (see below, under 'Checking the ECG').
14. If the ECG machine does not allow direct entry of patient details, these should be attached to the ECG as soon as the tracing is recorded.

The modern, standard 12-lead ECG requires that 10 ECG leads be attached to the patient's body. The leads are labelled to assist correct placement. These leads must be placed correctly to avoid obtaining a misleading ECG. The ECG leads should be placed as follows[3, 4]:

1. LL: left leg, distally
2. RL: right leg, distally
3. LA: left arm, distally
4. RA: right arm, distally
5. V1: fourth intercostal space, to the right of the sternum
6. V2: fourth intercostal space, to the left of the sternum
7. V3: midway between V2 and V4
8. V4: fifth left intercostal space, mid-clavicular line
9. V5: at the horizontal level of V4, anterior axillary line (or midway between V4 and V6 if the anterior axillary line is not well defined)
10. V6: at the horizontal level of V4 and V5, mid-axillary line.

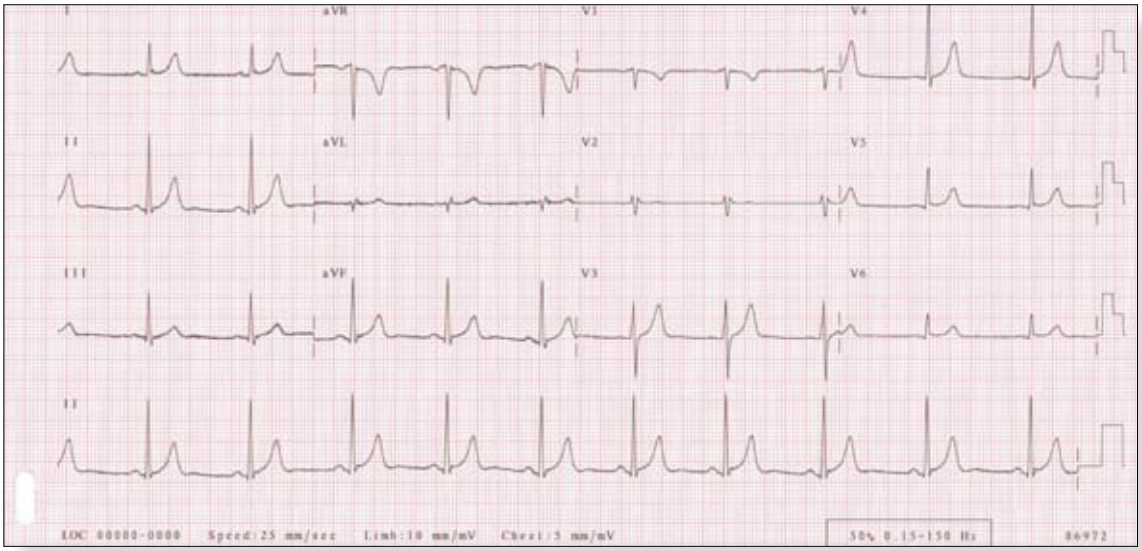


Figure 4: 12-lead ECG

Accurately locating the fourth intercostal space is important. One of the most common errors in recording an ECG is to place V1 and V2 too high, resulting in all V leads positioned at a higher level on the chest. The fourth intercostal space is found by undertaking these steps:

1. Identify the sternal angle or 'angle of Louis' (the angle between the upper part of the sternum and the body of the sternum), where the manubrium meets the body of the sternum. Run your finger down the sternum from the sternal notch at the top, until you meet a bony horizontal ridge. This is the sternal angle.
2. From this ridge, slide your finger down and to the side to locate the second intercostal space.
3. Count down from this space to identify the third and fourth intercostal spaces.

When recording an ECG from female patients, the convention is to place the lateral chest leads (V4, 5 and 6) beneath the breast, rather than over it[5].

Checking the ECG

The ECG potentially contains a lot of information. Checking the ECG and communicating its findings requires a systematic approach. The following features should be observed and described:

1. **Cardiac rate:** this can be estimated by dividing 300 by the number of large squares between QRS complexes.
2. **Underlying cardiac rhythm:** the presence of P waves indicates normal sinus rhythm. Each P wave should be followed by a QRS complex. Sinus rhythm should be regular.
3. **PR interval:** this should normally be less than 200 ms (5 mm), and indicates normal conduction through the AV node.

4. **A description of the QRS complexes:** this should normally be less than 120 ms (3 mm), and indicates normal conduction through the bundle of His and bundle branches.
5. **A description of the ST segment and T waves:** the ST segment should be 'isoelectric' (that is, at the baseline), and T waves should be upright in most leads (except for aVR and occasionally V1, III).

Common ECG abnormalities that should be identified immediately and warrant referrals to an experienced ECG interpreter include:

1. heart rhythms that are irregular
2. absence of P waves
3. fast heart rates (> 100 bpm)
4. slow (< 50 bpm) heart rates
5. wide QRS complexes (> 120 ms, or 3 mm)
6. ST segments that are either elevated or depressed—that is, not isoelectric
7. T wave inversion (apart from isolated T wave inversion in aVR).

Common problems

An underappreciated cause of ECG abnormality is electrode disconnection, misplacement, misconnection and artefact. ECGs recorded in these instances should be recognised and discarded, and a correctly recorded ECG obtained immediately.

Leads may be correctly placed initially, but then become disconnected. This is reflected as one straight line in the case of a chest lead (V lead) disconnection, and straight lines in all leads in the case of a limb lead disconnection.

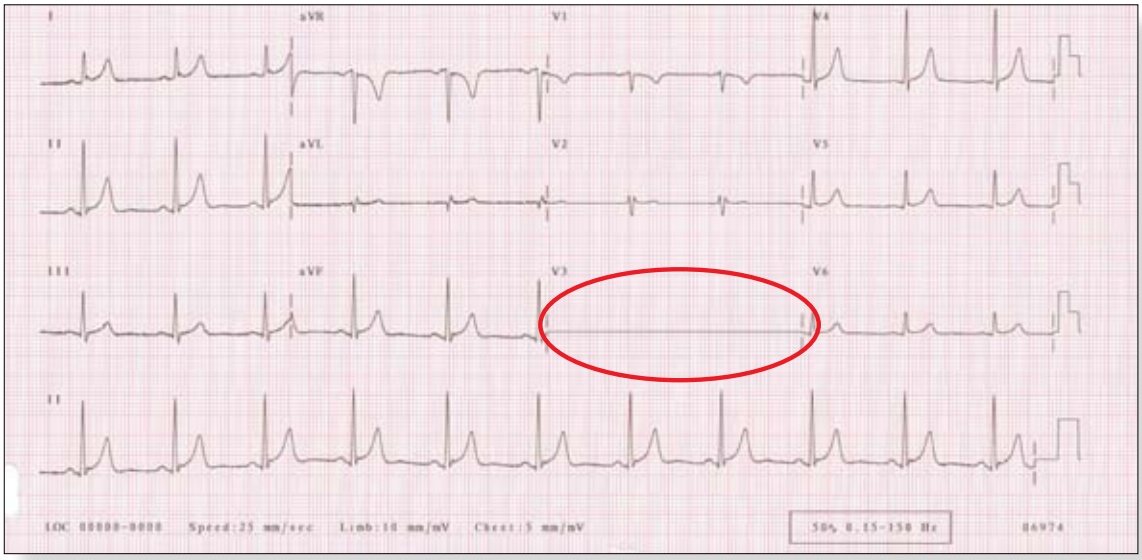


Figure 5: V3 disconnected

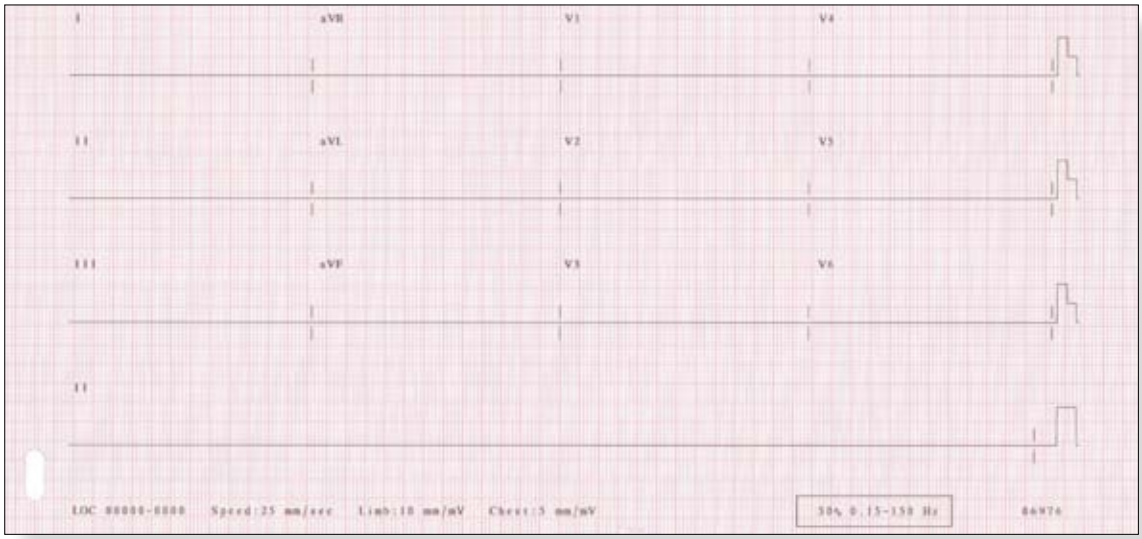


Figure 6: 12-lead ECG with left arm lead disconnected (no leads are seen by ECG machine)

Leads may be misplaced if care is not taken to identify the sternal angle, second and subsequent intercostal spaces and mid-clavicular and axillary lines for placement of chest leads. Misplacement of the chest leads may result in QRS and T wave abnormalities.

Limb electrode reversal is a common error[6], and includes RA/LA, RL/LL, RA/RL and LA/LL reversal. RA/LL and LA/RL reversal is less common. Arm electrode (RA/LA) reversal is the commonest error, but fortunately, is easy to detect on ECG. Lead I is essentially reversed in this instance, resulting in negative (inverted) P waves, QRS complex and T wave in lead I and aVL. Conversely, aVR displays positive deflections for these waves and complexes, rather than the normal negative deflections in this lead.

Reversal of leg electrodes (RL/LL) causes no discernible difference in ECG appearances, because the RL electrode merely serves as a ground electrode, and there is no potential difference between the two leg electrodes. However, RL electrode reversal with either arm electrode (RA/RL or RL/LA) results in a relatively flat line (or reduced amplitude) in one of the limb leads (lead II if RL/RA reversal, lead III if RL/LA reversal). Lead III will also appear inverted.

Left-sided electrode reversal (LA/LL) is the most difficult to detect, and may appear normal until compared with previous ECGs for that patient. However, two inferior leads (II, aVF) become lateral (I, aVL) and vice versa.

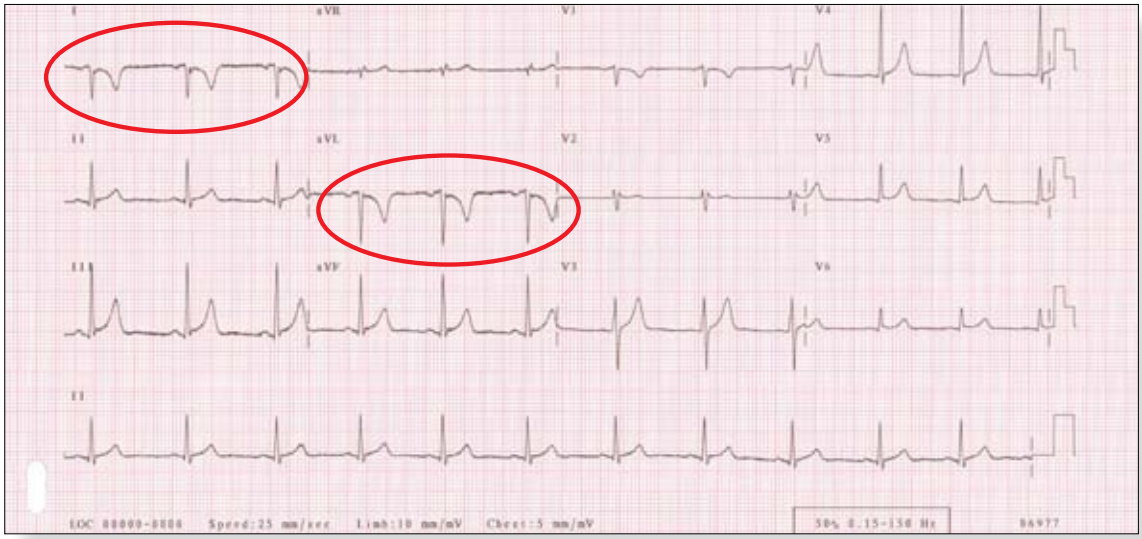


Figure 7: RA/LA reversal

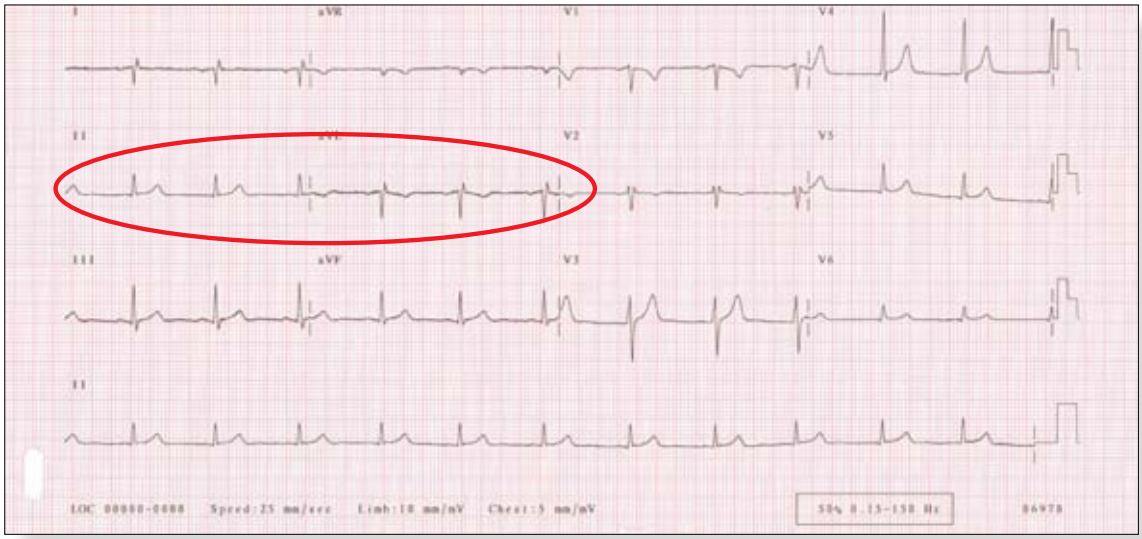


Figure 8: RA/RL reversal

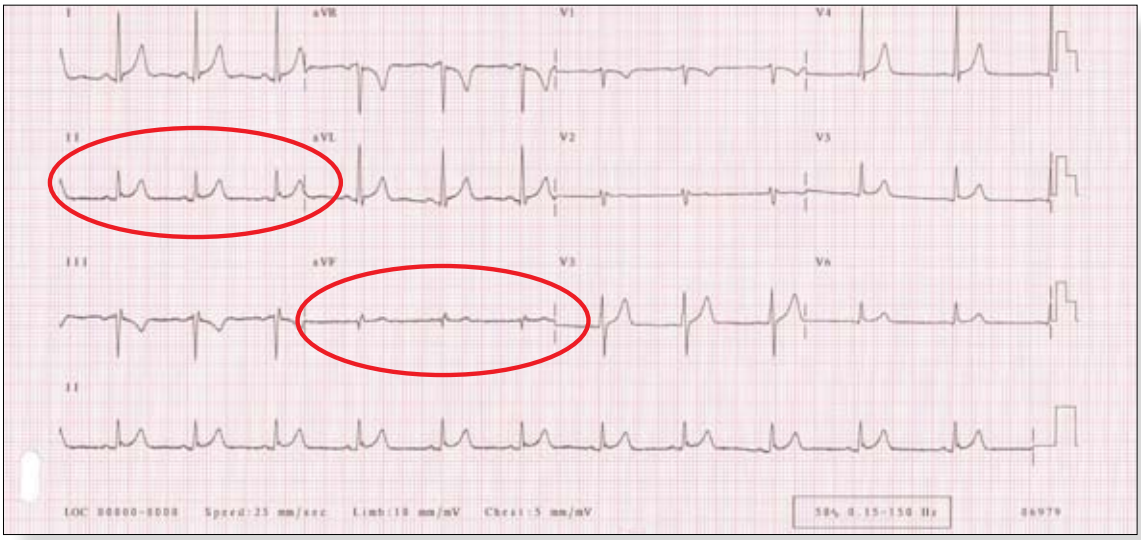


Figure 9: LA/LL reversal

Chest leads may also be misconnected, but these are usually easily detected by an interruption to the usual R wave growth and S wave regression from V1 to V6.

ECG artefact is usually easily recognised, and may be produced by patient movement (tremor, rigors, restlessness, seizures) or electrical interference. ECGs should be performed in a warm environment with the patient still, with good electrode contact with the skin and away from interfering electrical devices.

Figure 10: Artefact in leads due to patient tremor

Learning activities

Suggested learning activities and timetable are outlined below.

Timing	Activity	Objective
40 minutes	Facilitated discussion	1, 2, 4, 5
60 minutes	Skills stations: ■ ECG recording ■ ECG interpretation	3, 4, 5
10 minutes	Summary	All
10 minutes	Evaluation	

Total time = 2 hours

Facilitated discussion

The facilitator should lead a discussion amongst participants about the issues covered in the background information, for example, cardiac conduction and electrophysiology and normal ECG interpretation. The facilitator should not give a didactic lecture, but instead promote open discussion and knowledge sharing amongst participants.

Participants should be encouraged to describe any real-life experiences they have encountered.

The facilitator should ensure these major issues are covered:

- indications for ECG recording
- relationship between ECG waves and cardiac electrophysiology
- correct procedure for recording an ECG
- techniques for describing ECG findings
- common errors in ECG recording.

PowerPoint slides are available for the facilitator to use to summarise these main points at the end of the discussion, or as triggers if participants have not identified the major issues.

Skills stations

The skills stations allow participants to practise recording, interpreting and communicating the appearance of normal ECGs using appropriate models, while receiving feedback in a structured format from peers and/or facilitators.

The program and resources required assume two facilitators for every eight participants, a ratio of 1:4. Four participants start at each of the two stations and change over after 30 minutes.

1. ECG recording

Participants should be guided through the recording of an ECG using Peyton's four-step model[7]. Feedback should be provided at the completion of the skill.

For this station, it is important that participants actually practise locating intercostal spaces, attach ECG leads and record an ECG. Few manikins or simulation models have enough fidelity to provide this experience adequately. Some models allow 12-lead ECGs to be recorded, but do not allow for accurate assessment of lead positioning. Therefore 'live models' should be used. These may be participant volunteers, other faculty or other volunteers as available. Thus, participants can actually locate the sternal angle and associated intercostal spaces before applying electrodes and recording an ECG. This also allows the facilitator to demonstrate changes that might appear in the ECG tracing, should electrodes be misplaced.

During these exercises, previously unrecognised ECG abnormalities might be found when using volunteers. Facilitators should ensure that a process is in place at their particular institution to review these ECGs and make appropriate referrals to the relevant medical specialist if required. This process should be clearly outlined to volunteers when they are recruited.

Each participant should have approximately seven minutes of hands-on experience in correctly obtaining an ECG and confirming that it is acceptable as a tracing and normal.

2. ECG interpretation

This station allows participants to review a series of ECGs and verbalise the findings according to the standard procedure described. The module includes a series of ECGs on which to practise, but facilitators may like to use real 'patients' (volunteers), as for the ECG recording skills station. In this station, leads can be deliberately disconnected, misconnected or misplaced to demonstrate the changes that result.

The following ECG examples are provided with this module:

1. normal ECG 'A'
2. normal ECG 'B'
3. mislabelled ECG
4. disconnected V-lead ECG
5. disconnected limb lead ECG
6. misconnection (RA/LA reversal) ECG
7. misconnection (RA/RL reversal) ECG
8. misconnection (LA/LL reversal) ECG
9. tremor artefact ECG.

Note: ECG 1 and 4–9 are from the same person and recorded all at the same time. Instruct participants of Group B that they can compare ECGs 4–9 with 1 to determine findings.

Each participant should have the opportunity to describe the findings of at least one ECG, and as a group, discuss the ECG appearances that indicate that an error in recording has occurred.

Summary

The summary session reinforces content covered in the learning activities, and is an opportunity for participants to reflect on what they have covered. No new material should be introduced.

Major points to recap in the summary include:

- the normal cardiac conduction system
- indications for ECG recording
- the importance of following procedure when recording the ECG
- the appearances of a normal ECG
- common errors encountered in ECG recording.

Participants should be encouraged to read from the reference list to consolidate their understanding of ECG principles and interpretation. While some health professionals may need to complete official hospital credentialling processes before performing these skills in their workplace, participants should be encouraged to assist others in recording and assessing ECGs as a lead-up to that process.

Resource list

The following resource list assumes two facilitators for every eight participants, a ratio of 1:4. As a minimum, the following resources are needed to conduct this module.

Resource	Quantity	Additional comments
PowerPoint presentation	1	Provided with module
12-lead ECG machine	1	Including paper
ECG electrodes	10	
Volunteer chest	1–2	At least one for ECG recording station, preferably a second for the ECG interpretation station
ECG sample set	1 set	For use in ECG interpretation station
Evaluation sheets	8	One for each participant
Alcohol swabs	1 packet	

Evaluation

A formal evaluation has been specifically developed for this module. It incorporates the objectives of the module and the perceptions of the participants about whether they have increased their understanding by working through the module. It is highly recommended that this formal evaluation be copied and completed by all participants at the completion of the module.

A range of informal evaluation tools may also be used in conjunction with this evaluation throughout the module, including those available in the Department of Human Services' *Clinical Skills Facilitators Manual* from the basic course conducted in 2007.

References

1. Hampton J. 2003 *The ECG made easy* (6th ed.) Churchill Livingstone, Edinburgh
2. Hampton J. 2003 *The ECG in practice* (4th ed.) Churchill Livingstone, Edinburgh
3. Kligfield P., Gettes L., Bailey J. et al. 2007 Recommendations for the standardization and interpretation of the electrocardiogram: Part I: the electrocardiogram and its technology. Circulation 2007, 115: 1306–1324
4. Lee Garvey J. 2006 ECG techniques and technologies. *Emerg Med Clin Nth Amer*, 24: 209–225
5. Clinical guidelines by consensus 2006 Recording a standard 12-lead electrocardiogram: An approved methodology. The Society for Cardiological Science and Technology, October 2006
6. Harrigan R. 2006 Electrode misconnection, misplacement and artefact. *Emerg Med Clin N Am*, 24: 227–235
7. Peyton J. 1998 *Teaching and Learning in Medical Practice*. Manticore Europe Ltd, Great Britain

Resources

Facilitator feedback form

The following form should be used to assist you in giving feedback after each participant has practised their ECG skills at the skill station.

Feedback using the Pendleton model

Pendleton's model of feedback assists learners to maximize their potential at different stages of training, raise their awareness of strengths and areas for improvement, and identify actions to be taken to improve performance. Pendleton's rules are structured in such a way that the learner identifies the positives first, in order to create a safe environment. This is followed by the facilitator or group reinforcing these positives and discussing skills to achieve them. Different techniques are then suggested. The advantage of this method is that the learner's strengths are discussed first. Avoiding a discussion of weaknesses right at the beginning prevents defensiveness and allows reflective behaviour in the learner.

Below is a series of questions to assist you in this technique:

1. Ask the learner how they feel.
2. Ask the learner what went well and why (this can be combined with question 1 and 3).
3. Tell the learner what went well and why.
4. Ask the learner what could have been done better and why.
5. Tell the learner what could have been done better and why.
6. Summarise the learner's strengths and identify up to three things to concentrate on.

Note: This form does not need to be given to the participant — it is a guide for you, the group facilitator.

Module 1: Basic ECG recording and interpretation—evaluation

Thank you for participating in this module. As part of our commitment to quality improvement the following questionnaire will be used to plan future implementation of this module. We appreciate your time completing this evaluation.

1. Overall

How would you rate this module?

☐ poor ☐ fair ☐ good ☐ very good ☐ outstanding

2. Learning objectives

Please consider whether this module was successful in meeting the following learning objectives:

12-lead ECG Learning objectives of Module 1: Basic ECG recording and interpretation	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
Reviewed the electrophysiology of the heart as it relates to the ECG	☐	☐	☐	☐	☐
Identified the characteristics of a normal ECG	☐	☐	☐	☐	☐
Practised recording an ECG using an appropriate human volunteer	☐	☐	☐	☐	☐
Practised interpreting and communicating the appearance of normal ECGs	☐	☐	☐	☐	☐
Identified common errors in ECG recording	☐	☐	☐	☐	☐
Reviewed the electrophysiology of the heart as it relates to the ECG	☐	☐	☐	☐	☐

3. Important learning outcomes

What are the three most important things you have learned from this module?

4. Module implementation

Please indicate to what extent you agree or disagree with each of the following statements in relation to the implementation of the module.

	Strongly disagree	Disagree	Slightly agree	Agree	Strongly agree
The facilitator respected my experience	☐	☐	☐	☐	☐
The facilitator encouraged my participation	☐	☐	☐	☐	☐
I was able to ask the facilitator questions	☐	☐	☐	☐	☐
The facilitator was able to answer my questions	☐	☐	☐	☐	☐
The feedback I received was clear	☐	☐	☐	☐	☐
The feedback I received will assist me in my future performance	☐	☐	☐	☐	☐
There was adequate time for the skills stations	☐	☐	☐	☐	☐
There was adequate time for the facilitated discussions	☐	☐	☐	☐	☐
There was adequate time for the simulations	☐	☐	☐	☐	☐
I have increased my confidence in performing a 12-lead ECG	☐	☐	☐	☐	☐
I have identified future learning needs in this topic area	☐	☐	☐	☐	☐

5. Future module implementation

Do you think the module should be altered in any way? ☐ yes ☐ no

If yes, what recommendations do you have?

Thank you

PowerPoint presentation

1.

Clinical Skills in Hospitals Project

Electrocardiogram
MODULE 1
'Basic ECG Recording'

StV

A Victorian Government initiative

Victoria

2.

Module Outline

- Facilitated discussion
- Skills stations
  - ECG recording
  - ECG interpretation
- Summation
- Evaluation

3.

The Normal ECG

- Electrophysiology
- ECG waves and complexes
- ECG recording
- Checking the ECG
- Common problems

Appendix 1: Skill station Group B

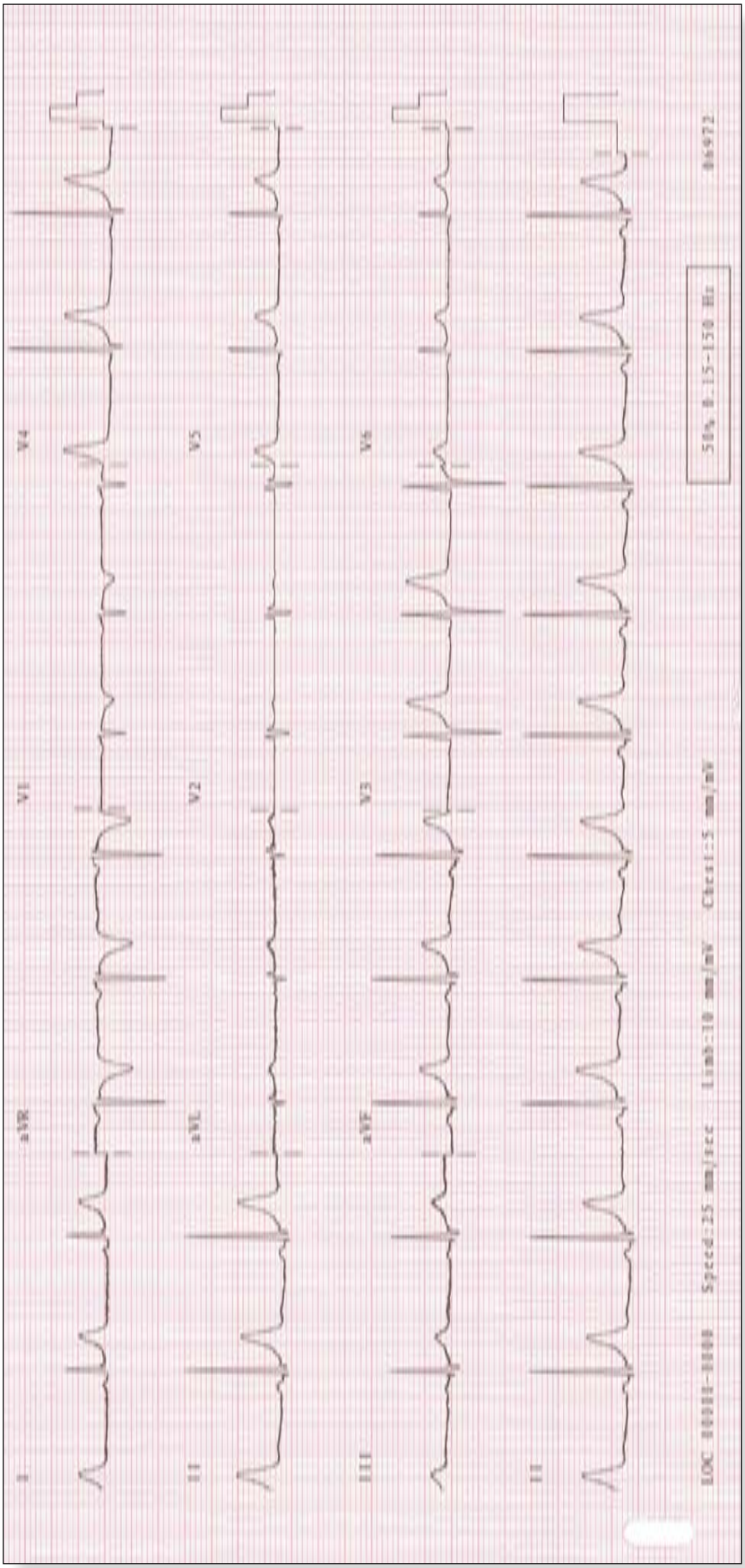


Figure 11: 12-lead ECG 1

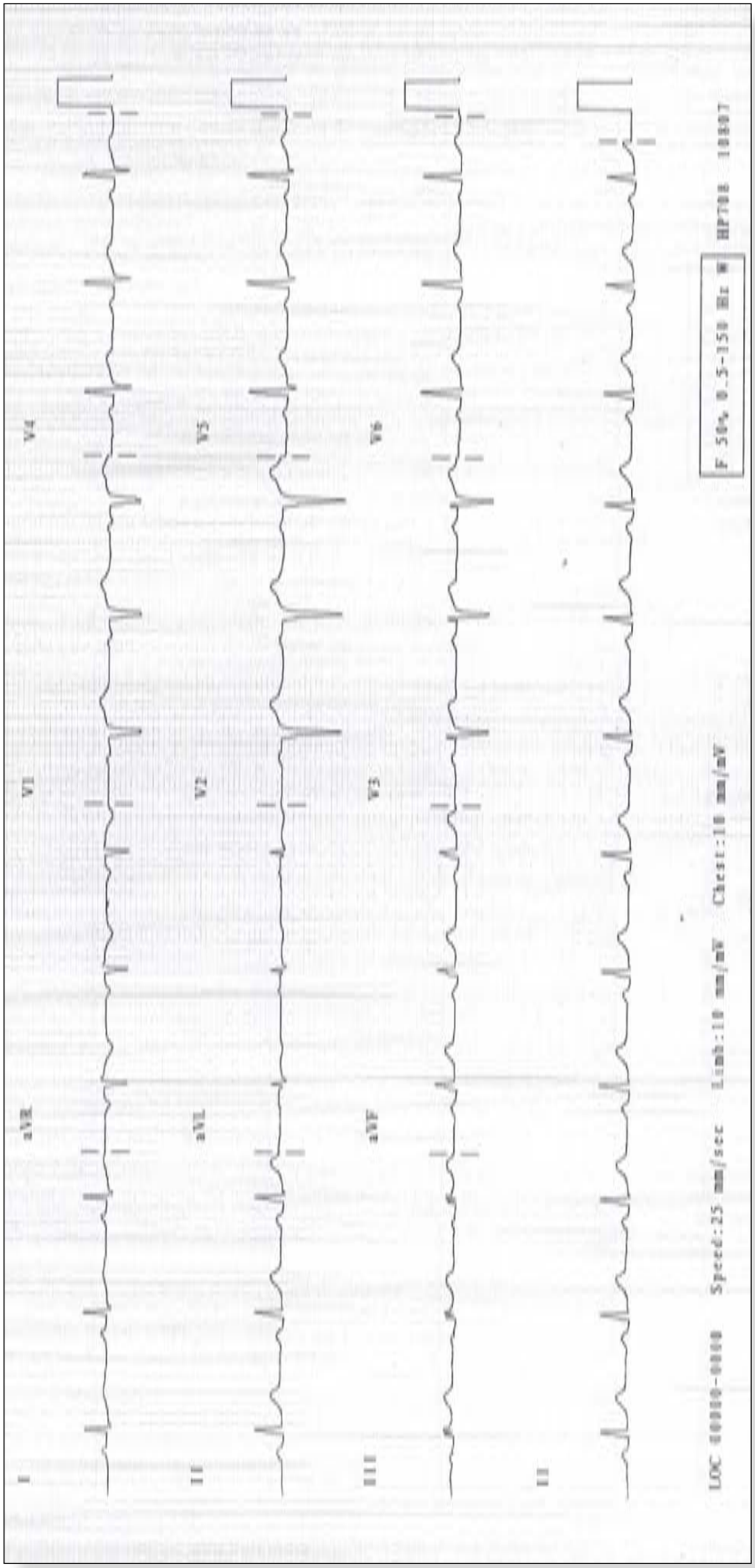


Figure 12: 12-lead ECG 2

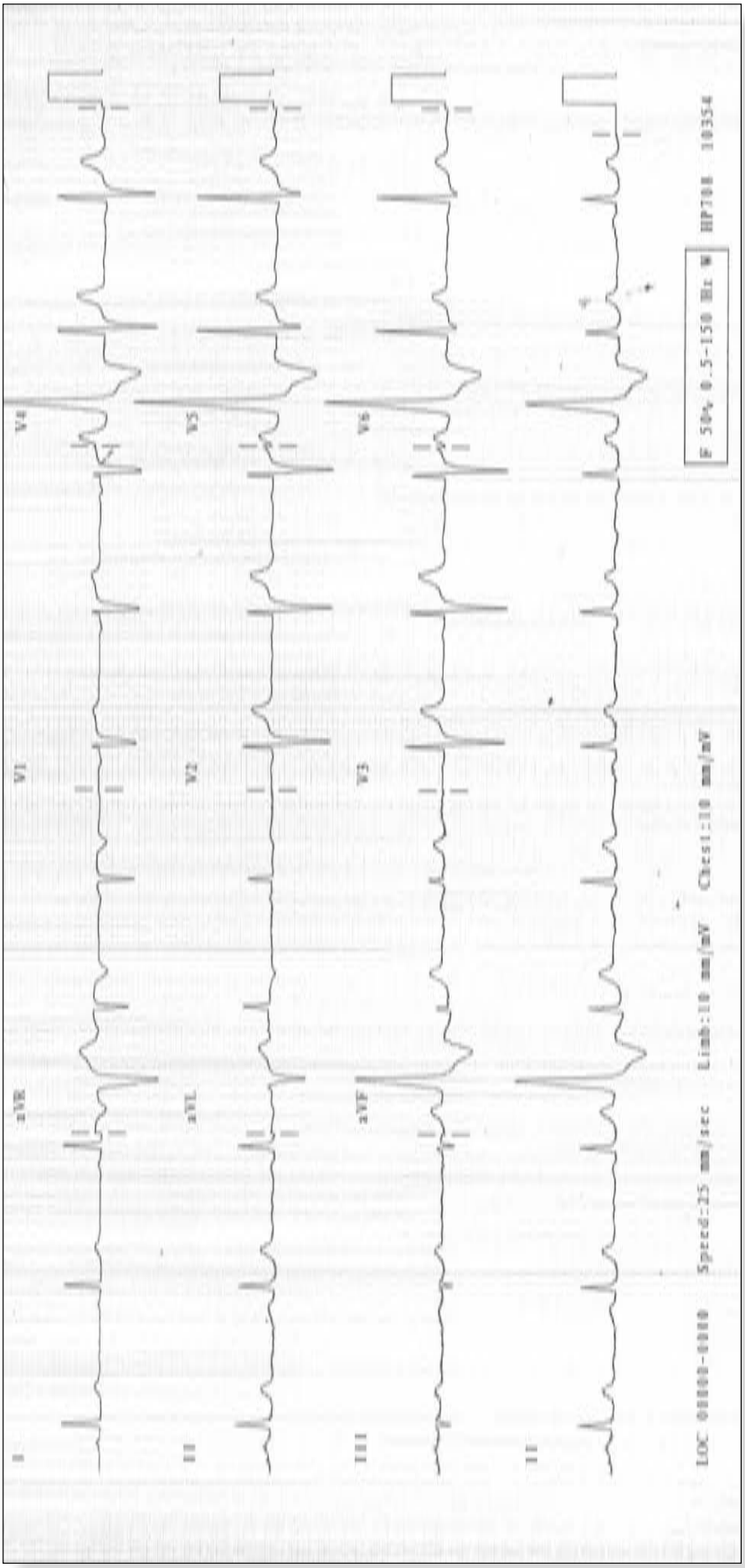


Figure 13: 12-lead ECG 3—filed as that of a 35-year-old woman admitted 27 May

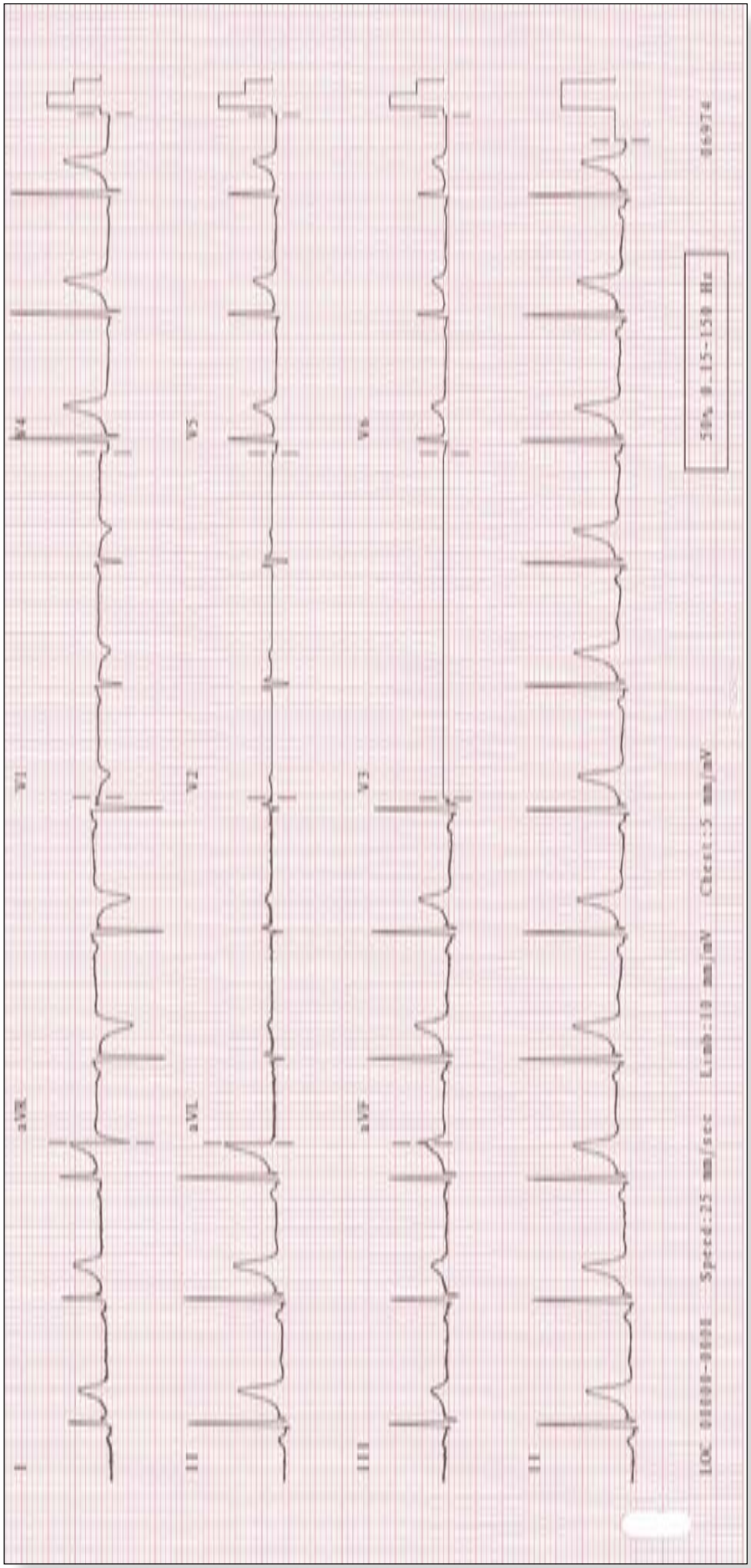


Figure 14: 12-lead ECG 4

Figure 15: 12-lead ECG 5

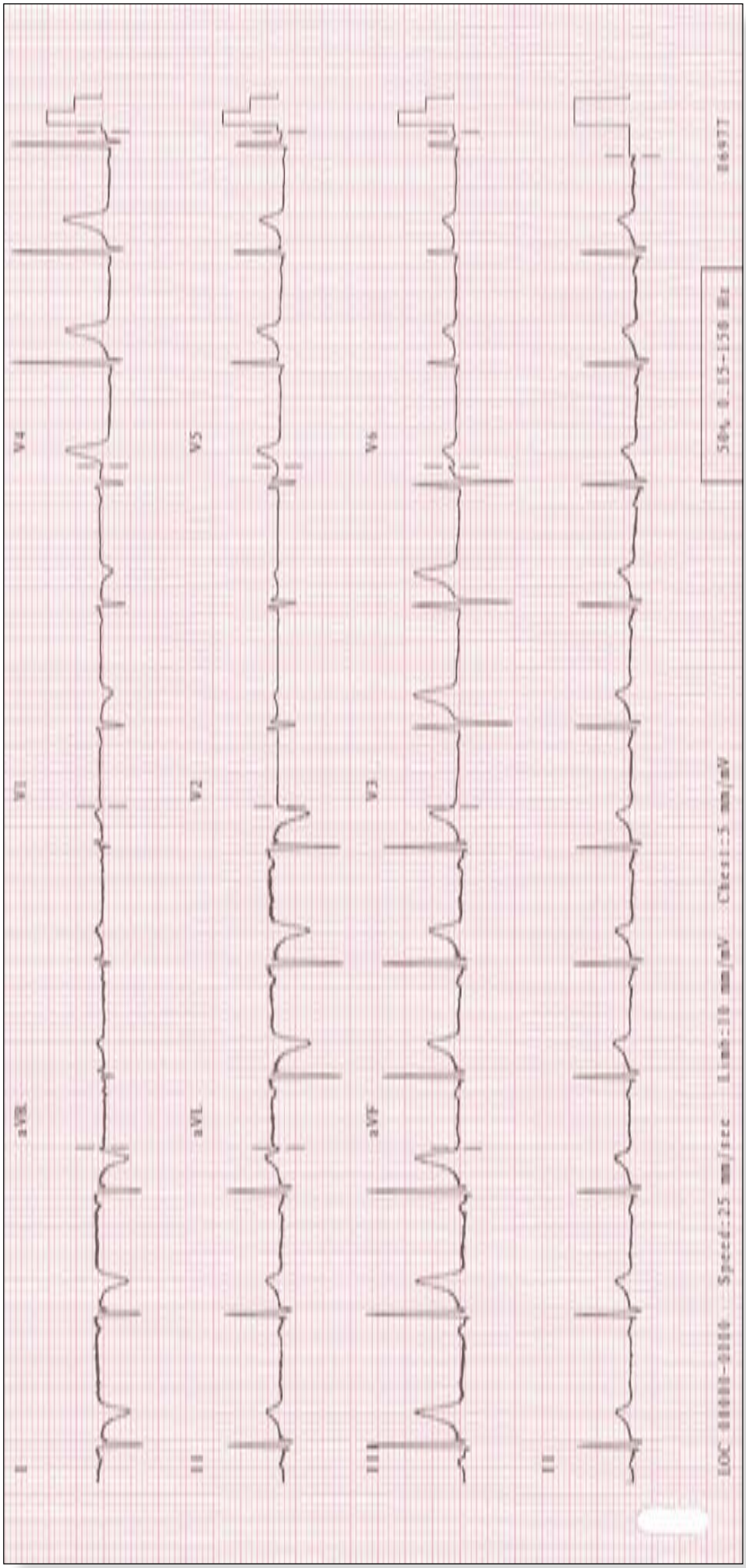


Figure 16: 12-lead ECG 6

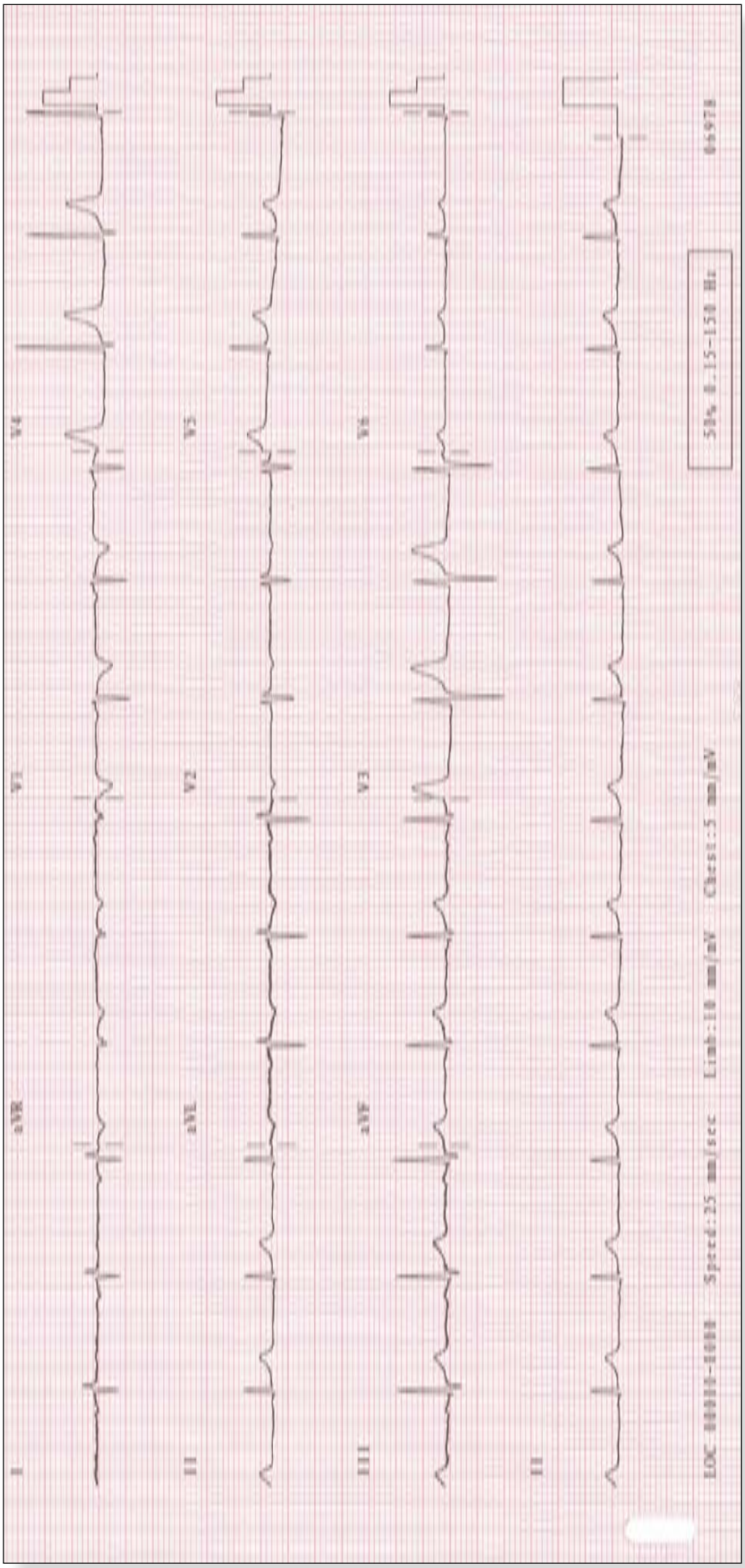


Figure 17: 12-lead ECG 7

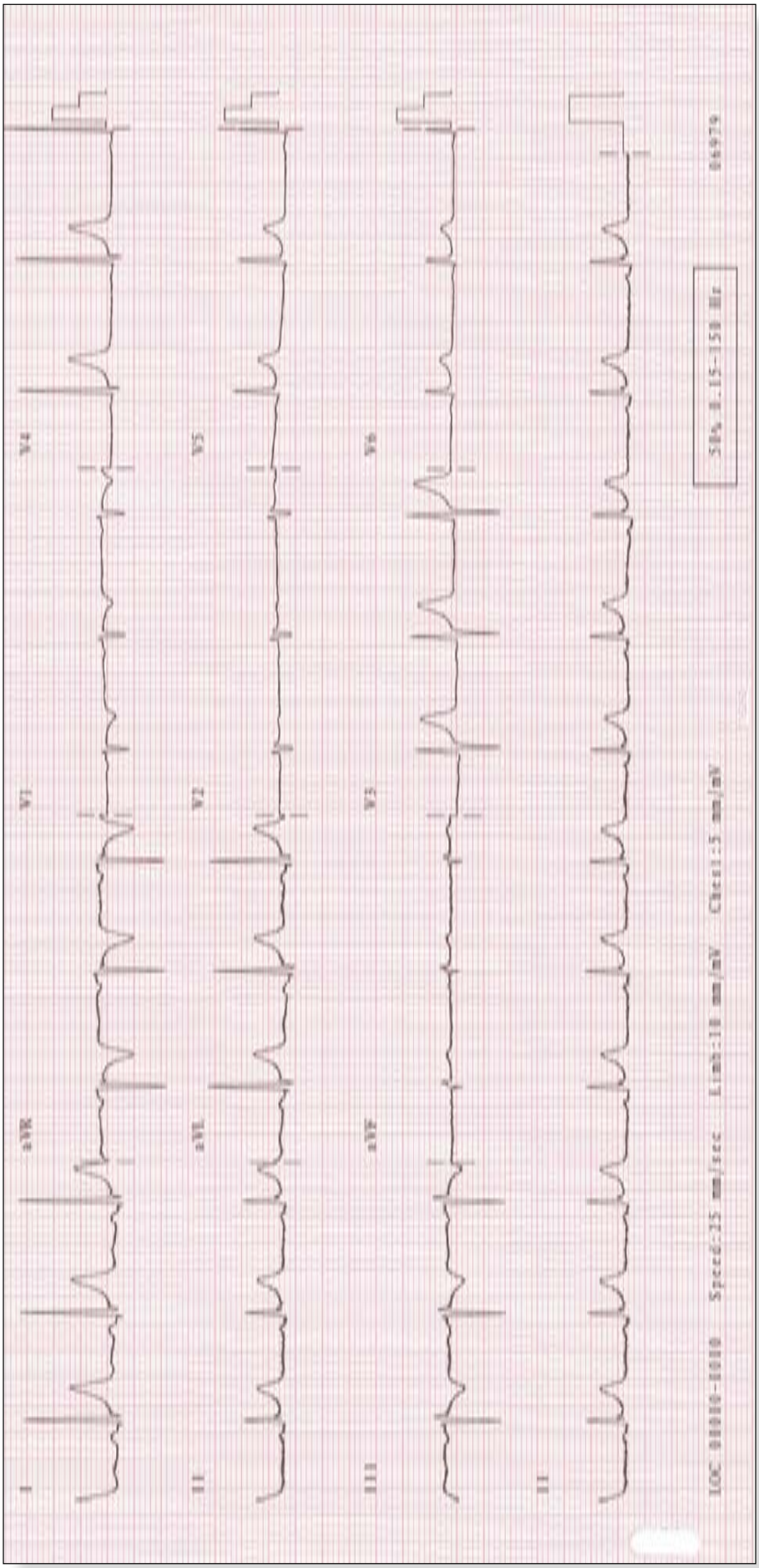


Figure 18: 12-lead ECG 8

Figure 19: 12-lead ECG 9