TARGET AUDIENCE
Junior Medical Staff in ICU
Critical Care Trained ICU Nurses

PURPOSE
This document is intended as a basic guide to managing patients in ICU who require insertion of Temporary Trans-venous Cardiac Pacing (TVP).

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1. INDICATIONS

Temporary TVP is instigated as an emergency intervention used primarily to correct profound bradycardia with associated haemodynamic compromise unresponsive to transcutaneous pacing or drug therapy. Temporary TVP involves stimulation of the endocardial surface of the right ventricular apex using an electrode tipped catheter which is passed via a large central vein sheath or pacing port of a Pulmonary Artery Catheter (PAC). Temporary TVP can be used as a bridge to permanent pacemaker insertion.

2. COMPLICATIONS
   - During insertion
     o Pneumothorax / haemothorax and other complications associated with introducer sheath insertion
     o Ventricular tachy-arrhythmias
     o Perforation of the right ventricular free wall with cardiac tamponade
   - During Use
     o Dislodgement of catheter
     o Perforation of right ventricular free wall with cardiac tamponade
     o Complications associated with introducer sheath

3. CHOICE OF TVP CATHETERS AVAILABLE
   - Two types of TVP catheter & insertion kit are available. These are located in the Emergency TVP Box outside ward clerk desk in Cardiac Pod
     o Edwards L: Swan-Ganz Bipolar Catheter D97120F5 with Edwards: Introflex Perc Sheath Introducer Set 1301F6
Emergency Insertion of Temporary Trans-venous Pacing Catheter in ICU

Bipolar PACING CATHETER (plus balloon) equipment required for insertion via SVC

1. A 6 french percutaneous sheath

2. The Bipolar Pacing Catheter

3. Bridging cables and a pacing box

OR

- Edwards: Thermodilution Paceport Catheter 931HF75 and Edwards: Chandler Transluminal V Pacing Probe D98100H with Arrow:MAC two Lumen Central Venous Access Kit CA 11142A

PACEPORT SWANGANZ CATHETER Equipment required for insertion

1. At least an 8 french percutaneous sheath or MAC line

2. The Thermodilution Paceport Catheter

3. The Chandler Transluminal V-Pacing Probe

4. Bridging cables and a pacing box

*a primed pressure transducer* attached to monitoring will be required to float the Pacing Catheter into the correct position – confirmed by presence of a PA trace.
4. INSERTION OF TVP CATHETER

A temporary TVP catheter should only be inserted by the consultant or an experienced senior registrar.

Sites of insertion (In order of preference)
- Right internal jugular (due to ease of positioning straight into the Right Ventricle)
- Left subclavian vein
- Left jugular vein
- Right subclavian vein
- Femoral vein
- Brachial Vein

Commonly in ICU, balloon tipped or floating (flow directional) TVP catheters are inserted ‘blindly’ using electrocardiographic (ECG) guidance to provide evidence of ventricular capture.

If required, intensive imaging to guide the insertion of the TVP catheter is possible. Alternatively, those who are proficient in critical care ultrasound may use echocardiography to guide the insertion.

4.1 EQUIPMENT
- Sonosite point of care ultrasound machine for vessel identification and ultrasound guided insertion of introducer sheath
- Standard Pack used for CVC insertion
- Central Venous Line insertion trolley
- Local anaesthetic
- Pulse generator & spare battery
- Bridging cables (sterile preferably)
- Occlusive dressing
- Secondary anchor dressing
- Two transducer sets and other equipments necessary for transducing if Pacing Swan is used.

4.2 PATIENT PREPARATION

This is often an emergency procedure. Often the patients will be on temporary transcutaneous pacing at the time of commencement of temporary TVP. Ensure that the Airway and Breathing are stabilised. Check that the patient has proper venous access. Check that defibrillator is connected to the patient and ready for use as ventricular tachyarrhythmias may be precipitated by the procedure. Also, check that emergency cart and emergency medications are available and ready to use.

Ensure that patient is connected to the bedside monitoring system and vital signs and ECG are monitored continuously throughout the procedure.

If the patient is conscious explain the procedure in plain language and obtain informed consent.
Position the patient appropriately for the introducer sheath insertion as per the PAC guideline.

4.3 INSERTION PROCEDURE FOR THE BIPOLAR CATHETER:

4.3.1 Insertion of introducer sheath

- Prepare the preferred site and insert the introducer sheath as per the PAC guideline using all aseptic precautions.

4.3.2 Preparing the pulse generator

- Ensure that the battery is fresh and backup battery is attached
- Wearing rubber gloves, attach the electrodes to the bridging cable
- Do not connect pulse generator to bridging cable yet.
- Turn the pulse generator on
- Set the rate according to the physiological needs of the patient (usually set at 80/min)
- Set the milliamperage to 15-20 mA
- Set the sensitivity to 1-2 mV

4.3.3 Insertion of pacing catheter

- Check the balloon-tipped pacing catheter by inflating the balloon to ensure that the balloon is working
- **Plastic protective sheath should be inserted** properly over the pacing catheter at this stage.
- Insert the balloon-tipped catheter through the introducer and advance the pacing lead
- Inflate the balloon when the catheter is inserted approximately 30 cm
- Insert the bridging cable to the ventricular socket on the pulse generator
- Monitor surface ECG as pacing electrode is advanced for appropriate sign of Ventricular capture. This is usually obtained at approximately 40cm.
- Once capture is obtained balloon is deflated and the catheter is advanced a further 1-2 cm.
- Assess rhythm for appropriate pacemaker function.
  - **Capture**: is there a widened QRS complex for every ventricular pacing artefact (spike)?
  - **Rate**: is the monitored rate at the pacemaker set rate?
  - **Sensing**: does the sensitivity light flash green to indicate that every QRS complex is paced
- Secure the catheters and all connections and place the pulse generator in a safe and visible location
- Using the plastic protective sheath cover the external portion of the pacing catheter and lock the protective sheath into the adapter on the introducer sheath
- Document length of pacing catheter on ICU chart
- Perform 12 lead ECG to confirm correct pacing
- Perform Chest X-Ray to confirm electrode position and rule out any complications of introducer sheath insertion.
4.4. INSERTION OF THE PACEPORT SWAN GANZ CATHETER:

4.4.1 Insertion of introducer sheath

Follow the PAC protocol for the insertion of introducer sheath

4.4.2 Preparing the Pulse Generator

Prepare the pulse generator as above

4.4.3 Insertion of pacing catheter

- Pulmonary artery catheter prepared as per PAC protocol except transducers are attached to the distal lumen and the RV lumen (Orange lumen).
- The PAC is introduced to approximately 30 cm- RA waveform on the distal lumen transducer on the monitor is observed before floating the Swan.
- The balloon is then inflated and the catheter is then advanced as for PAC protocol until RV trace is observed on the RV lumen transducer. This implies that the RV port has just passed Tricuspid valve and is in RV. Once this appears, the catheter is usually advanced further 1-2 cm distal to tricuspid valve.
- At all times the distal lumen trace for PAP waveform is observed on the monitor and advancing of catheter is stopped if PCWP trace appears on the screen.
- Transducer on RV lumen is then disconnected and the Chandler probe is attached.
- The Chandler Probe is advanced until the black mark on the probe is on the zero marking of the RV lumen - the tip of the probe will now be flush with the opening in the RV lumen.
- The Chandler probe is now connected to the ventricular port of the pacing box using the bridging cable.
- Monitor surface ECG as the Chandler probe is pushed 4 -5 cm further on until capture occurs.
- Secure the catheters and all connections and place the pulse generator in a safe and visible location.
- Using the plastic protective sheath cover the external portion of the pacing catheter and lock the protective sheath into the adapter on the introducer sheath.
- A flush system is attached to the sidearm of the RV line.
- Document length of pacing catheter on ICU chart.
- Perform 12 lead ECG to confirm correct pacing.
- Perform Chest X-Ray to confirm catheter position and rule out any complications of introducer sheath insertion.

4.4.4 POST PROCEDURE

- Once the pacing has been established and the patient is haemodynamically stable perform threshold testing (see appendix one).

5. NURSING CONSIDERATIONS

- Continuous cardiac monitoring and documentation of vital signs
- Check all pacing connections and ensure that they are secure.
• Perform threshold testing *(As per Appendix one)* once per shift/PRN
• Monitor insertion site for haemorrhage/haematoma, infection and ensure dressing is secure
• Document pacing catheter length each shift and ensure secondary anchor dressing intact
• If it is a Paceport Swan, then the distance PAC is inserted should be recorded.
• Daily CXR to check position of pacing catheter
• Ensure spare battery is attached to the pulse generator
• Ensure that a spare pulse generator is always available in ICU in case of pulse generator failure.
• Microshocks transmitted through the TVP catheter may result in life threatening arrhythmias. The following precautions should be implemented to reduce this risk:
  o Cover exposed TVP catheter with a dry dressing as wet surfaces conduct current more readily
  o Apply rubber gloves when handling a TVP catheter

6. REMOVAL OF TVP CATHETER

Before a temporary TVP catheter is removed, pacing should no longer be required. A gradual reduction in base rate or back up pacing in DEMAND mode should occur before the decision is made to remove the TVP catheter. *If a Permanent Pacemaker (PPM) is to be inserted* removal of the temporary TVP catheter will occur at the time of insertion PPM.

6.1 PREPARATION

• Removal of the TVP catheter is only performed following a medical order from the ICU consultant
• Removal of the TVP is performed by a medical officer or registered nurse who is proficient in this procedure
• Assess the patient for the following prior to removal of the TVP catheter:
  o **Rhythm Stability:**
    - Perform 12 lead ECG to exclude potential arrhythmias
    - Ensure serum electrolytes are within normal range
  o **Anticoagulation Therapy:**
    - Note patient’s coagulation profile
    - DVT prophylaxis should not delay removal of TVP catheter
  o **Time of Removal:**
    - Continuous cardiac monitoring is necessary both during and post procedure to assess for potential arrhythmias secondary to mechanical irritation of the myocardium at the time of removal

6.2 PROCEDURE

• Explain the procedure to the patient and place patient in a supine position
• Ensure pulse generator is turned off, and disconnect from bridging cable
• Ensure that the balloon is deflated
• Don Sterile gown, gloves and adopt aseptic technique
• *If sheath is to remain in-situ*
  o Gently disconnect hub of plastic covering.
If the TVP catheter is in the subclavian or jugular vein ask the patient to take a breath in and hold, then visualising the monitor for arrhythmias slowly but steadily pull out the TVP catheter.
- Place your thumb over the hub post removal to ensure the air valve is functioning properly.
- Once this is established your thumb can be removed safely.
- Wash sheath hub again with 70% Chlorhexidine solution.

- **If the sheath is to be removed**
  - Refer to ICU Central Venous Catheter (CVC) Management Guideline
  - Refer to ICU Pulmonary Artery Catheter (PAC) Guideline

### 6.3 POST PROCEDURE
- Observe and record monitored vital signs
- Document date and time of TVP catheter removal

### 6.4 COMPLICATIONS
- Bleeding at insertion site
- Arrhythmias during removal of TVP catheter
- The TVP catheter may become lodged in internal structures such as the tricuspid valve or chordae tendinae during removal (rare complication, requires immediate surgical intervention)
- Infection due to bacterial colonization at insertion point or TVP catheter tip.
Appendix One

Emergency TRANSVENOUS PACING: A Quick Guide
(For more information, please refer to the Guideline on Intranet)

1. **Pacing indicated**
   - Bradycardia and hypotension
   - If required, initiate temporary transcutaneous pacing while preparing for the insertion of transvenous pacing

2. **Patient preparation**
   - Ensure Airway and Breathing is secured and emergency equipment is ready to use
   - Patient is supine position
   - Monitor ECG, HR and SpO2 continuously

3. **Pacing sets available**
   - Edwards L. Swan Ganz Bipolar Catheter D97120F5 OR
   - Edwards: Thermodilution Paceport Catheter 931HF75 Edwards: Chandler Transluminal V Pacing Probe D981001

4. **Insert Introducer sheath**
   - Use Edwards: Introtex Perc Sheath Introducer Set 1301F6 for Bipolar Catheter D97120F5
   - Use Arrow: Max Two Lumen Central Venous Access Kit CA 11142 A for paceport V Pacing probe. Insert Thermodilution Paceport Catheter 931HF75 through the sheath. Ensure protector sheath is on prior.

5. **Prepare Pulse generator**
   - Insert new battery
   - Adjust settings: 1 Select mode of pacing - VVI (7) turn mA to 10-20 (8) turn Sensitivity (mv) to most sensitive (1.2mV) (9) Turn rate to 80 BPM

6. **Insert Pacing catheter**
   - Ensure protector sheath is on prior to insertion of catheter
   - Connect pacing electrodes to pulse generator
   - Follow section 4.3.3 for bipolar catheter and section 4.4.3 for Paceport Swan Ganz Catheter insertion

7. **Post procedure Care**
   - Sheath, pacing wire & dressing insitu as per CVC Guideline
   - Length of electrode is checked and documented on ICU chart
   - If Patient and pacing has stabilised, proceed to test ventricular thresholds as per Temporary Pacemaker Assessment guideline on ICU.net
Appendix Two

**Temporary Pacemaker Assessment**

Pacemaker assessment is to be performed by CRN or CRN proficient in pacemaker assessment

Ensure pt is in a supine/semi upright position

Ensure continuous ECG and haemodynamic monitoring (ASP or NIBP set to 3 min)

Explain procedure to patient

- Pacemaker cables and connections
- Pacemaker battery
- Note pacemaker settings

Assess for correct pacemaker function

Underlying rhythm
Slowly decrease pacing rate until intrinsic rhythm is identified (Minimum rate 50 bpm)

Obtain rhythm recording

Haemodynamic Status
Assess continuously to ensure MAP >90 mmHg otherwise reset pacemaker to the prescribed rate

Document pacemaker settings and patient’s haemodynamic response

Proceed to test atrial or ventricular thresholds

**Sensitivity**

1. Set sensitivity to MOST sensitive (- - mV)
2. Reduce the output to 0.1 mA
3. Set pacemaker rate 10 beats/min lower than patient’s intrinsic rate
4. Decrease sensitivity (- - mV) until the sense indicator stops flashing and the pace indicator starts flashing
5. Slowly increase sensitivity (+ - mV) until the sense indicator flashes continuously. This is the sensing threshold
6. Set the sensitivity (mV) at half the sensitivity threshold value

**Capture**

1. Turn the pacemaker rate up 10 beats/min higher than patient’s intrinsic rate
2. Increase the output (+ - mA) until depolariation occurs after every pacing spike. The mA setting at which depolariation occurs with every spike is the threshold for capture
3. Set the output (mA) to 2 times the determined threshold +1

- Document pacemaker settings and thresholds
- Reset the pacemaker settings and prescribed rate
- Obtain paced rhythm recording

* If pacing indicator continues to flash = Failure to Sense (refer to troubleshooting guide)

* If pacing spike not followed by a wave or QRS complex = Failure to Capture (refer to troubleshooting guide)
KEY RELATED DOCUMENTS

- The Clinical Care Standards Guideline
- Mutual Obligation for Patient Safety and Quality of Services at Bayside Health
- The ICU Pulmonary Artery Catheter (PAC) Guideline
- Central Venous Catheter (CVC) Management Guideline
- Epicardial Pacing management in ICU

All available on ICU net

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