Managing patients with pacemaker or ICD

General Recommendations for management of patients with CRMD’s undergoing surgery
1. Determine presence and type of device
2. Obtain records from the device clinic that is monitoring the patient’s device
3. Determine original indication for device placement
4. Is patient pacemaker-dependent?
5. If pacemaker-dependent, has the device been evaluated during the 3 to 6 months prior to surgery
6. Determine device settings and program status

Appendix 2: Summary of Practice Advisory

Preoperative Evaluation

- Establish whether a patient has a CRMD.
  - Conduct a focused history (patient interview, medical records review, review of available chest x-ray films, electrocardiogram, or any available monitor or rhythm strip information).
  - Conduct a focused physical examination (check for scars, palpate for device).
- Define the type of CRMD.
  - Obtain manufacturer’s identification card from patient or other source.
  - Order chest x-ray studies if no other data are available.
  - Refer to supplemental resources (e.g., manufacturer’s databases).
- Determine dependency on pacing function of the CRMD.
  - History of symptomatic bradyarrhythmia resulting in CRMD implantation.
  - History of successful atrioventricular nodal ablation.
  - Inadequate escape rhythm at lowest programmable pacing rate.
- Determine CRMD function.
  - Interrogate device (consultation with a cardiologist or pacemaker–ICD service may be necessary).
  - Determine whether the device will capture when it paces (i.e., produce a mechanical systole with a pacemaker impulse).
  - Consider contacting the manufacturer for perioperative recommendations.

Preoperative Preparation

- Determine whether EMI is likely to occur during the planned procedure.
- Determine whether reprogramming pacing function to asynchronous mode or disabling rate responsive function is advantageous.
- Suspend antitachyarrhythmia functions if present.
- Advise individual performing the procedure to consider use of a bipolar electrocautery system or ultrasonic (harmonic) scalpel.
- Temporary pacing and defibrillation equipment should be immediately available.
- Evaluate the possible effects of anesthetic techniques and of the procedure on CRMD function and patient CRMD interactions.

Intraoperative Management

- Monitor operation of the CRMD.
  - Electrocardiographic monitoring per ASA standard.
  - Monitor peripheral pulse (e.g., manual pulse palpation, pulse oximeter plethysmogram, arterial line).
- Manage potential CRMD dysfunction due to EMI.
  - Electrocautery.
    - Assure that the electrosurgical receiving plate is positioned so that the current pathway does not pass through or near the CRMD system. For some cases, the receiving plate might need to be placed on a site different from the thigh (e.g., the superior posterior aspect of the shoulder contralateral to the generator position for a head and neck case).
    - Advise individual performing the procedure to avoid proximity of the cautery’s electrical field to the pulse generator or leads.
    - Advise individual performing the procedure to use short, intermittent, and irregular bursts at the lowest feasible energy levels.
    - Advise individual performing the procedure to reconsider the use of a bipolar electrocautery system or ultrasonic (harmonic) scalpel in place of a monopolar electrocautery system, if possible.
  - Radiofrequency ablation.
    - Advise individual performing the procedure to avoid direct contact between the ablation catheter and the pulse generator and leads.
    - Advise individual performing the procedure to keep the radiofrequency’s current path as far away from the pulse generator and lead system as possible.
  - Lithotripsy.
    - Advise individual performing the procedure to avoid focusing the lithotripsy beam near the pulse generator.
    - If the lithotripsy system triggers on the R wave, consider preoperative disabling of atrial pacing.
  - MRI.
    - MRI is generally contraindicated in patients with CRMDs.
    - If MRI must be performed, consult with the ordering physician, the patient’s cardiologist, the diagnostic radiologist, and the CRMD manufacturer.
  - Radiation therapy.
    - Radiation therapy can be safely performed in patients who have CRMDs.
    - Surgically relocate the CRMD if the device will be in the field of radiation.
  - Electroconvulsive therapy.
    - Consult with the ordering physician, the patient’s cardiologist, a CRMD service, or the CRMD manufacturer.
- Emergency defibrillation or cardioversion.
  - For a patient with an ICD and magnet-disabled therapies:
    - Advise individual performing the procedure to terminate all sources of EMI while magnet is removed.
    - Remove the magnet to reenable antitachycardia therapies.
    - Observe the patient and the monitors for appropriate CRMD therapy.
    - If the above activities do not restore ICD function, proceed with emergency external defibrillation or cardioversion.
  - For a patient with an ICD and programming-disabled therapies:
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- Advise individual performing the procedure to terminate all sources of EMI while magnet is removed.
- Reenable therapies through programming if the programmer is immediately available and ready to be used.
- Observe the patient and the monitors for appropriate CRMD therapy.
- If the above activities do not restore ICD function, proceed with emergency external defibrillation or cardioversion.
  - For external defibrillation:
    - Position defibrillation/cardioversion paddles or paddles as far as possible from the pulse generator.
    - Position defibrillation/cardioversion paddles or paddles perpendicular to the major axis of the CRMD to the extent possible by placing them in an anterior–posterior location.
    - If it is technically impossible to place the paddles or paddles in locations that help to protect the CRMD, defibrillate/cardiovert the patient in the quickest possible way and be prepared to provide pacing through other routes.
    - Use a clinically appropriate energy output.

Postoperative Management
- Continuously monitor cardiac rate and rhythm and have backup pacing and defibrillation equipment immediately available throughout the immediate postoperative period.
- Interrogate and restore CRMD function in the immediate postoperative period.
  - Interrogate CRMD; consultation with a cardiologist or pacemaker–ICD service may be necessary.
  - Restore all antitachyarrhythmic therapies in ICDs.
  - Assure that all other settings of the CRMD are appropriate.

Refer to Table 3 for an example of a stepwise approach to the perioperative treatment of the patient with a CRMD.
ASA _American Society of Anesthesiologists; CRMD _cardiac rhythm management device; EMI _electromagnetic interference; ICD _implantable

### Example of stepwise approach to the Periop Treatment of Patient with CRMD

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<tr>
<th>Perioperative Period</th>
<th>Patient/CRMD Condition</th>
<th>Intervention</th>
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| Preoperative evaluation | Patient has CRMD | ● Focused history  
● Focused physical examination |
| | Determine CRMD type (pacemaker, ICD, CRT) | ● Manufacturer’s CRMD identification card  
● Chest x-ray studies (no data available)  
● Supplemental resources* |
| | Determine whether patient is CRMD dependent for pacing function | ● Verbal history  
● Bradyarrhythmia symptoms  
● Atrioventricular node ablation  
● No spontaneous ventricular activity† |
| | Determine CRMD function | ● Comprehensive CRMD evaluation‡  
● Determine whether pacing pulses are present and create paced beats |
| Preoperative preparation | EMI unlikely during procedure | ● If EMI unlikely, special precautions are not needed |
| | EMI likely: CRMD is pacemaker | ● Reprogram to asynchronous mode when indicated  
● Suspend rate-adaptive functions§ |
| | EMI likely: CRMD is ICD | ● Suspend antitachyarrhythmia functions  
● If patient is dependent on pacing function, alter pacing functions as above |
| | EMI likely: all CRMD | ● Use bipolar cautery; ultrasonic scalpel  
● Temporary pacing and external cardioversion–defibrillation available |
| Intraoperative physiologic changes likely (e.g., bradycardia, ischemia) | | Plan for possible adverse CRMD–patient interaction |
| Intraoperative Management | Monitoring | ● Electrocardiographic monitoring per ASA standard  
● Peripheral pulse monitoring |
| | Electrocautery interference | ● CT/CRP—no current through PG/leads  
● Avoid proximity of CT to PG/leads  
● Short bursts at lowest possible energy  
● Use bipolar cautery; ultrasonic scalpel |
| | Radiofrequency catheter ablation | ● Avoid contact of radiofrequency catheter with PG/leads  
● Radiofrequency current path far away from PG/leads  
● Discuss these concerns with operator |
| | Lithotripsy | ● Do not focus lithotripsy beam near PG  
● R wave triggers lithotripsy? Disable atrial pacing_ |
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<th>Perioperative Period</th>
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| MRI                 | ● Generally contraindicated  
                       ● If required, consult ordering physician, cardiologist, radiologist, and manufacturer |
| RT                  | ● PG/leads must be outside of RT field  
                       ● Possible surgical relocation of PG  
                       ● Verify PG function during/after RT course |
| ECT                 | ● Consult with ordering physician, patient’s cardiologist, a CRMD service, or CRMD manufacturer |
| Emergency defibrillation–Cardioversion | ICD: magnet disabled | ● Terminate all EMI sources  
                       ● Remove magnet to reenable therapies  
                       ● Observe for appropriate therapies |
|                     | ICD: programming disabled | ● Programming to reenable therapies or proceed directly with external cardioversion–defibrillation |
|                     | ICD: either of above | ● Minimize current flow through PG/leads  
                       ● PP as far as possible from PG  
                       ● PP perpendicular to major axis PG/leads  
                       ● To extent possible, PP in anterior–posterior location |
| Regardless of CRMD type | Postoperative Management | • Monitor cardiac R&R continuously  
                       • Backup pacing and cardioversion/defibrillation capability |
|                     | Immediate postoperative period | | |
|                     | Postoperative interrogation and restoration of CRMD function | ● Interrogation to assess function  
                       ● Settings appropriate/?#  
                       ● Is CRMD an ICD/**  
                       ● Use cardiology/pacemaker–ICD service if needed |

* Manufacturer’s databases, pacemaker clinic records, cardiology consultation. † With cardiac rhythm management device (CRMD) programmed VVI at lowest programmable rate. ‡ Ideally CRMD function assessed by interrogation, with function altered by reprogramming if required. § Most times this will be necessary; when in doubt, assume so. _ Atrial pacing spikes may be interpreted by the lithotriptor as R waves, possibly inciting the lithotriptor to deliver a shock during a vulnerable period in the heart. # If necessary, reprogram appropriate settings. ** Restore all antitachycardia therapies. CRP _ current return pad, CRT _ cardiac resynchronization therapy; CT _ cautery tool; ECT _ electroconvulsive therapy; EMI _ electromagnetic interference; ICD _ internal cardioverter–defibrillator; MRI _ magnetic resonance imaging; PG _ pulse generator; PP _ external cardioversion–defibrillation pads or paddles; R&R _ rhythm and rate; RT _ radiation therapy.

### References:
