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CCAT Temporary Transvenous Pacemaker Clinical Practice Guideline

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I. **Goal.** To provide guidance for the management of patients with bradycardia requiring a temporary transvenous pacemaker.

II. **Background.**

- A. Severe bradycardia is rare in-theater, but can occur in association with myocardial infarction. Other causes of bradycardia such as drug toxicity, infiltrative disease, collagen vascular disease, cardiac surgery, endocrinologic abnormalities, and autonomic insufficiency are exceedingly rare in theater.
- B. Many bradycardic episodes are temporary in nature and therefore may not require pacemaker support at all. Discussion with the Theater Cardiology Consultant should be the first step in determining the necessity for pacemaker support.
- C. Placement of a permanent pacemaker requires specialized personnel and equipment, and may not be possible in-theater. In patients requiring pacemaker support, a temporary transvenous pacemaker may be utilized.
- D. Temporary transvenous pacemakers may be placed at the bedside and transported with a portable pulse generator.
- E. When transporting a patient with a temporary pacemaker, familiarity with the basic modes and settings is necessary.
- F. **Transvenous pacemakers may be subject to electromagnetic and mechanical interference during transportation. Special consideration regarding this interference should be taken during transportation of these patients.**

III. **Evaluation and treatment**

- A. Indications: Generally, bradycardia resulting in hemodynamic compromise or impending hemodynamic compromise is an indication for pacemaker support. Common rhythms include sinus arrest, second-degree type 2 heart block, and third-degree (complete) heart block.
- B. History and Physical
 1. Symptoms for bradycardia may be obvious, with dizziness and/or syncope; or more insidious, with fatigue and decreased energy upon exertion.
 2. Physical examination should include cardiac auscultation to evaluate for extra cardiac sounds to suggest congestive heart failure (S3), evaluation for cardiac murmurs, auscultation of the lungs and jugular veins, as well as neurologic examination.
 3. The cause of the above-described symptoms will often become evident on electrocardiogram. A 12-lead ECG with rhythm strip should be obtained.
- C. Electrocardiogram: Look for sinus arrest or heart block with long (>3 second) pauses or slow (<30 bpm) escape rhythm.

IV. **Pacemaker settings:**

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- A. NASPE/BPEG Generic (NBG) Codes: The NBG Code is a five-position coding system used to program permanent and temporary pacemakers, as well as implantable cardioverter defibrillators (Appendix). The first three letters apply to both temporary and permanent pacemakers, while the last two apply only to permanently implanted pacemakers and implantable cardioverter defibrillators.
- B. Basic Mode settings. Common settings for temporary pacing are VVI and VOO.
 - 1. **VVI.** In mode VVI, the ventricle is paced, as well as sensed. If an impulse is sensed by the pulse generator, the extrinsic impulse is not sent, thus the pulse generator is inhibited. This mode is used to prevent possible complications when there is an underlying ventricular rhythm, and is therefore the preferred mode.
 - 2. **VOO.** In mode VOO (asynchronous mode), the ventricle is paced, but there is no sensing and therefore no response to sensing. This mode delivers the set rate of electrical impulses no matter what the underlying ventricular rhythm, and is best used during use of electrocautery (surgery), and during periods of excessive mechanical stimulation.

V. Placement of temporary transvenous pacemaker

- A. A temporary transvenous pacemaker is available from many vendors. It is generally a balloon-tipped catheter that is inserted through a venous sheath. Some temporary pacemakers have active fixation devices to ensure lead stability.
- B. Maintain continuous ECG monitoring during the procedure, as well as backup transcutaneous pacing with pacer pads and a defibrillator.
- C. The venous sheath should be inserted using sterile technique through the right internal jugular vein or the left subclavian vein because these access points provide a natural curve from the insertion site to the right ventricle, and therefore fluoroscopic guidance is usually not required.
- D. If the venous sheath cannot be placed in the above sites, the femoral vein may be used and the pacemaker may be guided using fluoroscopy. This should not be attempted without fluoroscopic guidance.
- E. Ensure the lead is secure by tying down at least two different sites, one proximally at the exit site and another at a loop formed with the lead.
- F. Connect the lead to the pulse generator. The current pulse generator in-theater is the Medtronic 5348 single-chamber pacemaker.

VI. Management of the temporary pacemaker

- A. Setup
 - 1. A new battery should be inserted into the pacemaker device prior to initiation of pacing.
 - 2. Set the rate to maintain hemodynamic stability. A reasonable starting rate is 70-90 beats per minute.
 - 3. Set the output current (1-25 milliamps). Start at 20-25 milliamps and reduce the current until you lose 100% capture (threshold). Set the output current to 3X the threshold. An ideal threshold is ≤ 1 milliamps.
 - 4. If using a sensing mode, set the sensitivity (0.5-20 mA). If an electrical impulse is sensed at or above the set sensitivity level, the generated impulse will be inhibited.
- B. In-hospital management
 - 1. Continuous monitoring is required at all times when the patient has a temporary pacemaker.

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2. Whenever a patient is moved, all connections should be rechecked.
3. Record a 12-lead ECG daily to evaluate the appearance of the QRS complex. Proper lead placement in the right ventricular results in left bundle branch block morphology.
4. Obtain a chest x-ray daily to establish adequate lead placement in the right ventricular apex.
5. Change the dressing at the insertion site daily and apply antibiotic ointment or antimicrobial disc at site to prevent infection.
6. Obtain a 12-lead ECG and chest X-ray prior to CCATT movement to ensure pacemaker position. Be sure there is adequate capture and sensing prior to CCATT movement. It is much easier to troubleshoot the pacemaker prior to leaving the hospital than it is during transportation.

C. Management during CCATT transportation

1. **Electromagnetic interference (EMI) from aircraft equipment such as Radar may cause dropped pacemaker beats.** Place patient at the rear of the aircraft to minimize this.
2. Mechanical vibrations during take-off and landing and during transportation to and from the aircraft may cause over-sensing, resulting in inhibited pacemaker output.
3. **We recommend first ensuring the lead is properly placed and adequately secured prior to CCATT movement, then converting to VOO at a rate of 80 for the duration of the transport to avoid EMI and over-sensing.** VOO pacing is accomplished by turning the sensitivity dial all the way counterclockwise past the “click.” The indicator should point to “ASYNC.” Any other setting for transport should only be considered in conjunction with the Theater Cardiology Consultant.
4. At least one spare battery should be available for the pacer during transport.
5. CCATT personnel should be prepared to immediately initiate transcutaneous pacing and chronotropic drug infusion in the event of pacemaker failure or loss of capture.

D. Troubleshooting

1. Change to asynchronous (VOO) mode to avoid EMI.



2. If over-sensing is suspected (inhibited pacemaker output), increase sensing threshold to increase signal-to-noise ratio. If over-sensing still occurs, change to asynchronous mode.
3. Failure to sense occurs when patient’s intrinsic rhythm is not recognized by the pacemaker (pulse is delivered despite intrinsic rhythm). Turning down the sensitivity threshold on the pulse generator will allow the patient’s intrinsic rhythm to

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be detected more easily.



4. Failure to capture occurs when the pulse generator fires an electrical impulse, but that impulse does not cause a corresponding depolarization (pacemaker spike without corresponding QRS complex). This may be due to lead migration or dislodgement. First, increase the voltage of the pulse generator until you see 100% capture on the monitor. If this does not result in capture, switch to transcutaneous pacing.



5. Do not attempt to re-advance pacemaker lead during flight unless you have experience with this.

**CCATT Transvenous Pacing CPG
Appendix A - Pacemaker Modes**

NASPE/BPEG Generic (NBG) Codes

Position I	Position II	Position III	Position IV	Position V
Chamber Paced	Chamber Sensed	Response to sensing	Programmable Functions	Antitachycardia Functions
A - Atrial	A- Atrial	T – Triggered	R - Rate Modulated	P - Paced
V - Ventricle	V - Ventricle	I – Inhibited	C - Communicating	S - Shocks
D - Dual	D - Dual	Dual - Triggered/ Inhibited	M - Multi- Programable	D - Dual (Paced & Shocks)
	O - None	O – None	P - Single Programmable	O - None
			O- None	