Indigenous Device for Intra-atrial ECG-Guided Central Venous Catheter Placement

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INTRODUCTION

Central venous catheters (CVCs) are frequently inserted in the operating room or the intensive care unit (ICU) for fluid management and haemodynamic monitoring. There are two main concerns during central venous catheterization. One is to locate and cannulate the vein rapidly and safely, avoiding accidental arterial puncture and acute pleuro-pulmonary complications (such as pneumothorax). Another is correct positioning of the catheter tip. Accurate placement of the catheter tip is not easy, and malpositions are a frequent complication of central venous cannulation. The ultrasound-guided CVC insertion provide visualization of vein and its anatomical variations, improves the success rate and decrease the number of venipuncture attempts and complications associated with it but does not guide the subsequent correct positioning of catheter tip. Different methods have been advocated for guidance of correct positioning of the catheter tip because incorrect CVC position can be associated with serious adverse effects like cardiac tamponade, malignant arrhythmias, placement in coronary sinus and tricuspid valve. The accurate length of the catheter to be inserted, can be estimated by anatomical landmarks or by ready-to-use algorithms, radiological methods (intraoperative fluoroscopy or postoperative chest radiography), electrocardiographic (ECG) methods, echocardiographic methods (standard or transoesophageal echocardiography).

Intra-atrial ECG (IAECG) guidance is a simple, inexpensive, and safe method which can be used for this purpose. Although ECG guidance for CVC positioning was suggested in 1949 with several studies indicating the usefulness of the technique, this is not widely used. It could be due to the non availability of the device used for IAECG monitoring. This is an electrical switching device for alternating between the skin lead and intra-atrial lead.

Here, we are reporting an indigenous device for the IAECG which can be used in place of the devices supplied by the various manufacturers, like Certodyn Universal Adaptor (B Braun Melsungen, Germany) or Tyco/Arbo VIDM-P73 complete cable.

MATERIALS AND METHODS

The components required for the device are as follows:
1. Band switch: Used in radio for changing band FM/AM
2. Two small crocodile clips
3. Male plug (single pin connector) which fits snugly to the ECG cable connector
4. Cable for connection
5. A small plastic box to fix the components
6. Cable with crocodile clip at one end and pin at the other end (it comes with central line) (Certofix B Braun Melsungen, Germany).

METHODS

Components are arranged and soldered as shown in the line diagram (Fig. 1). Fix this assembly in a small plastic box. The device is ready for use (Fig. 2). There are two cables coming out of this box. One cable has red coloured crocodile clip which will be connected to right arm electrode, other clip will be connected to the right arm lead of monitor. The ECG cable which comes with central line kit (Certofix Duo, Certofix Trio B Braun Melsungen, Germany) is fitted snugly into the socket of the device. The other end of the ECG cable is attached to the guidewire of the central line through clip (Fig. 3). The band switch is used to change ECG from surface electrode to IAECG.

DIRECTIONS FOR USE

The CVC is inserted using the selnder technique, according to hospital protocol. The catheter is mounted over
guidewire such that the ‘J’ tip of guidewire just protrude out of the distal tip of catheter. By turning the switch toward ECG plug, IAECG could be recorded. The catheter is advanced with simultaneous monitoring of the ECG in the monitor (lead II). A gradual increase in the amplitude of the P wave is noted as catheter with guidewire is advanced and P wave equals almost R wave as it approaches close to SA node. Now, the catheter is withdrawn till the P wave reverts back to its normal size indicating correct placement (Figs 4A to D).

Good quality ECG and clear display of the P wave on the ECG monitor are essential for successful guidance and positioning of CVCs.

DISCUSSION

Traditionally, chest X-ray (CRX) has been used as a gold standard method for confirmation of CVC tip positioning, but there are some studies coming in which role of CRX for confirmation of CVC tip has been questioned.\textsuperscript{10} There are various other methods also for confirmation of CVC tip placement like and echocardiography, transoesophageal echocardiography (TOE), but the non availability and the inexperience of the anaesthesiologists for the above resources in the operating room demands an alternate feasible method for the guidance of correct placement of the CVCs. ECG-guided CVC placement is an easy method which can be used during blind insertion, once the guidewire goes beyond the junction of the SVC and the right atrium, ECG shows prominent P wave as it approaches to the SA node. There are studies which suggest that it is safe to omit routine CRX after uncomplicated insertion of CVC through the right IJV\textsuperscript{11} and a survey of anaesthetists in the UK revealed that nearly half of the respondents did not order CRXs after CVC insertion unless specifically indicated.\textsuperscript{12} ASPEN guidelines for parenteral and enteral nutrition\textsuperscript{13} also recommend that routine CRX is not required for uncomplicated CVC insertions, it is indicated only when
there is a suspicion of some pleuropulmonary complication or other methods for confirmation of tip are not used. Adjusting the depth of the CVC postoperatively on the basis of the CRX can be a cumbersome procedure and has the potential to become a source of infection, especially when the catheter needs to be advanced. This is a small handy device which makes the correct placement of the CVCs a switch away.

**ADVANTAGES**
1. Easy to make and use (reusable)
2. Handy
3. Cost-effective
4. Reliable
5. Compatible with any standard monitor
6. Helps to identify correct position during procedure and avoiding repositioning later on.
7. Helps to avoid intraatrial insertion thus decreasing the incidence of life-threatening arrhythmias and cardiac tamponade.
8. Can avoid unnecessary exposure to radiation in non-complicated insertions.
9. ECG-guided CVCs positioning may also have the potential to save resources.

**LIMITATION**
It cannot be used in patients with atrial fibrillation and supraventricular arrhythmias or pacemaker driven rhythm.

**REFERENCES**

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