Cardiac Resynchronization Therapy Defibrillator

Introduction

Heart failure patients have symptoms of shortness of breath and body swelling caused by decreased pumping of blood from the heart. Initial management includes treating underlying cause, adopting a healthy lifestyle and taking medications. Patients with persistent symptoms despite the above treatments and a high risk of developing life-threatening arrhythmias such as ventricular tachycardia (VT) and ventricular fibrillation (VF) may consider implantation of a Cardiac Resynchronization Therapy Defibrillator (CRTD) - Cardiac Resynchronization Therapy device with a backup defibrillation function. It is essentially an implantable cardiac pacemaker which consists of a battery-powered generator and leads which connect the generator to the patient's heart. But there is a special lead placed in the left heart or near conduction system of the heart, so that the device can stimulate both the left and right heart in a coordinated (synchronized) manner. The synchronized contraction will increase pumping of blood from the heart. Moreover, the lead placed in the right heart has defibrillation function. As soon as a VT or VF is detected, the CRT-D will automatically try to correct it by anti-tachycardia pacing, cardioversion or defibrillation.

Importance of Procedure

Studies have shown that in selected groups of patients, CRT-D improves heart failure symptoms, quality of life, exercise capacity and heart function and reduce the death rate from the disease. If you refuse this procedure, you may have persistent or worsening heart failure symptoms and the result may be detrimental or even fatal especially when VT or VF occurs. Alternative treatments include continuation of medical therapy or more invasive surgical treatment (such as cardiac transplant).

Pre-Procedure Preparation

- Preliminary investigations including blood tests, chest X-ray, electrocardiogram and echocardiogram of the heart will be performed.
- You need to sign an informed consent.
- Blood thinning drugs or metformin (for diabetes) may have to be stopped several days before the procedure. Steroid will be given if contrast injection is necessary and there is history of allergy.
- An IV infusion will be set up and you need to fast for 4-6 hours.
- Shaving and disinfection near the implant site may be required.
- If you are a female, please provide your last menstrual period (LMP) and avoid pregnancy before the procedure as this procedure involves exposure to radiation.

The Procedure

- This invasive procedure is performed under local anesthesia in a cardiac catheterization centre. You are alert during the procedure, but we may give you sedation to calm you down.
- Electrodes are adhered to the chest to monitor the heart rate and rhythm. Blood oxygen monitor through your finger tip will be set up. Measurement of blood pressure from your arm will be taken during the examination.
- Skin disinfection will be performed and a small skin incision (about 3-5 cm long) will be made under your left (sometimes right) clavicle.
- Contrast may be injected intravenously to visualize the veins in your arm and needle puncture under the clavicle may be required to obtain access to your vein.
- 3 leads will be advanced to your heart chambers through your vein under X-ray guidance. One lead is placed in the right atrium and one in the right ventricle. A special lead is implanted in a vein called the coronary sinus which lies on the surface of the left ventricle (if patient is in permanent atrial fibrillation, the lead in the right atrium may not be necessary) or close to conduction system of the heart. Contrast injection is required to show this vein.
- The generator will be connected with the lead(s) and implanted in a pocket created under the skin or muscle.
- VF may be induced under sedation for testing the proper functioning of the CRT-D.
- The wound will be closed with suturing material and covered with dressing.
- The procedure usually takes around 3-4 hours.

Post-Procedure Care

- After the procedure, you will be kept on close monitoring in the ward.
- Nursing staff will check your pulse and wound regularly.
- You should inform your nurse if you find blood oozing from the wound site.
- You may resume oral diet as instructed.
- Mild wound pain is common. You may take simple analgesic to relieve pain.
- Antibiotics will be given for a few days to minimize the risk of wound infection.
- Before discharge, CRT-D testing and programming will be performed and VF may be induced.
- You may be discharged from hospital several days after the CRT-D implantation.

Post-Procedure Follow up

- The wound should be covered with light dressing. Please keep the wound site clean and avoid making the dressing wet during a bath. Always change dressing if wet.
- You may need to come back to the ward or clinic for suture removal 1 week after the procedure. You may remove the dressing 2-3 days after suture removal.

- Please avoid lifting the affected arm for 1 week, and avoid vigorous arm movement in the first month after the procedure.
- You will be arranged to attend device clinic for regular CRT-D analysis, re-programming and battery power assessment. To maximize the benefits of CRT-D, the settings will be optimized with the help of echocardiogram.
- Please carry your CRT-D identity card at all times.
- Follow your doctor's instructions or refer to the information booklet from the CRT-D company to minimize the risk of CRT-D malfunction due to electromagnetic interference. In general, strong electro-magnetic field or radiofrequency signal will interfere your CRT-D. Please keep a distance of >15 cm (6 inches) from an active mobile phone. Household electrical or electronic appliance usually does not affect CRT-D.
- CRT-D generator will need to be replaced several years later when the battery is depleted.

Risks and Complications

- The procedure carries certain risks.
- Major complications include death (<1%) and perforation of heart chambers (0.3-0.7%).
- Other potential risks include wound infection (0.7-1.7%), wound haematoma (<1%), vein thrombosis (0.1-2.6%), air embolism, contrast allergy, vascular injury, pneuomothorax (0.5-2.2%), haemothorax (0.1%), and tricuspid regurgitation.
- Special risks related to the device include lead dislodgement, insulation break or fracture, pocket erosion, generator or lead problem and inappropriate shock.
- The special left ventricular lead can cause damage to coronary sinus or cardiac veins (0.7-2.1%), and is more prone to dislodgement which may require re-intervention (1-5.9%).
- Risk of bleeding may increase in patient on blood thinner while there is stroke risk during interruption of blood thinner periprocedure.
- Other potential risks include air embolism resulting in death or neurological damage, retained foreign body such as guide wires.
- Device deployment complications include device dislodgement, device entrapment and wire fracture

Magnetic Resonance Imaging (MRI) Conditional Issue

- Patient with MRI Conditional device can undergo MRI only when specific conditions are fulfilled. The device may produce artifacts around the generator and leads.

Fees and Charges

- This procedure involves the use of device which is 'Privately Purchased Medical Item'.

- Your doctor will advise you in choosing an appropriate model. You have to pay for the device before the procedure.
- Please note that the procedure may have to be repeated, either planned or unplanned, for various reasons. Separate charging may be required.
- If you have financial difficulty, you can apply for assistance through our medical social worker.

Remarks

- It is hard to mention all the possible consequences if this procedure is refused.
- The list of complications is not exhaustive and other unforeseen complications may occasionally occur. The risk quoted is in general terms. In special patient group, the actual risk may be higher.
- Should a complication occur, another life-saving procedure or treatment may be required immediately.
- If there is further query concerning this procedure, please feel free to contact your nurse or your doctor.

References

1. Glikson M, et al. 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy: Developed by the Task Force on cardiac pacing and cardiac resynchronization therapy of the European Society of Cardiology (ESC) With the special contribution of the European Heart Rhythm Association (EHRA) European Heart Journal 42 (35), 3427–3520.
2. Fred M, et al. 2018 ACC/AHA/HRS Guideline on the Evaluation and Management of Patients With Bradycardia and Cardiac Conduction Delay: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. Circulation. 2019;140:e382–e482.