



Perioperative CIED Guidelines

Perioperative Guidelines for use in patients with cardiac implanted electronic devices (CIEDs) undergoing elective or emergency surgery.

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Draft VI: Aug 2020

Table of Contents

Background	3
Permanent Pacemakers (PPMs).....	3
Implantable cardioverter defibrillators (ICDs)	3
Implantable Loop Recorder (ILR's).....	4
Sources of EMI:	4
Suggested Decision Making For Elective Surgery [In Hours]	5
Guidance For Management Of Patients Presenting For Emergency Surgery [In Hours]	6
Pacemakers	6
ICDs	6
Suggested Decision Making for Emergency Surgery [Out of Hours]	7
Appendix 1: Standard Intra-operative Precautions	8
General.....	8
Diathermy	8
Defibrillation Machine and Pads.....	8
Appendix 2: Use of Magnets intra-operatively	9
Pacemakers	9
ICDs	9
Applying a Magnet	9
When To Apply.....	10
Appendix 3: Where to Find Magnets:	11
Royal Infirmary:.....	11
Western General Hospital:.....	11
St John's Hospital:	11
Appendix 4: Cardiac Physiology Site Cover and Directory	12
Royal Infirmary of Edinburgh	12
Western General Hospital.....	12
St John's Hospital	12
Appendix 5: Nursing Perioperative Assessment (PoA) Algorithm For Elective Surgery	13
Appendix 6: Preoperative Cardiac Implantable Electronic (CIED) Device Checklist (for completion by PoA nurses and cardiac electrophysiologists).....	14
References	15

Background

These guidelines have been established by NHS Lothian Anaesthesia and Cardiology Departments to improve the perioperative planning and decision making for all patients undergoing surgery both in the emergency and elective setting.

When further advice is required in hours, we recommend first calling the on-site cardiac pacing physiologist. Out of hours, the on-call cardiology registrar may be called for further guidance – see *Appendix 3*.

Permanent Pacemakers (PPMs)

These are for the control of bradyarrhythmias and those at risk of asystole. They may be single chamber (right atria OR right ventricle) or dual chamber (right atria AND right ventricle).

They may also be biventricular in the context of **Cardiac Resynchronisation Therapy (CRT)**. A Cardiac Resynchronisation Therapy – Pacemaker (**CRT-P**) device is used for the treatment of heart failure using ventricular resynchronisation. These utilise 2 or 3 leads situated in the right atrium, right ventricle and coronary sinus (to pace the left ventricle).

They can be programmed for multiple modes including:

Synchronous modes

Preserve AV synchrony. ‘Physiological’ in that ventricular depolarisation follows atrial depolarisation.

Asynchronous modes

Do not preserve AV synchrony. Often used in emergency situations or in an environment (e.g. theatre) where electromagnetic interference (EMI) can cause inhibition of pacing.

PPM problems due to Electromagnetic Interference (EMI - e.g. diathermy)

- ❖ **Sensing of EMI as intrinsic cardiac depolarisation and NOT delivering a paced beat**
- ❖ **THEREFORE RISK OF ASYSTOLE IF COMPLETELY PACEMAKER DEPENDENT**
- ❖ **Risk of R On T Phenomenon precipitating arrhythmia**

Implantable cardioverter defibrillators (ICDs)

These are for the treatment of life-threatening ventricular tachyarrhythmias e.g. VF/VT and may be single or dual chamber.

These also may be biventricular, again in the context of Cardiac Resynchronisation Therapy (CRT) for the treatment of heart failure. If the CRT device has a defibrillatory component, it is called a Cardiac Resynchronisation Therapy - Defibrillator (**CRT-D**).

ICDs detect and deliver a shock and ALL have a back-up pacing mode should a bradyarrhythmia or asystole follow shock delivery.

ICD problems due to EMI:

- ❖ **Inappropriate delivery of a shock**
- ❖ **Failure to deliver a shock as for PPM and Asystole if CRT-D**
- ❖ **Risk of R On T Phenomenon precipitating arrhythmia**

N.B: All CRT devices have the ability to act as a pacemaker (for the treatment of bradyarrhythmias and some tachyarrhythmias). Indications for and the effect of magnet application for CRT-P and CRT-D are not the same – see Appendix 2.

Implantable Loop Recorder (ILR's)

Implanted for detailed, long term cardiac monitoring only. No Pacing. No Defibrillation.

ILR Issues with EMI:

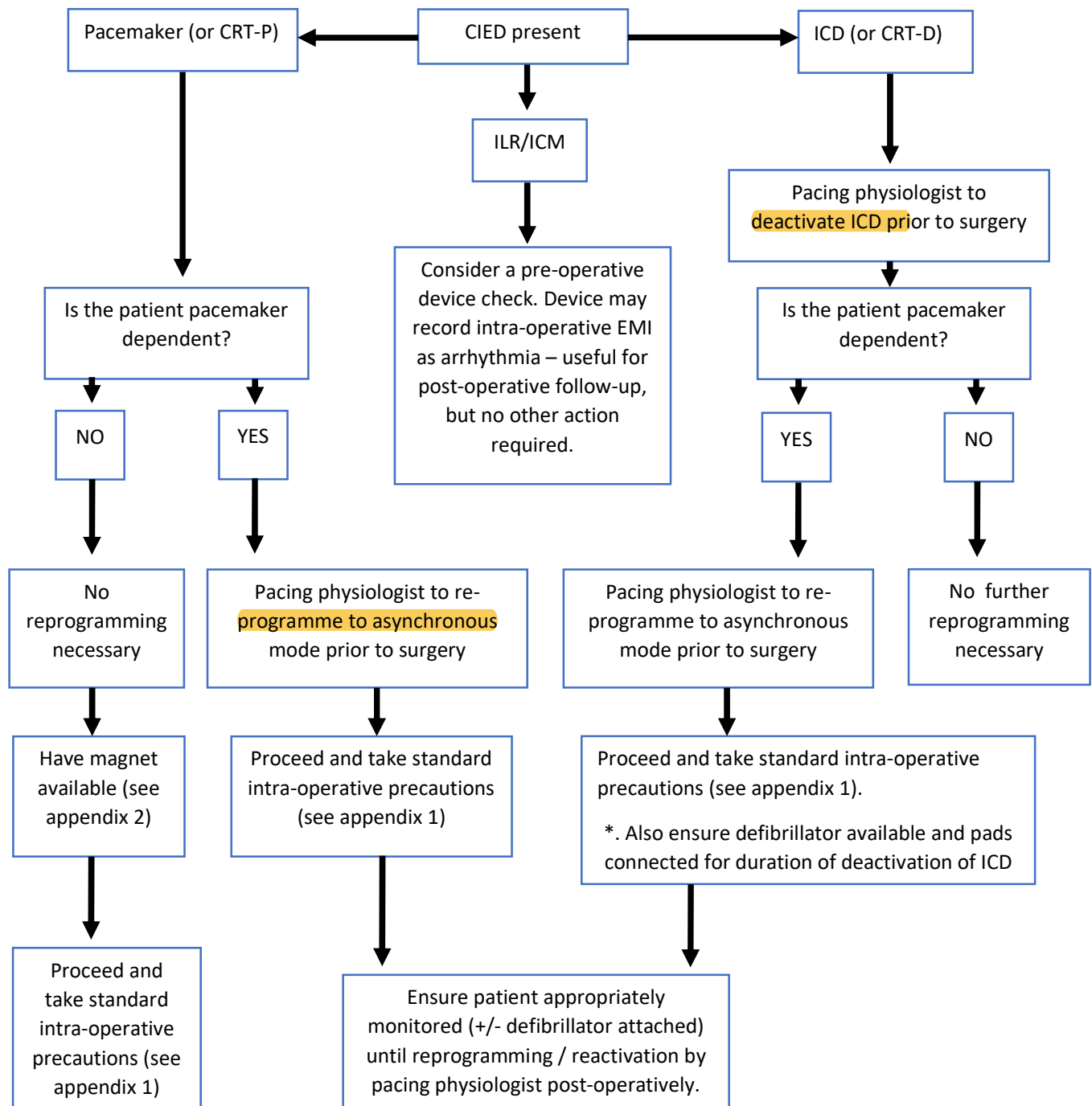
- ❖ **Possible episodes of artefact making interpretation a challenge at check-up**

Sources of EMI:

Potential sources of EMI include:

- Diathermy (poses greatest risk)
- Evoked potential monitors
- Nerve stimulators
- Radiofrequency ablation
- Extracorporeal shockwave lithotripsy

Suggested Decision Making For Elective Surgery [In Hours]



Guidance For Management Of Patients Presenting For Emergency Surgery [In Hours]

Or Elective Surgery But Without Appropriate Device Work-Up.

Follow the algorithm for emergency surgery (see next algorithm) but also contact the on-site cardiac pacing physiologist (or cardiology on-call) for advice if time allows. A cardiac pacing physiologist may not be physically on-site 5 days a week. However, from Mon-Fri 9-5pm there will always be one available on one of the sites to contact for advice - See Appendix 3.

NB. Cardiac pacing physiology advice should be your first port of call. These specialists will be more familiar with cardiac devices and perioperative management than a generic on-call cardiology registrar.

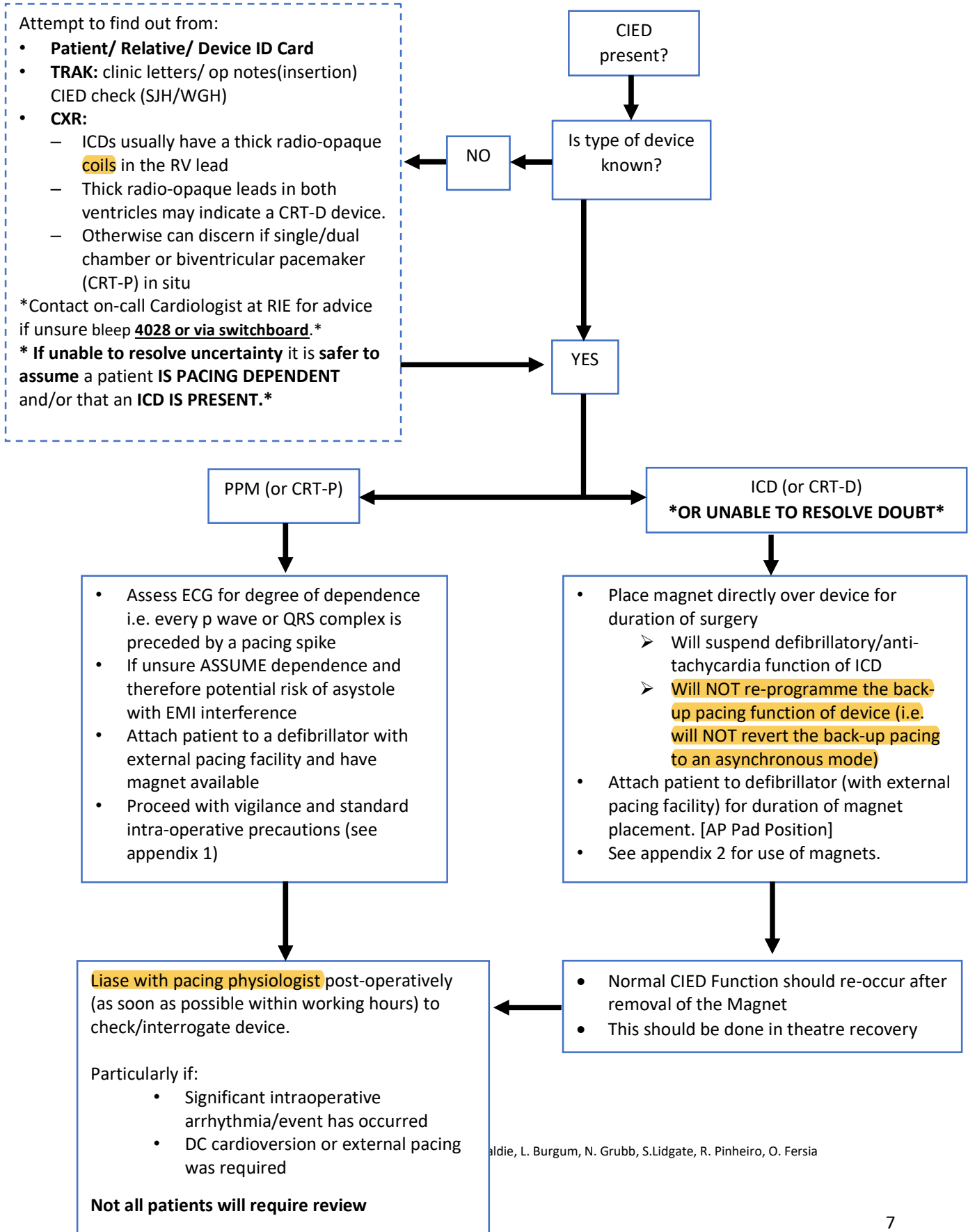
Pacemakers

- Generally if the patient is **not** pacemaker dependent and **bipolar** diathermy (or no diathermy) can be used, the risk of adverse effect from EMI interference is **low** with modern pacemakers (those sited since 2000 are likely to have bipolar leads which are significantly less subject to interference).
- Risk is **lower** again if surgery is **below the umbilicus**.
- If surgery is **within 15 cm** of pacemaker site, risk is **higher**.
- For elective surgery, it is the decision of the Consultant Anaesthetist and Consultant Surgeon whether to proceed or postpone theatre, depending on the urgency of surgery, balance of risks, and availability of a pacing physiologist (depending on their advice).
- If emergency surgery needs to proceed urgently, continue as per emergency surgery algorithm with standard intra-operative precautions – See appendix 1.

ICDs

- ALL ICDs/CRT-D devices **must** have the defibrillatory/anti-tachycardia component deactivated prior to surgery. In-hours a cardiac pacing physiologist should do this where available.
- **If a pacing physiologist is physically unavailable** true **elective surgery** (that can wait) should be **postponed** and rearranged for another suitable date.
- For 'urgent' elective or emergency surgery in-hours, it may be appropriate to proceed using a magnet. However, advice should be taken from a cardiac physiologist/cardiologist, and ultimately it is the decision of the Consultant Anaesthetist and Consultant Surgeon whether to proceed or postpone, depending on the urgency of surgery and balance of risks.
- For emergency surgery out-of-hours, continue as per emergency surgery algorithm with standard intra-operative precautions - See appendix 1.

Suggested Decision Making for Emergency Surgery [Out of Hours]



Appendix 1: Standard Intra-operative Precautions

General

- Peripheral pulse must be monitored continuously e.g. pulse oximeter, direct palpation or arterial waveform.
- Place the **diathermy plate as far from the device as possible** and avoid the device being between the operation site and plate (e.g. if the device is in the left upper chest, place a plate on the right thigh for surgery below the chest).
- **Do not** place a ring magnet over the device, unless advised to do so by a cardiac pacing physiologist/cardiologist who knows the details of that patients' device and programming **OR** you are proceeding under the emergency/ out-of-hours management algorithm.
- Always treat CIEDs as **NOT** MRI safe when in doubt. Even MRI safe devices may have been fitted with non-MRI safe leads and therefore be unsafe.

Diathermy

Monopolar diathermy should **NEVER be used near** a pacemaker generator or ICD (e.g. ipsilateral upper anterior chest wall, shoulder or neck area) as it will probably damage the pacemaker/ICD, and could cause arrhythmias such as asystole or VF, or inappropriate shock delivery from an ICD.

If diathermy must be used:

- Use bipolar diathermy where possible, to minimise electrical interference.
- If monopolar diathermy is essential, use away from the device, and in **short bursts, 1 second** or less, with ECG monitoring to observe the effect on the rhythm.
- Between each 1 second burst of diathermy there should be a **3 second delay** to allow recovery from any asystole that occurs during the delivery of diathermy.
- Cutting diathermy is better than blend or coagulation current.

Defibrillation Machine and Pads

- Apply pads in an **Anterior - Posterior setting**.
- Ensure application of a machine with pacing function.
- **Do not** adjust required joules because of the presence of an indwelling CIED.

Appendix 2: Use of Magnets intra-operatively

Pacemakers

- A magnet secured over a pacemaker will produce an asynchronous mode of pacing i.e. will pace either the atria (AOO), ventricle (VOO), or both (DOO) at a fixed rate. As it is 'non-sensing' mode, it will not misinterpret EMI as an intrinsic depolarisation.
- The rate delivered depends on the programming of the individual device and defaults that vary by manufacturer.
- The mode of asynchronous pacing (e.g. AOO, VOO, DOO) depends on the programming of the individual device.
- Asynchronous pacing will continue for the duration of magnet application over the device. Removal of magnet results in reversion to baseline programming.

ICDs

- For ICDs, a magnet should suspend the arrhythmia/anti-tachycardia detection function of the device, preventing an inappropriate discharge of a shock should the device mistakenly interpret EMI as a malignant arrhythmia.
- Subsequent removal of the magnet immediately reactivates the ICD.
- A pacing physiologist or cardiologist should ideally be involved for ICD deactivation in all but emergency out-of-hours situations.
- All ICDs have a pre-programmed back-up pacemaker mode, should a period of asystole or bradycardia follow a shock delivery. **The applied magnet will NOT affect this back-up mode i.e. will NOT produce an asynchronous mode.**

Applying a Magnet

- Magnet application should **only** be considered when reprogramming by cardiac physiology is not available.
- Locate the patients' CIED by feeling for the device under the skin (typically in the right or left pectoral area). To secure, place on chest over the device generator and secure with tape – any tape is fine e.g. sleek. Ensure it will not move for duration of procedure.
- Keep the magnet at least 15cm from electronic and recording devices such as computers, phones and bank cards.
 - A Boston Scientific device will produce an audible tone (in synchrony with the R-wave) indicating successful deactivation of the device, which will remain when the magnet is in situ.
 - Medtronic devices also produce audible tones that only indicate an ALERT is present, but not specifically the status of the anti-tachycardia detection or therapy.

When To Apply

For physical magnet locations see Appendix 4.

Table 1. Indication and effect of magnet application to CIEDs

Device	Indication For Magnet (REPROGRAMMING NOT AVAILABLE)	Effect Of Magnet
PPM	<p>Monitor for inappropriate inhibition of pacemaker.</p> <p>If possible, stop or reduce interference from EMI (e.g. short bursts diathermy/switch to bipolar diathermy/stop diathermy).</p> <p>If not possible or inappropriate inhibition continues - apply a magnet.</p>	<p>Pacing usually assumes an asynchronous mode.</p> <p>Rate response suspended.</p>
ICD	All cases using any diathermy	<p>ICD is deactivated*.</p> <p>No effect on bradycardia pacing function.</p>
ICD + PPM	All cases using any diathermy.	<p>ICD is deactivated*.</p> <p>Pacing usually assumes an asynchronous mode.</p> <p>Rate response suspended**.</p>
CRT-P	<p>Monitor for inappropriate inhibition of pacemaker.</p> <p>If this occurs then apply magnet.</p>	<p>Pacing usually assumes an asynchronous mode.</p> <p>Rate response suspended**.</p> <p>Pacing usually continues as biventricular (i.e. CRT continues).</p>
CRT-D	All cases using any diathermy	<p>ICD is deactivated.</p> <p>No effect on bradycardia pacing function.</p> <p>Pacing usually continues as biventricular (i.e. CRT continues).</p>

***ICD deactivation** - this means deactivation of all tachyarrhythmia detection and therapies (tachyarrhythmia pacing, cardioversion and defibrillation).

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 Date: Aug 2020
 Approved by: Preoperative Assessment Guideline Group
 Next review date: Aug 2022

****Suspension of rate response** - rate modulation is switched off and pacing will remain at a fixed rate whilst the magnet is in situ (device dependent but can be 85 – 120bpm).

Appendix 3: Where to Find Magnets:

Royal Infirmary:

Theatres:

- Theatre 3 – drug cupboard (for Simpsons use)

ICU (Ward 118):

- Drug cupboard

CCU (Ward 114):

- One in drug cupboard
- One in pacing procedure room

Ward 103:

- Drug cupboard

ED: Resus bay 1 defib trolley

Cardiac physiology also keep a supply of them in the ECG department, OPD 3

Western General Hospital:

Theatres: Main theatre, **box at the bottom of pharmacy cupboard 3**

ICU: Stuck to the safe in the ICU charge nurse office

St John's Hospital:

Theatres:

- Box in Theatre 4 anaesthetic room/on top of equipment trolley in store room during COVID
- Labour Suite anaesthetic Room

CCU: On wall in office behind main desk

ED: Usually in CD cupboard in Resus (During COVID, there is one located in Green Zone CD cupboard, and one in Red Zone cardiology cupboard)

Appendix 4: Cardiac Physiology Site Cover and Directory

There is not always a cardiac pacing physiologist on site for every NHS Lothian Site every day. However, a member of the pacing team should be available to answer questions even if on a different site.

Royal Infirmary of Edinburgh

Email: CRM.RIE@nhslothian.scot.nhs.uk

Phone: 21813 (ECG Department) 21817 (Pacing office – not always occupied)

Availability:

Fully staffed 5 days a week (0900 – 1700)

Mondays	Tuesdays	Wednesdays	Thursdays	Fridays
Staffed	Staffed	Staffed	Staffed	Staffed

Western General Hospital

Email: CRM.WGH@nhslothian.scot.nhs.uk

Phone: 31852 (ECG Department)

Availability:

Fully staffed on Thursdays. Often there is a physiologist in attendance the other days. (0900 – 1700)

Mondays	Tuesdays	Wednesdays	Thursdays	Fridays
Most	Most	Most	Staffed	Most

St John's Hospital

Email: CRM.SJH@nhslothian.scot.nhs.uk

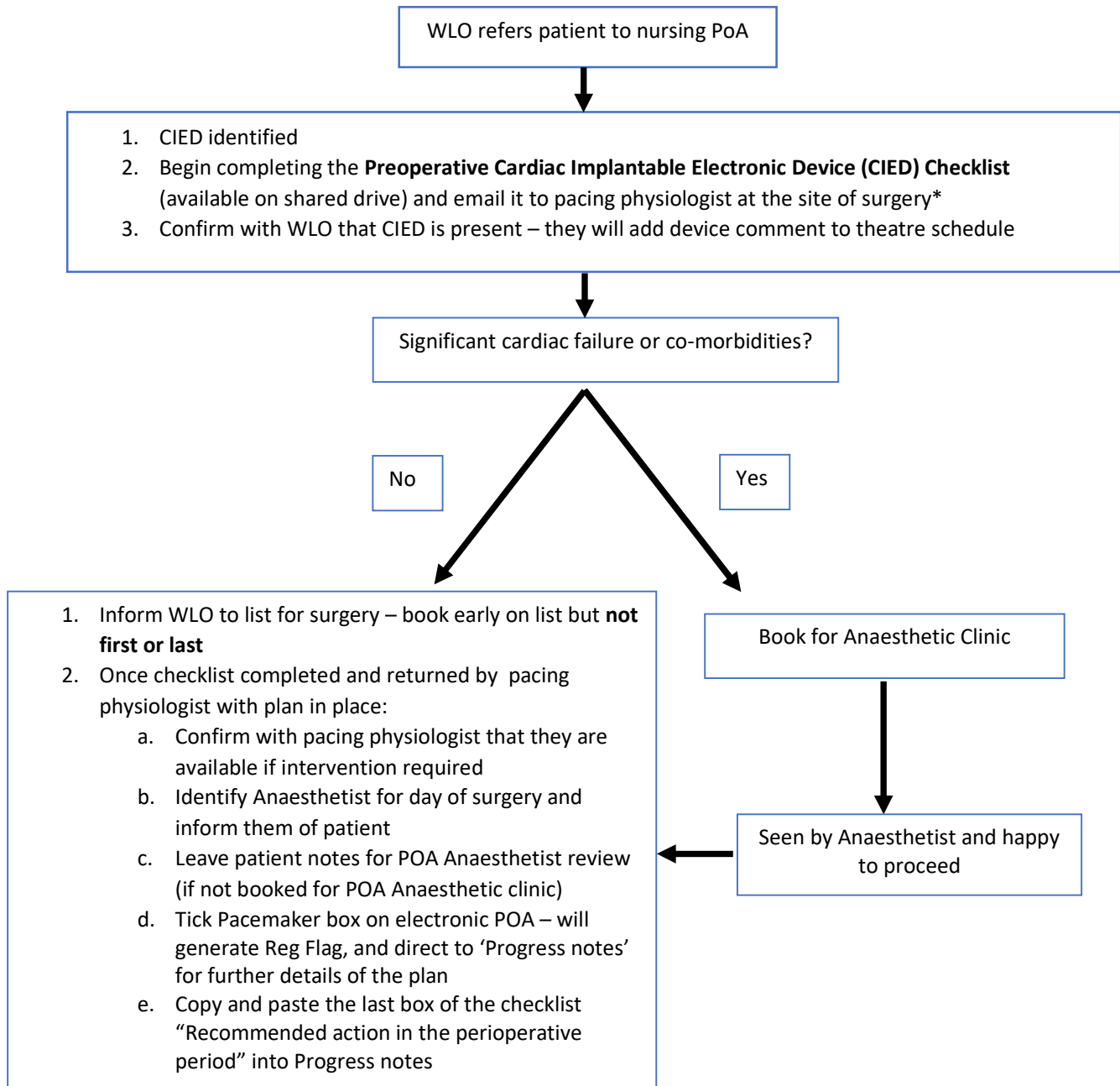
Phone: 53851 (ECG Department)

Availability:

Fully staffed on Tuesdays. First Thursdays of every month are staffed. Often there is a physiologist in attendance the other days. (0900 – 1700)

Mondays	Tuesdays	Wednesdays	Thursdays	Fridays
Most	Staffed	Most	Some	Most

Appendix 5: Nursing Perioperative Assessment (PoA) Algorithm For Elective Surgery



* Key information required for email to physiologist (information sought from patient, device ID card, TRAK):

- Patient details
- Type of device (if known)
- Location of device e.g. left sub-pectoral region
- Pacing clinic/hospital where device followed up
- Type of surgery (including site if not obvious) and date (if already known)
- Name of Consultant surgeon

For further details please refer to the full policy document 'Perioperative CIED Guidelines'.

Appendix 6: Preoperative Cardiac Implantable Electronic (CIED) Device Checklist (for completion by PoA nurses and cardiac electrophysiologists)

Pre-operative Assessment Nurses to complete:

Please complete the following questions as much as possible from the patient history, device information card and TRAK Notes. The completed form should be forwarded to the cardiac electrophysiology department at the hospital site where surgery will take place:

RIE: CRM.RIE@nhslothian.scot.nhs.uk WGH: CRM.WGH@nhslothian.scot.nhs.uk

SJH: CRM.SJH@nhslothian.scot.nhs.uk

(The key bits of information ideally required are marked with '*'.)

*Patient Name:	
*CHI:	

*Proposed Operation:	Consultant Surgeon:
*Operative Hospital Site:	Scheduled Date if known:
Type of Device e.g Pacemaker/ICD/CRT device:	Date of Insertion:
Location of Device (e.g. left sub-pectoral region):	*Hospital Following-up Device:
Date of last device check-up:	Date of next check-up:

Cardiac physiology team to complete:

Please complete any unidentified fields above, plus the following, and email back to the sending Pre-operative assessment nurse:

Device details:
Device dependence:
Any further information required? (e.g. type of diathermy to be used by surgeon?)

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