SOP

HOW TO USE ECG MACHINE

Department of Physiology
Faculty of Medicine, UWUSL

Standard Operating Procedure (SOP) for Electrocardiography (ECG) Recording Using ECG Machine

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1. Purpose

This SOP describes the standard procedure for undergraduate physiology practical demonstrations using the EDAN SE-301 Electrocardiograph. The SOP ensures safe, accurate, and consistent ECG recording during physiology practical sessions.

2. Principle of ECG Measurement

The ECG machine records the electrical activity of the heart through electrodes placed on the body surface. Electrical impulses generated during cardiac depolarization and repolarization are detected, amplified, processed, and displayed as waveforms.

The EDAN SE-301 acquires 12-lead ECG signals simultaneously and records them using a thermal printer.

3. Scope

This SOP applies to ECG demonstrations and practical sessions conducted in the Physiology Skills Laboratory of the Department of Physiology.

4. Responsibilities

- Demonstrators are responsible for correct machine operation, student supervision, patient safety, and maintenance.
- Students must follow instructions carefully and handle equipment appropriately under supervision.
- Technical staff are responsible for maintenance and troubleshooting support.

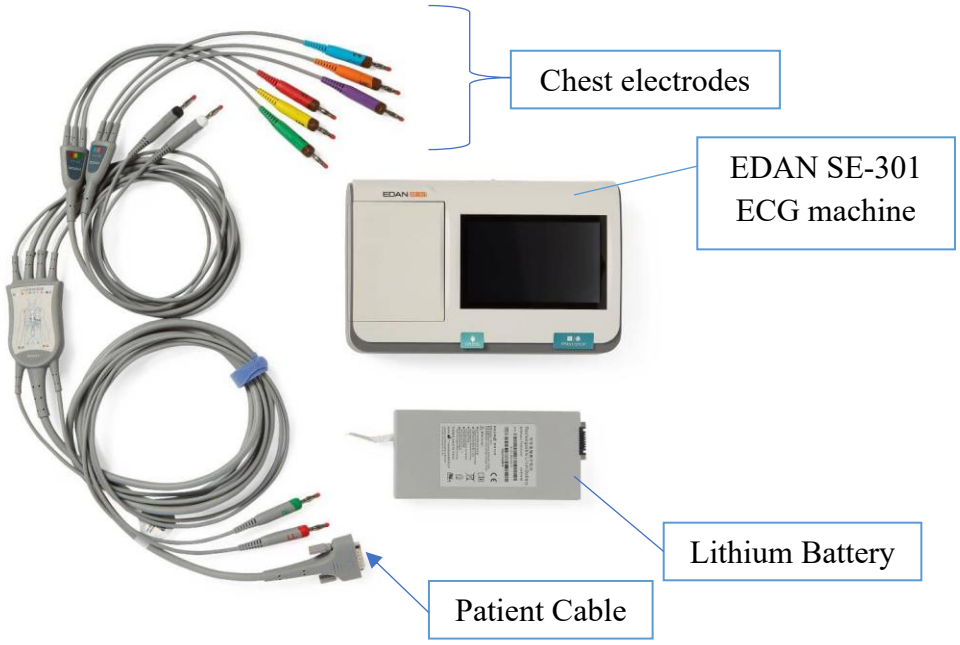
5. Definitions

- **ECG (Electrocardiogram):** Recording of the electrical activity of the heart.
- **Lead:** A view of cardiac electrical activity obtained using specific electrode placements.
- **Artifact:** Unwanted interference or distortion in ECG recordings.
- **Standard 12-lead ECG:** ECG obtained from limb and chest electrodes.

6. Safety Precautions

- Only trained personnel should operate the ECG machine.
- Ensure all electrodes are correctly attached before recording.
- Do not use damaged cables or electrodes.
- Keep liquids away from the equipment.
- Avoid use near strong electromagnetic sources.
- The machine is not MRI compatible.
- Disposable electrodes must not be reused.
- Ensure the patient is comfortable and relaxed before recording.

7. Equipment and Materials



- Limb and chest electrodes

Limb Electrodes

Chest Electrodes

- Disposable electrodes (if used)
- ECG paper
- Alcohol swabs or 75% alcohol
- Conductive gel

- Tissue or gauze

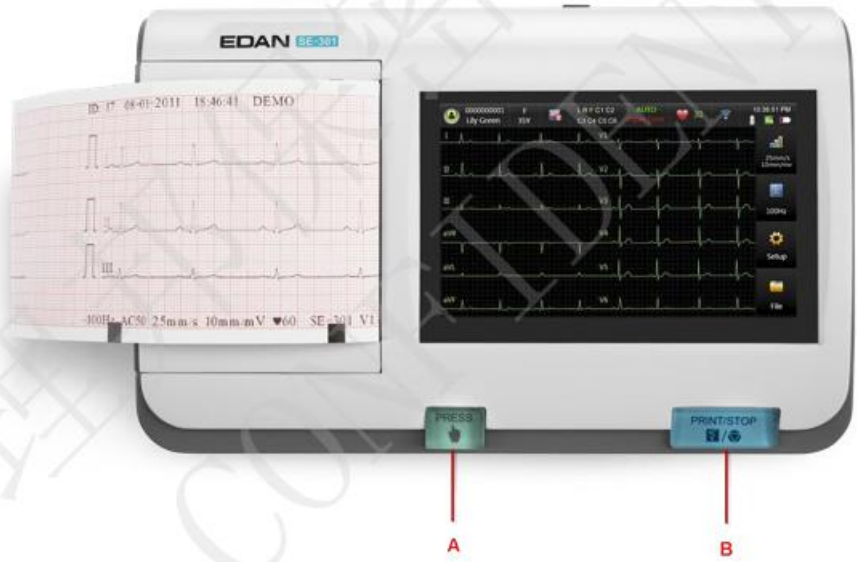


Figure 2-1 SE-301

No.	Description
A	Press to release the recorder casing
B	Press to start/stop ECG sampling

No.	Description
A	Patient cable socket
B	Power key (Long press: switch on/off; short press: sleep mode) Color when using the mains supply: Green Color when using built-in battery: Blue Color when recharging: Orange

No.	Description	No.	Description
A	USB socket	D	Equipotential grounding
B	Net port	E	SD card slot
C	Power adapter port	-	-

8. Environmental Conditions

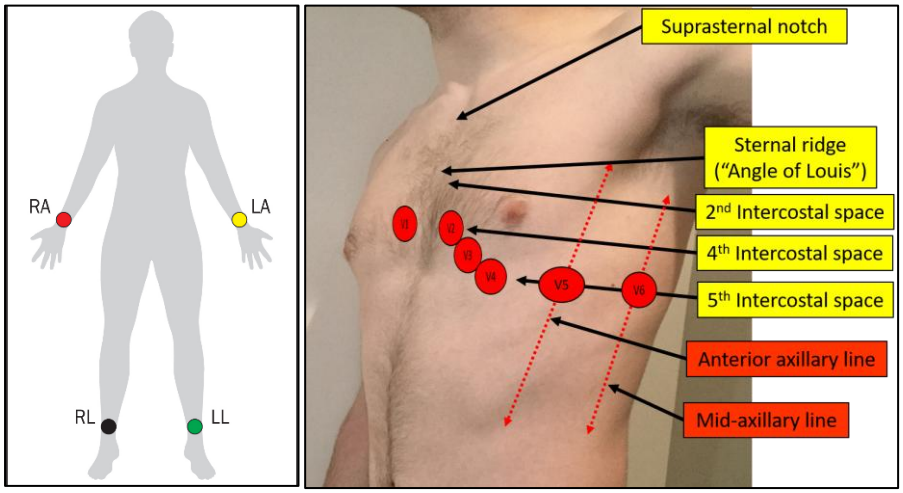
- Operating temperature: 5°C – 40°C
- Relative humidity: 15% – 95% non-condensing
- Avoid electromagnetic interference from nearby equipment.
- Keep the room warm and quiet to minimize muscle artifacts.

9. Patient Preparation

- Explain the procedure to the subject.
- Ensure privacy and comfort.

- Ask the subject to relax and remain still.
- Remove excessive hair if necessary.
- Clean electrode sites with alcohol and dry thoroughly.
- Minimize movement and talking during recording.

10. Electrode Placement



Limb Electrodes

- RA – Right arm
- LA – Left arm
- RL – Right leg
- LL – Left leg

Chest Electrodes

- V1 – Fourth intercostal space at right sternal border
- V2 – Fourth intercostal space at left sternal border
- V3 – Between V2 and V4
- V4 – Fifth intercostal space at left midclavicular line
- V5 – Left anterior axillary line at level of V4
- V6 – Left midaxillary line at level of V4

11. ECG Recording Settings

The following standard settings should be used unless otherwise instructed:

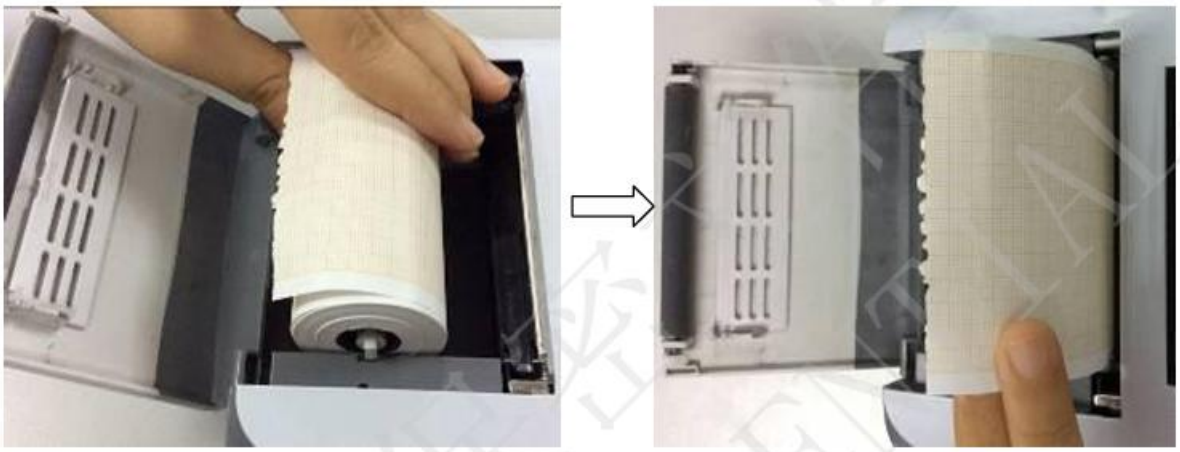
- Paper speed: 25 mm/s
- Gain (sensitivity): 10 mm/mV
- Filter settings: Standard diagnostic mode
- Recording mode: Automatic 12-lead ECG
- Frequency response: As specified by manufacturer settings
- 1 small square = 0.04 s
- 1 large square = 0.2 s

Calibration:

- Standard calibration signal should produce a 10 mm deflection for 1 mV input.
- Verify calibration before recording if waveform size appears abnormal.

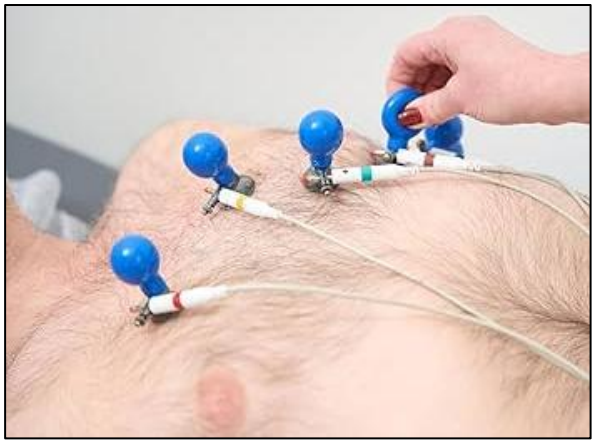
12. Procedure

1. Inspect the ECG machine, cables, electrodes, and paper.



Loading/Replacing Process of Rolled Thermal Paper

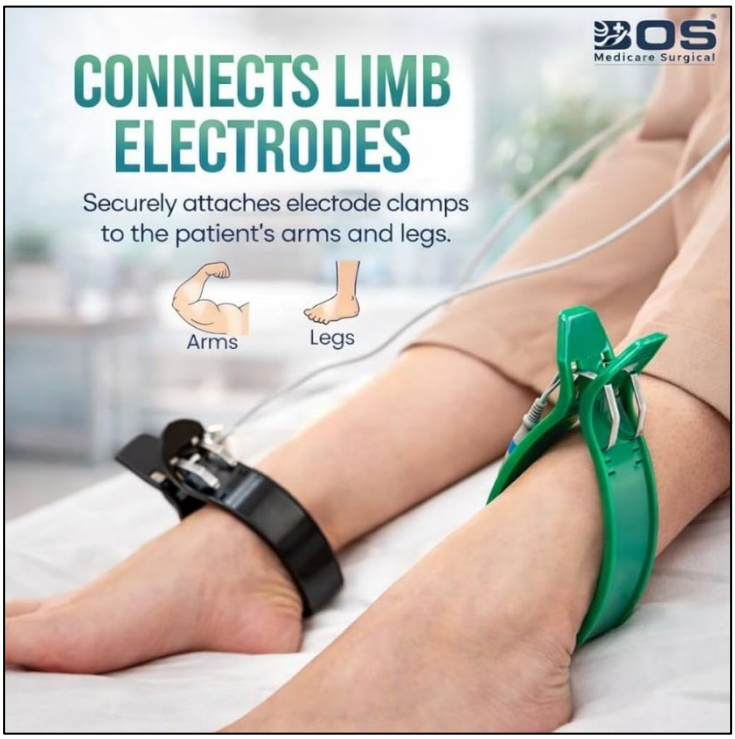
2. Connect the patient cable securely.
3. Prepare the subject and attach electrodes correctly.
    - Chest Electrode Connection:



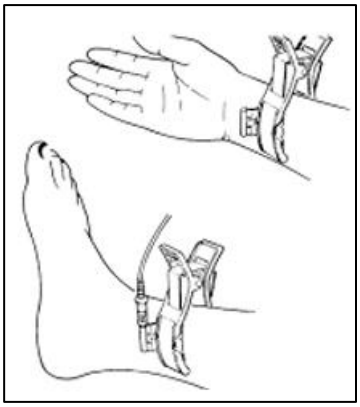
1. Ensure that the electrodes are clean.
2. Align all lead wires of the patient cable to avoid twisting, and connect the lead wires to the corresponding electrodes according to the colors and identifiers.
3. Clean the electrode area on the chest surface with 75% alcohol.
4. Daub the round area of 25mm in diameter on each electrode site with gel evenly.

5. Place a small amount of gel on the brim of chest electrode's metal cup.
6. Place the electrode on the chest electrode site and squeeze the suction bulb. Unclench it and the electrode is adsorbed on the chest.
7. Attach all chest electrodes in the same way. Switch on the ECG machine.

- Limb Electrode Connection:



1. Ensure that the electrodes are clean.
2. Align all lead wires of the patient cable to avoid twisting, and connect the lead wires to the corresponding electrodes according to the colors and identifiers.
3. Clean the electrode area which is a short distance above the ankle or the wrist with alcohol.
4. Daub the electrode area on the limb with gel evenly.
5. Place a small amount of gel on the metal part of the limb electrode clamp.
6. Connect the electrode to the limb, and make sure that the metal part is placed on the electrode area above the ankle or the wrist.
7. Attach all limb electrodes in the same way.



4. Enter patient information if required.
5. Ensure all leads are connected without artifact.
6. Select the desired recording mode.
7. Press PRINT/STOP to begin ECG recording.
8. Observe the ECG tracing for quality.
9. Print and save the ECG recording.
10. Remove electrodes after completion.
11. Clean reusable electrodes and accessories.

13. Quality Control and Assurance

- Verify correct electrode placement before each recording.
- Ensure ECG paper is loaded properly.
- Inspect cables regularly for damage.
- Repeat recordings if excessive artifact is present.
- Maintain proper cleaning and disinfection procedures.
- Perform maintenance checks periodically according to manufacturer recommendations.

14. Common Artifacts and Interference

- Muscle tremor artifact – caused by movement or shivering
- Baseline drift – caused by poor electrode contact or respiration
- AC interference – caused by electrical equipment nearby
- Loose electrode artifact – caused by poor attachment

To minimize artifacts

- Ensure proper skin preparation

- Keep the patient relaxed
- Reduce nearby electrical interference
- Check cable connections

15. Reference ECG Parameters

- Heart Rate: 60–100 bpm
- PR Interval: 0.12–0.20 s
- QRS Duration: 0.08–0.10 s
- QT Interval: 0.40–0.43 s
- ❖ QTc (corrected QT) is the QT interval at a standard heart rate of 60 bpm, which allows comparison of QT values over time at different heart rates and improves detection of patients at increased risk of arrhythmias.
  Bazett Formula for calculating QTc = QT/√RR
  QTc prolonged if;
  - > 440 ms in men
  - > 460 ms in women

  QTc short if;
  - < 350 ms
- ST Interval: 0.32 s on average

Normal ECG interpretation should always consider clinical context. Refer the practical guideline and lecture notes for interpretation of ECGs.

16. Cleaning and Disinfection

- Switch off the machine before cleaning.
- Clean the main unit using a soft cloth with approved disinfectant.
- Clean reusable electrodes after each use.
- Do not immerse cables or equipment in liquid.
- Allow accessories to air dry completely before reuse.
- Use 70% isopropanol or 75% ethanol where appropriate.

17. Troubleshooting

Problem	Cause	Action
Lead Off	Loose or detached electrodes	Reattach electrodes and check connections
Excessive artifact	Poor skin preparation or movement	Reclean skin and instruct patient to remain still
Paper error	Incorrect paper loading	Reload ECG paper correctly
Weak battery	Low battery charge	Recharge battery

18. Maintenance

- Inspect equipment regularly.
- Store the ECG machine in a clean, dry environment.
- Recharge battery as required.
- Replace damaged accessories immediately.
- Maintenance checks should be performed by qualified personnel.

19. References

- EDAN SE-301 Electrocardiograph User Manual
- Ganong's Review of Medical Physiology 24th Edition
- Life in the Fast Lane (www.litfl.com)

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