Management of Children with Cardiac Devices

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Key Points

- Cardiac implantable electronic devices (CIED) include pacemakers and implantable cardioverter defibrillators (ICD), and there is an increase in number of pediatric patients with device implants.
- Current cardiac devices can be implanted with transvenous leads or epicardial leads in smaller children.
- Device related infections can have serious consequences and may require antibiotics, explanation of the device and the leads, and reimplantation of a new system after a period of time.

Definition, Assessment, Diagnosis

Definition

Cardiac implantable electronic devices (CIEDs) in children include pacemakers and implantable cardioverter defibrillators (ICDs).

- These cardiac devices are implanted to treat electrical abnormalities that lead to an insufficient heart rate as well as to treat potential life-threatening arrhythmias.
- Implantation of a CIED system involves placement of the lead system and the pulse generator.
- Current CIED system leads are typically placed transvenously via the axillary, subclavian, or cephalic vein and the device is usually implanted in prepectoral position in infraclavicular

area.

- In infants and small children, the leads are placed surgically directly over the cardiac chamber epicardially via median sternotomy, and the connected device may be implanted in the abdomen.
- Cardiac implantable electronic device systems consist of several key parts:
    - Pulse generator which is a small metal box implanted under the skin that contains a battery to power the device, a computer to operate the device, and a wireless transmitter that allows communication and re-programming.
    - One or more leads which are wires that run from the device to the heart and terminate in one or more electrodes.
        - The electrodes are affixed to the heart muscle and allow for the battery in the pulse generator to stimulate the heart and initiate contractions.
        - Leads may be implanted on the epicardium (requiring a sternotomy) or the endocardium (requiring a transvenous approach).
    - In ICDs, a defibrillation electrode is present, which disperses a large defibrillation charge across the heart and chest in order to terminate tachyarrhythmias.
    - All contemporary ICDs are capable of conventional cardiac pacing.
- Other CIEDs exist that are not included in this guideline, including implantable loop recorders and subcutaneous ICDs; these are implanted in special circumstances and your patient's electrophysiologist can help you with the management of such devices.

Assessment

Common Indications for Pacemaker Implantation

- Sick sinus syndrome
- Congenital complete heart block
- Post-operative heart block
- Symptomatic bradycardia

Common Indications for ICD Implantation

- Primary prevention – in certain individuals with long QT syndrome, Brugada syndrome, hypertrophic cardiomyopathy
- Secondary prevention – history of sudden cardiac arrest or ventricular tachycardia/fibrillation associated syncope/cardiac arrest

Diagnosis

Important information to keep on each device patient

- Indication and date of device implant
- Primary arrhythmia diagnosis and secondary structural heart disorder diagnosis
- Device details including manufacturer of the device, transvenous or epicardial leads system, pacing mode
- Whether the patient is pacemaker-dependent
- Previous shocks
- Antiarrhythmic medications

Management

Initial Management after Implant

Pain Management

Typically overnight hospital stay followed by a week of analgesics, narcotic and NSAIDs

Infection

Like any other foreign bodies, implanted cardiac devices (i. e., pacemakers and implantable cardioverter defibrillators [ICDs]) can become infected.

- The presentation, consequences, and treatment of device infections vary according to the location and extent of infection and the clinical characteristics of the patient.
- Management may include antibiotics, explantation of the device and usually the leads, and implantation of a new system.
- Prophylactic antibiotics administered prior to implant are continued intravenously during the 23 hours of observation followed by oral antibiotics for 7 days.

Physical Activity Restrictions

- After a transvenous system implant, typically the child will keep the arm on that side in a sling for 1-2 weeks.
- Heavy lifting and vigorous activity involving the arm is discouraged for another 4-6 weeks.
- In general, the patient is allowed to return to normal activity, dependent on underlying diagnosis, after the initial 6 weeks.
- For generator change operations without new lead implants this period may be shorter.
- All patients are followed after one week of implantation for a
    - Wound check
    - Electrocardiogram
    - Chest X-ray, if needed
    - Device interrogation

Continued Management after Device Implantation

- Bacterial endocarditis prophylaxis
    - Antimicrobial prophylaxis is not recommended for dental or other invasive procedure not directly related to device manipulation to prevent CIED infection (Class III -American Heart Association).
    - Associated structural heart defects and operative repairs may require endocarditis prophylaxis.
- Exercise restrictions
    - Dependent on underlying diagnosis

        No restrictions after 4-6 weeks from a device standpoint except avoiding direct impact to device pocket
    - Dependent on type of device

        Pacemaker ─ related to underlying diagnosis

        ICD ─ current guidelines for athletes with ICDs state that all moderate and high intensity sports are contraindicated.
            - Class IA sports are permitted.
            - This will be a case-by-case basis, and refer to the patient's

electrophysiologist for clarification.

- Home device monitoring systems
  - Each patient is provided with a home monitoring system that allows them to transmit via landline to their electrophysiologist.
  - Emphasize the importance of home monitoring systems as they can detect complications earlier.
- MRI conditional
  - Most pacemakers are not MRI conditional; device, as well as leads, have to compatible
  - No current ICD is MRI-conditional
- Other operations
  - Changes to device settings may be required to avoid interference and complications during other surgeries.
  - Detailed plan for perioperative period should be discussed with the cardiac electrophysiologist.
- CIED generator changes may be required around every 5-12 years, depending on the usage of the device.

Device Failure/Complications

Periprocedural Complications of CIED Placement include:

- Bleeding
- Infection
- Pneumothorax
- Cardiac perforation
- Lead dislodgement
- Rarely, death

Management

Management will vary with primary diagnosis, nature of complication and patient's condition.

Lead-related problems

- Infection
- Lead dislodgement
- Lead fracture
- Insulation defects and lead perforation

Treatment

Treatment if patient is stable:

- Obtain Check X-ray
- EKG
- Consider antibiotics
- Contact cardiologist/electrophysiologist

Lead Extraction

- High-risk procedure
- Patient-by-patient decision

- Leads can be abandoned or extracted
- Remain open-minded with patient until it has been discussed with an electrophysiologist or lead extraction specialist

Device Malfunction/Displacement

Diaphragm Stimulation, Pocket Stimulation

- Treatment — Contact manufacturing company or device specialist or cardiac electrophysiologist to interrogate device
- Chest X-ray — 2 views

Inappropriate Shocks

- Refer to emergency room
- Place magnet over device to deactivate therapies
- Chest X-ray — 2 views
- EKG
- Contact cardiologist/electrophysiologist

Erosion of Device through Skin – Infection Treatment

- Obtain blood cultures X 2
- Start antibiotics
- Send to emergency room
- Contact cardiologist/electrophysiologist

Venous Occlusion with Transvenous System Treatment

- Lead extraction
- Contact cardiac electrophysiologist.

Twiddler's Syndrome

Patients twisting or manipulating the device in the pocket may result in lead dislodgement and device malfunction

- Prevention – Remind patients to not play with or scratch their devices
- Treatment
    - Chest X-ray
    - EKG
    - Counseling for patient
    - Contact cardiologist/electrophysiologist

This guideline was developed to improve health care access in Arkansas and to aid health care providers in making decisions about appropriate patient care. The needs of the individual patient, resources available, and limitations unique to the institution or type of practice may warrant variations.

References

References

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