

Peri-operative management of patients with cardiac pacemakers and implantable defibrillators undergoing surgery

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1.1 Introduction

Cardiac Implantable Electronic Devices (CIEDs) are implanted for a range of cardiac rhythm conditions. These include pacemakers (PPMs) for the control of bradycardias, Implantable Cardioverter Defibrillators (ICD's) for the treatment of dangerous ventricular arrhythmias, Cardiac Resynchronisation Pacemakers and Defibrillators (CRTPs and CRT-Ds) for the treatment of heart failure, and Implantable Loop Recorders (ILRs) for detailed, long term cardiac monitoring.

Wherever there is the possibility that a CIED may be exposed to electromagnetic interference there is also the possibility that the device may exhibit inappropriate functioning. This risk is significantly increased around the time of surgery due to the need for diathermy. It is therefore vital that any potential risks are identified effectively and procedures are established for the correct management of the CIED patient.

1.2 Effects of Electromagnetic interference (EMI) on CIEDS

The effect of EMI on CIEDS has been well documented however the risk to patients remains relatively low. Depending on device type the response to EMI is variable. The most significant risk occurs when either inhibition of pacing or inappropriate sensing of EMI occurs due to diathermy use. To avoid this risk the early identification of patients with CIED implantation is crucial.

Risk to patient with PPM: Potential inhibition of pacemaker function during diathermy use. This could result in loss of pacing and potentially loss of cardiac output in pacemaker dependent patients.

Risk to patient with ICD: Inappropriate detection of EMI resulting in inappropriate Anti-Tachycardia Pacing and/or shocks from ICD. This can be life threatening as VF may be induced.

Risk to patient with ILR: No risk to patient.

Wherever possible, surgical diathermy should be avoided in patients with these devices. However, where diathermy is deemed essential, the use of a bipolar diathermy circuit is preferable. Failing this, short pulses of mono-polar diathermy with the ground electrode remote from the pacemaker site may be acceptable bearing in mind that employing either of these two measures the possibility of electrical interference remains.

Reprogramming of CIED's at the time of surgery is used to reduce the risk of harmful interference with device function. The ability of ICD's to detect arrhythmia and deliver shock therapies can be "switched off" thereby removing the risk of electrical noise being misinterpreted as life threatening arrhythmia. In addition, pacemakers can be reprogrammed to an asynchronous pacing mode which effectively stops the pacemaker "sensing" resulting in the pacemaker ignoring all electrical noise (both true cardiac impulses and electrical noise artefact) and pacing at a pre-programmed rate. Patients who have their pacemakers programmed in this way are at a small risk of "R on T" pacing and subsequent VF. The risk of this is small and unquantifiable, but is higher in those patients who use their pacemaker very little and have more of their own heart rhythm. Therefore, there is no true "safe" pacemaker mode and reprogramming the pacemaker is a balance of risks.

1.3 Patient screening and pre-op assessment

Since most surgical procedures are planned, pre-operative assessment is an excellent opportunity to identify patients that have a CIED in-situ and to obtain any relevant details. All patients should carry a Pacemaker / ICD identification card issued at device implant that contains details of the device and leads.

When a pacemaker/ICD is identified it should be clearly recorded by the surgical / procedural assessment staff in the patient's notes and marked for the attention of key clinical staff. Prior to surgery the anaesthetist and surgeon involved should be aware of the implications of the patient having a pacemaker / ICD.

Information required by Pacemaker Clinic:

- Name
- Hospital Number
- Pacemaker / ICD implanting centre
- Follow-up centre
- Type of Device
- Device Manufacturer
- Percentage paced

Where possible inform the Pacemaker Clinic as soon as possible when a CIED patient is identified. At least two weeks' notice is needed to arrange pre/post procedure checks. This allows the Physiologists time to acquire the relevant information such as implant indication and underlying rhythm to ensure the device is programmed appropriately for surgery. Once the Pacemaker Clinic have received all appropriate information regarding the patient and their device, a plan will be made outlining what changes are required (if any) prior to surgery.

1.4 Standard peri-procedural precautions and considerations for all CIED patients

At the time of the procedure, the following should be considered when surgical diathermy / electro-cautery or other devices with potential electromagnetic interference (EMI) are to be used:

- Continuous cardiac monitoring.
- Availability of resuscitation facilities including external pacing.
- Minimise risks of electro-cautery / diathermy
 - Is diathermy necessary?
 - If essential can bipolar diathermy be used?
 - If mono-polar, can it be used in short bursts?
 - Ensure ground electrode remote from CIED

If detectable pacemaker inhibition occurs during a procedure, the surgeon should be informed immediately and diathermy either used intermittently or discontinued

If device programming has been altered then patients may need to have ECG monitoring until their device parameters have been restored to pre-op settings. This should be done as soon as practical and ideally the same day.

1.5 Procedure specific advice

These tables represent an attempt to provide practical guidance for common situations based on a consensus of expert opinion, the limited available data, device manufacturers' information and the views of the BTHFT pacemaker clinic.

1.5.1 General / Orthopaedic surgery

	Pacemaker	ICD
Surgery site: lower abdomen, lower limbs or upper arms distal to the elbow	<ul style="list-style-type: none"> • No reprogramming of the device likely to be required. • All elective cases to attend pacemaker clinic • Monitor during surgery to ensure no inhibition of pacemaker. • No post op device checks required unless programming has been altered or an adverse event has occurred. 	Deactivation of ICD during surgery and reactivation post operatively
If surgery in head, neck, upper abdomen or upper limb proximal to the elbow	<ul style="list-style-type: none"> • Discuss requirement for reprogramming with Pacemaker Clinic. • Monitor to ensure no inhibition of pacemaker. • No post op device checks required unless programming has been altered or an adverse event has occurred 	Deactivation of ICD during surgery and reactivation post operatively

1.5.2 Ophthalmic Surgery

	Pacemaker	ICD
If monopolar diathermy anticipated	<ul style="list-style-type: none"> • No reprogramming of the device likely to be required. • All elective cases to attend pacemaker clinic. • Monitor during surgery to ensure no inhibition of pacemaker. • No post op device checks required unless programming has been altered or an adverse event has occurred. 	Deactivation of ICD during surgery and reactivation post operatively

1.5.3. Endoscopy Procedures

Pacemaker	ICD
<ul style="list-style-type: none"> • No action likely to be required unless pacing dependant and prolonged diathermy / argon beam anticipated. • Discuss requirement for reprogramming with Pacemaker Clinic. • Monitor during procedure. • No post op device checks required unless programming has been altered or an adverse event has occurred. 	Deactivation of ICD may be appropriate if prolonged diathermy / argon beam anticipated and reactivation post operatively

1.5.4 Dental Surgery

Pacemaker	ICD
<ul style="list-style-type: none"> • No action required unless diathermy use is anticipated. • No post op device checks required unless programming has been altered or an adverse event has occurred. 	Deactivation of ICD may be appropriate if prolonged diathermy anticipated and reactivation post operatively

1.5.5 Lithotripsy

General measures as described above for patients receiving diathermy should be followed.

Pacemaker	ICD
Avoid focussing beam near the pulse generator. If lithotripsy triggers on R wave consider disabling atrial pacing during treatment.	
Interrogate device within 1 month after treatment	Deactivation of ICD during the procedure and carry out checks and reactivate immediately after procedure.

1.5.6 Electroconvulsive therapy

General measures as described in Section 1.4 should be followed.

Pacemaker	ICD
Interrogate device within 1 month after treatment	Deactivation of ICD during the procedure and carry out checks and reactivate immediately after procedure.

1.5.7 Nerve Conduction Studies (Electromyography, EMG)

General measures as described in Section 1.4 are recommended. The risk of interaction with a pacemaker / ICD is low but is raised if repetitive rather than single stimuli are applied and if the stimuli are applied to the proximal arm on the same side as the pacemaker / ICD device.

Pacemaker	ICD
<ul style="list-style-type: none"> • Consider pacemaker reprogramming only if pacing dependent and repetitive nerve stimulation close to the device. • Monitor to ensure no inhibition of pacemaker. • No post op device checks required unless programming has been altered or an adverse event has occurred. 	Deactivation of ICD may be appropriate if repetitive nerve stimulation is anticipated with reactivation post procedure.

1.6 BTHFT Standard operating procedure

1.6.1 Pacemakers

Elective cases

- All elective cases to attend pacing clinic on morning of surgery at 8:30 am – this will have been arranged in advance at the time of surgical pre-assessment.
- It is important to note that reprogramming a pacemaker is not always necessary or indeed safe. A risk/benefit decision will be made when the patient attends the pacemaker clinic. This decision will include variables such as pacemaker dependency / percentage of time paced and location of surgery.
- If surgery remote from pacemaker or risk of asynchronous pacing felt to be too high by the programming Physiologist the device will NOT be reprogrammed. This will be written clearly in the patient notes.
- Surgical lists to be organised in a way that pacemaker patients are on the **morning list** and will return to the ward in normal working hours.
- There is **NO** on-call service for pacemaker patients.
- In theatre, all safe precautions as detailed in Section 1.4 should be followed
- Device to be reprogrammed in a timely manner. If surgery continues beyond 5pm, it is the responsible of the surgical team to ensure that a monitored bed is available overnight until pre-op settings can be restored the following day. There is no on-call service for pacemakers.
- For pacemaker patients who go to theatre on Friday. Ideally, these patients will be reprogrammed post-operatively in the normal working day. However, in exceptional circumstances, to avoid patients remaining in an asynchronous pacing mode over the weekend a limited on-call service is available. The cardiac physiologist can be contacted via ward 22.

Emergency cases / Urgent (Out of hours)

- There is no on-call service for pacemaker patients
- If surgery is essential then it should proceed with appropriate cautions (see Appendix 2).
- All precautions detailed in Section 1.4 should be considered.
- A post-operative pacemaker check should be arranged in a timely manner.

Emergency cases / Urgent (Normal working hours)

- Where possible the patient will be accommodated by pacing clinic.
- If this is not possible then proceed as per “out-of-hours” cases.

1.6.2 Implantable Defibrillators (ICD)

All ICD's need tachycardia therapies switching OFF pre-procedure. Pacing functions are unaffected by these changes.

Elective cases

- All elective cases to attend pacing clinic on morning of surgery at 8:30 am – this will have been arranged in advance at the time of surgical pre-assessment.
- Surgical lists – patients to be **first on morning surgical lists** where possible to ensure that they are back from theatre in the normal working day.
- ICD programmed to “monitor only”
- Once the device has been deactivated, the patient is “unprotected” from ventricular arrhythmia and should be transferred to and from the pacing clinic monitored and with a qualified nurse escort. The patient should then be transferred directly to the operating theatre where they can be monitored in the recovery area until surgery.
- All peri-procedural precautions to be followed as detailed in Section 1.4
- Following surgery, elective ICD patients will either go to HDU or will remain in theatre recovery to have their devices reprogrammed. The Cardiac Physiologist should be contacted on Ext: 4073 to arrange a mutually convenient time to arrange device reprogramming. Every effort will be made to reprogram devices in a timely manner. Patients should remain in a high dependency area while they wait.
- The reprogramming and re-activation of ICD's is NOT an on-call procedure and will only be performed after 5pm in exceptional circumstances (minimal or no HDU beds). This decision should be made by the on-call Cardiology Consultant.

Emergency / Urgent cases (out of hours)

- Only limb- or life-threatening surgery should proceed out of office hours – all other cases should wait until normal working hours.
- If surgery is essential then it should proceed with appropriate cautions as described in Section 1.4 (also see Appendix 2).
- The use of a medical magnet taped securely to the device should be considered. A magnet will turn ICD tachycardia therapy OFF in most devices leaving bradycardia functions still working. Medical magnets are available on the Coronary Care Unit and in Nucleus theatres. When the magnet is removed ICD function will return to normal.
- An ICD check should be performed post-operatively the following day.
- Disabling ICD's and their re-activation is NOT an on-call procedure and will not be performed out of hours without direct instruction from the on-call Cardiologist

Emergency / Urgent cases (normal working hours)

- Where possible the patient will be accommodated by pacing clinic.
- If this is not possible then proceed as per “out-of-hours” cases.
- If an ICD is deactivated then the patient should be cared for in a high dependency area.

1.7 How to contact the Pacemaker Clinic

To discuss or request pacing support contact: Alison Cooke – Pacemaker Services Lead Physiologist on email: alison.cooke@bthft.nhs.uk

Urgent daytime queries – Ext: 4073 or Ext: 4180

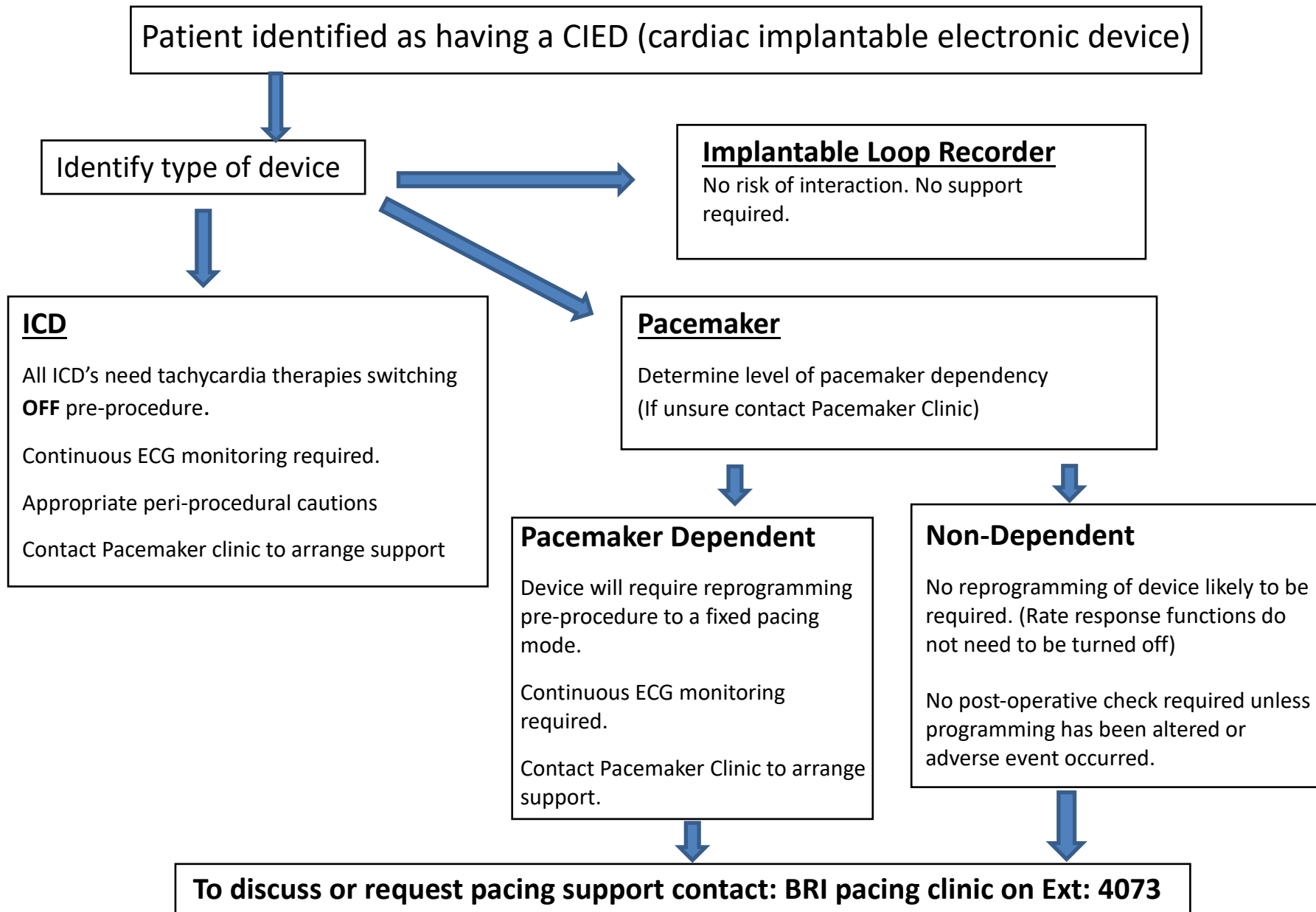
Out of hours /Emergency ICD queries – On call Cardiac Physiologist number available through Coronary Care Unit.

1.8 References

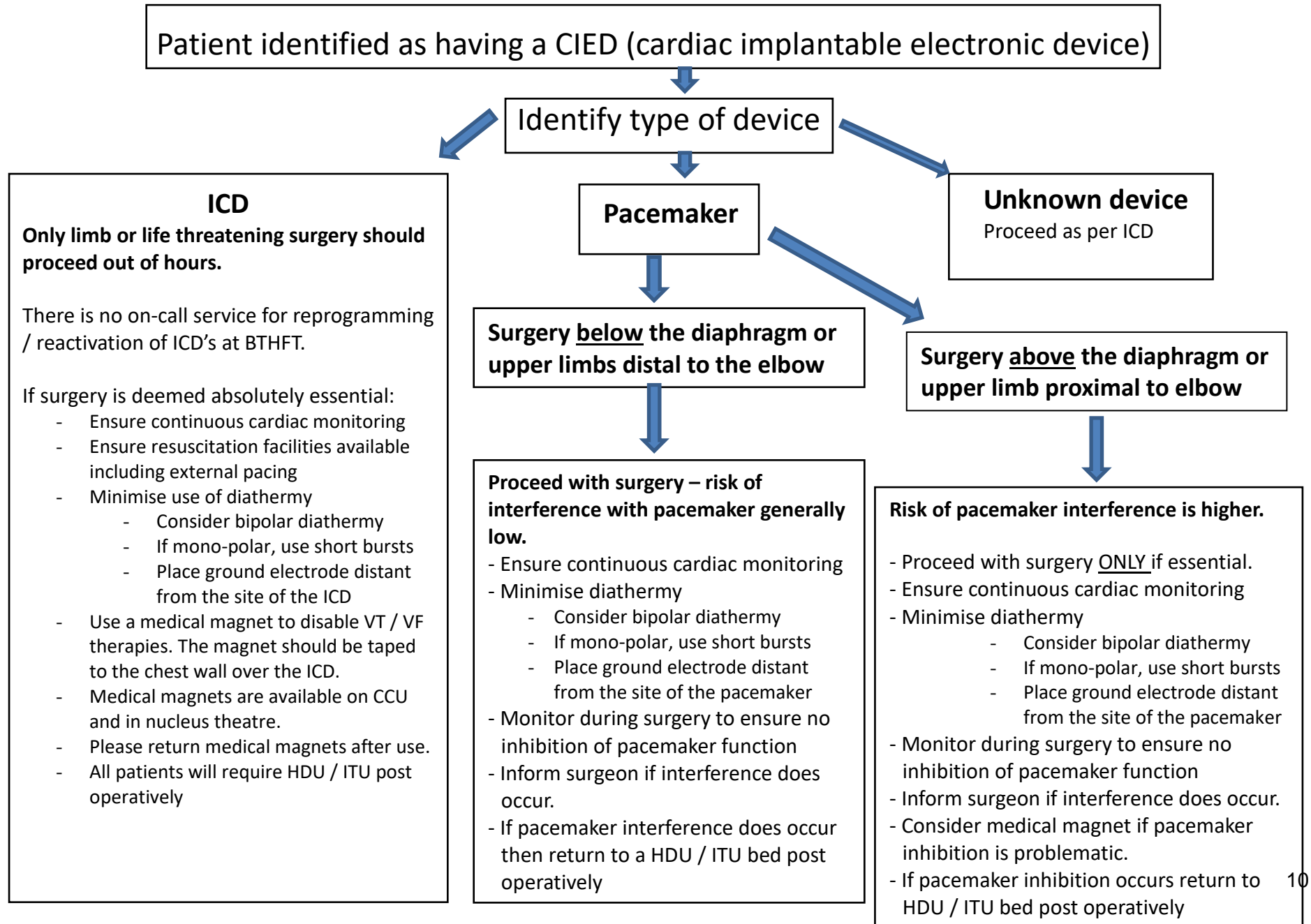
British Heart Rhythm Society guidelines for the Management of Patients with Cardiac Implantable Electronic Devices (CIEDs) Around the Time of Surgery (2016)

MHRA Guidelines for the perioperative management of patients with implantable pacemakers or implantable cardioverter defibrillators, where the use of surgical diathermy/electrocautery is anticipated (2006)

BTHFT Elective Surgery / Procedures – Flow Chart



BTHFT Emergency / Urgent Cases – Flow Chart



PERI OPERATIVE PACING CLINIC REFERRAL

*For patients with **pacemakers** or **implantable defibrillators***

*Please fax to **4741** and send form to **Cardiorespiratory Department, BRI***



PROCEDURE

Planned operation.....

Date of surgery.....

Consultant Surgeon.....

DEVICE DETAILS *see patient's pacemaker card*

Device manufacturer.....

Device model.....

Follow-up Pacemaker Clinic attended.....

REFERRED BY.....CONTACT NUMBER.....