Cardiac patient undergoing non-cardiac surgery

An evidence based approach
Contents

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• Arrhythmias (including Atrial Fibrillation)
• Anaesthetic considerations of major guidelines
  • Timing of Elective cardiac surgery post cardiac interventions
• Pacemakers and ICDs
• Ischaemic heart disease
• Hypertension
• Evaluation and treatment of acute coronary syndrome undergoing surgery
Pre-operative assessment

• “2014 ACC/AHA guidelines on peri-operative cardiovascular evaluation and management of patients undergoing non-cardiac surgery” algorithm
ACC/AHA algorithm

• Step 1: Is it emergency or elective surgery?
  
  • If emergency surgery calculate risk of surgery to a recognised risk stratification tool (click here to see tools), and if appropriate proceed to surgery.
  
  • If elective surgery move to step 2.
  
• Step 2: Has the patient had an acute coronary syndrome?
  
  • If yes, evaluate and treat (click here to see how to evaluate and treat). If no move to step 3 (next slide)
• Step 3: What is the estimated risk of the surgical procedure for MI or 30 day mortality?

• If low risk (<1% proceed to surgery)

• If elevated risk proceed to step 4 (next slide).

• Low risk surgery (<1%)
  • Breast, dental, thyroid, eye, carotid or minor orthopaedic

• Intermediate risk surgery (1-5%)
  • EVAR, head/neck surgery, hip/spine surgery, renal transplant

• High risk surgery (>5%)
  • Aortic/ major vascular surgery, pancreatic surgery, oesophagectomy, lower limb amputation
• Step 4: Assess functional capacity. If more than 4 METs proceed to surgery, otherwise step 5 (click here for definition of MET and its assessment).

• Step 5: If functional capacity <4 METs and further investigation will impact on decision making then proceed with pharmacological stress testing.

• If stress test is abnormal then proceed to coronary revascularisation according to existing guidelines.

• See next slide for supplemental investigations
• 12 lead ECG is reasonable for patients with IHD or structural heart disease. except for low risk surgery. It is not useful for asymptomatic patients undergoing low risk surgery.

• Routine pre-operative coronary angiography is not recommended.

• Assessment of LV function:
  • Reasonable in patients with known heart failure and worsening symptoms or dyspnoea
  • Can be considered in patients with stable disease
Cardiac risk indexes
(Lee revised is most commonly used in present day)

• Goldman cardiac risk index
  • N. Eng J Med. 297:845, 1977

• Detsky cardiac risk index
  • J Gen Intern Med 1:213, 1986

• Lee revised cardiac risk index
  • Circulation. 100:1043-1049, 1999
Goldman cardiac risk

- **History:**
  - Age >70 (5pts)
  - MI <6 months (10pts)

- **Examination:**
  - Signs of CCF (11pts)
  - Significant aortic stenosis (3pts)

- **ECG:**
  - Arrhythmia (excluding premature atrial contraction) (7pts)
  - >4 ventricular ectopics per minute (7pts)

- **General medical condition:**
  - Hypoxia, hypercarbia, liver failure, renal failure or bedridden (3pts)

- **Operation:**
  - Emergency (4pts)
  - Intrathoracic, intraperitoneal or aortic (3pts)

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Detsky cardiac risk

- Age >70 yrs (5pts)
- Prior MI:
  - <6 months (10pts), >6 months (5pts)
- Unstable angina within 6 months (10pts)
- Angina
  - Canadian class 3 (10pts), class 4 (20pts)
- Pulmonary oedema
  - With 1 week (10pts), anytime (5pts)
- Critical aortic stenosis (20pts)
- Arrhythmia (same as Goldman 5pts)
- Emergency surgery (10pts)
- Poor general health (same as Goldman 5pts)

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Revised cardiac risk index

• 6 points to consider
  • 1: High risk procedure, i.e. Intraperitoneal, intrathoracic or suprainguinal vascular
  • 2: History of ischaemic heart disease
  • 3: History of congestive heart failure
  • 4: History of stroke or TIA
  • 5: Diabetic treated with insulin
  • 6: Pre-operative creatinine of >2mg/dl

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*Risk is of “major cardiac event”, including myocardial infarction, pulmonary oedema, ventricular fibrillation, complete heart block or cardiac arrest
Cardiac medication

- Beta-blockers
- Statins
- Nitrates
- ACE inhibitors and ARBs
- Calcium channel blockers
- Alpha 2 receptor agonists
- Diuretics
Beta blockers

• Have had a controversial history over last 20 years:

• Rationale for benefit is: reducing heart rate, reduces myocardial oxygen requirement, you get longer diastolic filling and reduced contractility.

• Mangano et al showed improved outcomes at 2 years for people starting Atenolol 1 week prior to surgery.

• POISE failed to demonstrate this and showed increased risk of stroke and all cause mortality in acutely starting beta-blockers (though risk of MI reduced).

• Other studies on topics similar to this also show conflicting results, though important to realise all studies have flaws.

• See next slide for international recommendations
Beta blockers

• Current recommendations:
  • ESC/ESA:
    • Continue a beta-blocker if a patient is already receiving this medication.
    • Only consider pre-operative beta-blocker initiation in patients with IHD or high risk surgery with at least 2 risk factors.
    • If starting a beta-blocker use Atenolol or Bisoprolol. Does titration is essential.
    • Do not start beta-blockers for low risk surgery.
  • ACC/AHA:
    • Continue a beta-blocker if a patient is already receiving this medication.
    • Reasonable to start beta-blockers if high risk or >3 revised lee risk factors.
    • Beta-blocker therapy should not be started on the day of surgery.
Statins

• ACC/AHA recommend continuing statins if already on this medication. You can consider initiating this medication in patients undergoing vascular surgery or those with elevated risk factors undergoing elevated risk procedures.

• ESC/ESA mimic the above advice. They also state that statins should be commenced 2 weeks prior to surgery and preference should be for extended release/ long half life preparations.
Nitrates

- ESC/ESA guidelines state that there is insufficient evidence to recommend what to do for this medication.

- In theory: Could reverse/ prevent myocardial ischaemic but could also provoke tachycardia and hypotension.
ACE inhibitors and ARBs

- Risk of ACE/ARB is of profound hypotension under anaesthesia in around 50% of patients (more profound if also on beta-blocker). However, this hypotension appears not to influence outcomes.

- Despite organ preserving effects of longterm ACE/ARB therapy, there use has not been shown to effect mortality in surgery.

- ESC/ESA guidelines:
  - If ACE/ARB is used for hypertension discontinuation for surgery can be considered. It should be stopped 24 hours beforehand.
  - If ACE/ARB is used for heart failure or impaired LV continuation of medication should be considered

- ACC/AHA guidelines:
  - It is reasonable to continue ACE inhibitors/ARBs in the peri-operative setting.
  - If medications are withheld then restart as soon as clinically feasible.
Calcium channel blockers

• ACC/AHA review of the literature of this medication was unable to come up with any recommendations. From the limited evidence it seems that calcium channel blockers reduce incidence of ischaemia and SVT and possibly would reduce mortality. They note that this is mainly due to Diltiazem. They also note caution due to the negative inotropic effects of these medications.

• ESC/ESA guidelines mimic the ACC/AHA guidelines, but also state that you should separate drug classes dependant on whether they influence heart rate. They specifically recommend that these drugs should be continued in vasospastic angina and that Nifedipine independently increases mortality in aortic aneurysm repair.
Alpha 2 receptor antagonists

- It is hypothesised that these medications reduce noradrenaline release and therefore obtund the catecholamine surge of surge.

- Initial trials demonstrated reduced mortality and MI in vascular surgery and in IHD risk groups a reduced incidence of MI.

- However, it does increase the amount of clinically significant hypotension and non-fatal cardiac arrest as determined by the important POISE-2 trial.

- ESC/ESA recommend that these agents should not be used, and this is mimicked in the ACC/AHA guideline.
Diuretics

• ESC/ESA guidelines recommend the continuation of diuretics during the surgical period.

• It is extremely important to determine the electrolyte values of the patient on diuretics as particularly hypokalaemia can result in arrhythmia and increased mortality.

• Meticulous attention to fluid status should be undertaken to prevent hypo or hypervolaemia in this population.
Antiplatelets and anticoagulants

- Aspirin
- P2Y12 inhibitors
- Factor Xa inhibitors
- Direct thrombin inhibitors
Aspirin

• Balance of surgical bleeding risk against the risk of stopping Aspirin for its indication.

• POISE-2: 10,010 cardiac risk patients undergoing non cardiac surgery. Showed increased risk of major bleeding but decreased risk of stroke. No difference on risk of MI or death at 30 days. Importantly did not include patients with DES or bare metal stents! optimal time to restart aspirin is 8-10 days post operatively.
P2Y12 inhibitors

- i.e. Ticagrelor, Clopidogrel, Prasugrel etc. irreversibly inhibit platelet aggregation by inhibiting binding of ADP to P2Y12 receptor.

- Used in patients with peripheral vascular disease, those intolerant to aspirin, post TIA, for 1 year after drug eluting stent insertion or for 1 year post NSTEMI.

- Continue dual antiplatelet (DAPT) agents after BMS or DES insertion for the first 4-6 weeks after implantation unless the risks outweigh the benefits.

- Continue aspirin if possible and restart medication as soon as possible after surgery.

- Consideration can be given to bridging therapy with a glycoprotein 11b/IIIa inhibitor.
Factor Xa inhibitors

- Have been shown to demonstrate safety and efficacy in stroke prevention for AF patients, DVT prophylaxis in hip or knee replacement and treatment and secondary prevention of venous thromboembolism.
- Fondaparinux licensed in management of NSTEMI.
- Apixaban, Rivaroxaban, Edoxaban, Fondaparinux and Betrixaban.
- Rivaroxaban time to peak effect 3hrs, 1/2 life 7-9hrs.
Direct thrombin inhibitors

• Dabigatran

• Novel antidote called Idarucizumab

• Used for primary VTE prophylaxis in hip and knee replacements and prevention of stroke in AF patients

• Lower dose required if on Amiodarone or Verapamil

• 1/2 life of 14-17hrs.
When are antibiotics indicated?

- Indicated if procedure warrants antibiotic cover as per trust guidelines, i.e. prosthetics or contaminated surgery

- According to NICE guidance the following should have antibiotic cover due to endocarditis risk:
  - Acquired valvular heart disease with stenosis or regurgitation
  - Hypertrophic cardiomyopathy
  - Previous endocarditis
  - Valve replacement
  - Structural congenital heart disease, including corrected or palliative procedures. Excludes atrial septal defect or fully repaired ventricular septal defect or fully repaired patent ductus arteriosus or closure devices which are endothelialised
Heart failure

- Causes
- Pathophysiology
- NYHA classification
- NICE guidance on investigation
- NICE recommendation on medication
- NICE management of acute heart failure
- Peri-operative management
Heart failure: causes

- Ischaemic heart disease
- Hypertension
- Valvular heart disease (especially aortic stenosis or mitral regurgitation)
- Cardiomyopathy
- Infective and nutritional deficiencies
Pathophysiology

• Myocardial dysfunction reduces stroke volume.

• Reduction in stroke volume activates Renin-Aldosterone which retains Na and Water leading to circulatory overload.

• At the same time the left ventricle develops increase LV filling pressures and increased volumes. This in turn leads to increased myocardial oxygen demand and increased myocardial stiffness.
NYHA classification

- Class I: No limitation of physical activity
- Class II: Slight limitation of physical exercise. Physical activity results in fatigue, palpitations and SOB. Comfortable at rest.
- Class III: Marked limitation of physical exercise. Less than ordinary activity results in palpitations, SOB and fatigue. Comfortable at rest.
- Class IV: Unable to carry out any activity without discomfort. Symptoms at rest.
NICE guidance on investigation

• If had an acute MI in last two weeks perform transthoracic echocardiography. If no MI then measure natriuretic peptides and if raised proceed to transthoracic echocardiography.

• If both tests positive then assess severity, aetiology, precipitating factors and correctable causes.

• If raised natriuretic peptide and normal echo consider heart failure with preserved ejection fraction.

• Causes of raised natriuretic peptide also include: LVH, tachycardia, RV overload, sepsis, COPD, renal and liver failure.

• BNP >400pg/ml is high, normal is <100pg/ml and raised is 100-400pg/ml
NICE guidance on medication

- ACE inhibitors and beta-blockers should be given to all patients with left ventricular dysfunction. (NB: heart failure due to significant valve disease should not have an ACE inhibitor)

- Aldosterone antagonists or ARB if symptomatic despite beta-blocker and ACE inhibitor.

- Consider hydrazine and nitrate if moderate to severe heart failure and especially if afro-carribean.

- Diuretics can be used for the relief of congestive symptoms and fluid symptoms in heart failure.

- Consider Digoxin if the above have not controlled symptoms.

- Amlodipine can be used to control comorbid hypertension and angina but not verapamil or diltiazem.

- Aspirin should be prescribed if due to atherosclerotic disease.
NICE guidance on acute heart failure

• All hospitals treating acute heart failure should have a specialist service, specialist ward and an outreach service

• Do not routinely offer opiates, ultrafiltration or nitrates to patients in acute heart failure.

• Give intravenous diuretics and monitor weight, urine output and renal function.

• Start NIV without delay in patients with pulmonary oedema with academia and severe dyspnoea at presentation or if medical therapy fails.

• New presentations should have B-natriuretic peptide on admission. If raised then transthoracic echo should be undertaken (preferable within 48 hours).

• Continue beta-blockers unless HR<50 or 2-3 degree heart block.

• Restart beta blockers during hospital admission once stabilised.

• Consider starting ACE inhibitor and mineralocorticoid antagonist.

• Must be stable for 48 hours prior to discharge.
Peri-operative management

- Avoid drug interactions with long term therapy
- Maintain long term therapies
- Meticulous attention to fluid balance, normothermia, avoiding catecholamine release (i.e. good analgesia)
- Maintain sinus rhythm
- No strong evidence to show regional or general anaesthesia is superior
Diastolic dysfunction (DD)

• DD is “abnormalities of active myocardial relaxation and passive ventricular filling”. Can be caused by: incomplete myocardial relaxation, impaired LV peak filling rate, altered elasticity or pericardial constriction.

• Asymptomatic people more prevalent then symptomatic people. Similar symptoms to congestive heart failure.

• 40% have a preserved ejection fraction. difficult to diagnose but consider if raised BNP. Echocardiography may or may not be helpful. Gold standard is direct LV pressure studies but invasive.

• See next slide for anaesthetic considerations
DD and anaesthesia

- Develop left atrial enlargement which pre-disposes to AF. This is poorly tolerated due to need of atrial kick for ventricular filling.

- Tachycardia reduces filling time and hence cardiac output.

- Hypertension reduces the ability of myocardium to relax.

- Predisposed to pulmonary oedema.

- Kapila, CEACCP 2009 (9) reviews this topic.
Valvular heart disease

- Aortic stenosis
- Aortic regurgitation
- Mitral stenosis
- Mitral regurgitation
- Anticoagulation and mechanical valves
Aortic stenosis (AS)

- 1% end of life incidence
  - Degenerative calcified stenosis most common form in UK

- Normal aortic valve area 2.6-3.6cm². Haemodynamically significant when <1cm², jet velocity 4m/s and mean aortic pressure gradient >40mmHg.

- Initial pathophysiology is to have left ventricular hypertrophy to compensate and maintain gradient across the valve. The ventricle then becomes stiff leading to diastolic dysfunction. Poor ventricular filling and dependance on atrial contraction. Left atrium becomes hypertrophied. Left ventricular oxygen requirements increase but diastolic coronary flow is reduced (hence why angina occurs with normal coronary arteries). Finally stroke volume, cardiac output and pressure gradient fall.

- Next slide for more information
AS and anaesthesia

• Pre-operative: Echocardiography to assess left ventricular function and severity of stenosis, see ACC/AHA and ESC/ESA guidance.

• Peri-operative: Essential to avoid hypotension (spinal is potentially contraindicated), maintain sinus rhythm (treat new onset arrhythmia aggressively) and maintain vascular filling. Prevent tachycardia as reduces diastolic filling and coronary perfusion time. Normokaleamia is essential. Low threshold for invasive monitoring.

• Next slide for more information
AS and guidelines

• ACA/AHA guidance recommendations
  • Echocardiography is warranted in known aortic stenosis if no echo within the last year or change in clinical symptoms since last evaluation.
  • Peri-operative risk in non-cardiac surgery for people who met the standard criteria for valve replacement/repair is reduced by undergoing repair prior to non-cardiac surgery.

• ACC/AHA guidance notes:
  • Originally peri-operative 30 day mortality with AS was 13% vs. 1.6% without AS.
  • Non-emergency, non-cardiac surgery mortality rates for moderate to severe AS is now 2.1% at 30 days compared to propensity matched controls which is 1%. 
AS and guidelines

- ESC/ESA guidelines recommend:
  - Clinical and echocardiographic evaluation is recommended in all patients with known or suspected aortic stenosis who are scheduled for intermediate or high risk surgery.
  - AVR is recommended in symptomatic patients with severe aortic stenosis who are scheduled for elective non cardiac surgery provided that they are not at high risk of an adverse outcome.
  - TAVI and valvuloplasty may be reasonable to undertake prior to non cardiac surgery in patients whom AVR is contraindicated or high risk.
Mitral stenosis (MS)

• Usually the result of recurrent rheumatic inflammation.

• Normal valve area 4-6cm². usual symptoms develop when <1cm² (severe <0.5cm²).

• As disease progresses left atrial pressure (LAP) rises to aid ventricular filling, but ultimately this adaption fails and cardiac output reduces. Pulmonary vein and capillary pressure mirrors LAP and pulmonary oedema when hydrostatic pressure>osmotic pressure.

• Decreased compliance of lungs develop and right heart failure develops due to pulmonary hypertension.

• Complications include: Atrial Fibrillation, systemic emboli/thrombi and recurrent chest infections.
MS guidelines

• ESC/ESA guidelines state:
  
  • Relatively low of risk if valve area >1.5cm²
  
  • Relatively low risk if asymptomatic and systolic pulmonary artery pressure <50mmHg if valve area is <1.5cm².
  
  • If asymptomatic with systolic pulmonary artery pressure >50mmHg or symptomatic consider percutaneous mitral commissurotomy or open repair prior to surgery (particularly high risk surgery).
Aortic and mitral regurgitation

• ESC/ESA guidelines state:
  
  • Non-significant aortic or mitral regurgitation does not increase the risk of non cardiac surgery.
  
  • If asymptomatic and persevered LV then severe mitral and aortic regurgitation patients do not have increased risk.
  
  • Symptomatic or ejection fractions <30% have highly increased risk.
Anticoagulation and mechanical valves

• Essential to prevent thrombus formation of heart valves, but need to balance risk of bleeding during surgery. Ideally maintain some form of anticoagulation.

• Mitral valves are low flow valves and are at particularly high risk. If warfarin is to be discontinued then bridging therapy with either unfractionated or LMWH should be instigated.

• Aortic valves have less risk but anticoagulation should be considered especially if additional risk exist such as AF.
Arrhythmias

- Atrial fibrillation
- ALS guidelines on arrhythmias
Atrial fibrillation (AF), NICE guidance

• In suspected AF: feel pulse, perform ECG and for Paroxysmal AF consider 24hr ambulatory monitoring.

• Transthoracic echocardiography if important for long term management, cardioversion being considered, structural heart disease is suspected or refinement in risk stratification is required.

• Assess stroke and bleeding risk (see next slide) and rhythm vs rate control
Assessment of stroke and bleeding risk

- Use **CHA2DS2VASC** score for stroke risk.
  - Consider anticoagulation if score >1 (excluding female sex under 65 years old), offer anticoagulation if score >2.
  - Use either Apixaban, Dabigatran, Rivaroxaban or Warfarin dependant on patient choice.
- Use the **HAS-BLED** score for bleeding risk.
  - Risk vs benefit of bleeding and stroke risk.
- To reduce risk of bleeding modify uncontrolled hypertension, poor INR control, harmful alcohol consumption and concurrent use of NSAIDs.
- Consider left atrial appendage occlusion if anticoagulation is contraindicated.
- Next slide for rate vs rhythm control
Rate vs. rhythm control

- Rhythm control patients with: AF due to reversible cause, heart failure induced by AF and new onset AF.

- Rate control with a beta blocker (excluding Sotalol) or rate limiting calcium channel blocker. Consider Digoxin monotherapy if sedentary lifestyle.

- If single agent dose not control rate use any two if beta blocker, diltiazem or digoxin.

- Do not offer Amiodarone for long term therapy.

- See next slide for cardioversion
Cardioversion for AF

- Electrical rather pharmacological if AF >48 hours. Consider Amiodarone 3 weeks prior and 12 months after to increase likelihood of success. Need transthoracic echo or TOE during procedure to exclude thrombus and will need anticoagulation.

- To maintain rhythm control consider beta blocker if needed or Dronedarone (particularly if have cardiac risks but do not have LV dysfunction)

- Consider “pill in the pocket strategy” for paroxysmal AF.

- Other treatments include “Pace and ablate” and left atrial ablation.

- Next slide for acute AF management
Acute AF management

- Electrically cardiovert patients in new onset AF with life threatening features. Do not delay for anticoagulation.

- If not life threatening. Offer rate or rhythm control <48 hours duration otherwise offer rate control.

- If pharmacologically cardioverting consider Flecanide (if no structural heart disease) or Amiodarone.
ALS guidance on arrhythmias

- **Tachy-arrhythmia**
- **Brady-arrhythmia**

Remember adverse features:

- Shock (systolic <90mmHg)
- Syncope
- Myocardial ischaemia
- Heart failure
Assess using the ABCDE approach:
- Monitor SpO₂ and give oxygen if hypoxic
- Monitor ECG and BP, and record 12-lead ECG
- Obtain IV access
- Identify and treat reversible causes (e.g., electrolyte abnormalities)

**Adverse features?**
- Shock
- Syncope
- Myocardial ischaemia
- Heart failure

**Atropine 500 mcg IV**

**Satisfactory response?**
- Yes
- No

**Consider interim measures:**
- Atropine 500 mcg IV repeat to maximum of 3 mg
- Transcutaneous pacing
- Isoprenaline 5 mcg min⁻¹ IV
- Adrenaline 2-10 mcg min⁻¹ IV
- Alternative drugs*

**Seek expert help**
**Arrange transvenous pacing**

**Risk of asystole?**
- Recent asystole
- Mobitz II AV block
- Complete heart block with broad QRS
- Ventricular pause > 3 s

**Continue observation**

* Alternatives include:
- Aminophylline
- Dopamine
- Glucagon (if bradycardia is caused by beta-blocker or calcium channel blocker)
- Glycopyrrolate (may be used instead of atropine)
Anaesthetic considerations of major guidelines

• Timing of Elective cardiac surgery post cardiac interventions
Timing of Elective cardiac surgery post cardiac interventions

- Elective non-cardiac surgery should be delayed 14 days post balloon angioplasty and 3 days if a bare metal stent has been inserted.

- Elective non-cardiac surgery should optimally be delayed 365 days post drug eluting stent (DES) insertion. However, surgery can occur at 180 days if the risk of no surgery is greater than the risk of stent thrombosis/MI.

- Elective surgery for patients with DES should not be performed within a year if dual anti platelet therapy needs to be stopped peri-operatively.
Pacemakers

- Pacemakers
- Generic pacemaker coding scheme
- Implantable cardioverter defibrillators
- Cardiac resynchronisation therapy
- Peri-operative management
Pacemakers

• “Class I” Indications for pacing according to ACC/AHA consensus guidelines
  
  • Bradycardias: 3rd degree heart block, symptomatic bradycardia due to presumed AV block, conditions which require drugs that cause symptomatic bradycardia, pauses of $\geq 3$ seconds (including carotid sinus pressure), escape heart rate of $<40$bpm and asymptomatic, neuromuscular disorders with AV block, post catheter ablation of AV node, symptomatic second degree heart block with bradycardia and postoperative AV block that is not expected to resolve.

  • Tachycardias: Symptomatic SVT resistant to ablation and medical management (overdrive pacing).
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Implantable cardioverter defibrillators

- NICE indication: “people who have had a serious ventricular arrhythmia, who have an inherited heart condition linked to a high risk of sudden death, or who have had surgery to repair congenital heart disease”.

- ACC/AHA class I indications: cardiac arrest due to VT/VF not due to a transient cause, spontaneous sustained VT or non sustained VT with either IHD, prior MI, LV dysfunction.
Cardiac resynchronisation therapy (CRT)

- CRT has three leads that go to the right atrium and both ventricles. CRT synchronises the contraction of the ventricles to optimise cardiac output.

- CRT-D and CRT-P exist; D means with defibrillator function whereas P is pacing function.

- CRT-D or CRT-P is recommended treatment option in patients with heart failure who have LV dysfunction and an ejection fraction <35%. The device is tailored according to NYHA class and QRS interval on ECG.
Preoperative management of patients with cardiac implantable electronic devices


- See next page for algorithm developed from this article
Fig 3 Suggested algorithm for preoperative decision-making regarding a modern CIED with bipolar leads. Suggested actions involving magnet application assume that the magnet response for the device is enabled, and cautery dispersal pads are appropriately located. Additional considerations may involve suspending rate-adaptive functionality, increasing outputs for cases involving transfusions or large volume shifts, and increasing the backup rate of a demand pacemaker.
Peri-operative management

- MHRA guidance:
  - Pre-operatively clarify: Indication for insertion, presence of heart failure, degree of pacemaker dependency, implant complexity, if approaching replacement phase and if any safety advisory notices exist or restrictions apply. Should have been checked and verified for function in the last 3 months.
  
  - Peri-operative management: If diathermy is in close proximity to the pacemaker then you should contact the follow up clinic for advice and to check if reprogramming or post operative support is required. ICDs should be placed in the “monitor only” mode. If difficult access to chest is anticipated for an ICD consider placing defibrillator pads prior to surgery.

  - Mandatory equipment: Availability of CPR equipment with temporary pacing function, availability of cardiac personnel, continuous ECG monitoring, have an additional method of detecting the patient’s pulse (i.e. pulse oximeter or arterial line).

Next slide for more information
• If monopoly diathermy is unavoidable limit bursts to short duration. Ensure current pathway is as far from device as possible for any form of diathermy.

• In emergency situations: Have CPR and pacing facilities immediately available. If pacemaker cannot be checked pre-operatively then it should be checked as soon as feasible post-operatively. For ICDs consideration should be given to taping a magnet over the device to inhibit shock delivery (note that VF/VT will require external management and some ICDs can be programmed not to be inhibited by a magnet). If a magnet is used then the device must be checked post-operatively.

• Some pacemakers respond to a magnetic field by going into asynchronous pacing, however, this cannot be guaranteed.
Ischaemic heart disease

- NICE guidance on secondary prevention medication
NICE guidance on secondary prevention medication

• Offer all people who have had an MI:
  
  • ACE inhibitor. Start as soon as haemodynamically stable and ARB if intolerant.
  
  • Dual anti platelet therapy (aspirin and another anti-platelet)
  
  • Beta-blocker. Start as soon as haemodynamically stable. Only continue if there is evidence of left heart failure after 12 months. If beta blocker intolerant and no evidence of heart failure give verapamil.
  
  • Statin
Hypertension

- NICE guideline
- Peri-operative management
NICE Hypertension guidance

• Stage 1: Clinical blood pressure >140/90mmHg and ambulatory or home BP >135/85mmHg

• Stage 2: Clinical BP >160/100mmHg and ambulatory or home BP >50/95mmHg

• Stage 3 (severe): Clinical BP >180 systolic or >110mmHg diastolic.

• see next slide for investigation and management
Investigation and management

• Assess for end organ damage and perform formal cardiovascular risk assessment. This involves: urine protein:creatinine ratio, urinalysis, ECG, fundoscopy and bloods for glucose, cholesterol and renal function.

• Treat stage 1 if target organ damage, cardiovascular disease, renal disease, diabetes or 10yr cardiovascular risk >20%. Treat all stage 2 disease.

• Consider alternate diagnosis such as phaeochromocytoma etc.

• If <55yr old start with ACE inhibitor or ARB if intolerant. If black or >55yr old start calcium channel antagonist or thiazide diuretic if intolerant. Add calcium channel blocker if ACE is insufficient and then diuretic. Refer to specialist if adding fourth line agent (i.e. spironolactone).
Hypertension peri-operative management

• ESC guidelines recommend:
  • New onset hypertensives should be screened for evidence of end-organ damage and other cardiac risk factors
  • Avoid large fluctuations in blood pressure in these individuals
  • “may consider not deferring surgery if systolic <180mmHg or diastolic <110mmHg)
Evaluation and treatment of acute coronary syndrome undergoing surgery

• ACA/AHA guidance states:

  • Revascularisation prior to surgery is only indicated if existing indications already exist. Otherwise there is no reduction in risk.

  • Delay surgery after PCI for 14 days after balloon angioplasty, 30 days after bare metal stent (BMS) and 365 days after drug eluting stent (DES) (can be considered after 180 days).

  • Continue dual antiplatelet (DAPT) agents after BMS or DES insertion for the first 4-6 weeks after implantation unless the risks outweigh the benefits.
METs and Duke activity status index

- METs stands for “metabolic equivalents”.

- 1 MET is equivalent to the basal oxygen consumption of a 40 year old, 70Kg male.

- Functional capacity is deemed:
  - Excellent if >10 METs
  - Good 7-10 METs
  - Moderate 4-6 METs
  - Poor <4 METs

<table>
<thead>
<tr>
<th>METs</th>
<th>Example</th>
</tr>
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<tbody>
<tr>
<td>2.75</td>
<td>Dressing, bathing, toiling</td>
</tr>
<tr>
<td>5.5</td>
<td>Climb a flight of stairs</td>
</tr>
<tr>
<td>4.5</td>
<td>Gardening- raking, cutting grass</td>
</tr>
<tr>
<td>7.5</td>
<td>Swimming, tennis, football</td>
</tr>
</tbody>
</table>

(Table is of Duke activity status)
Heart transplant

- Complications of a heart transplantation:
  - Donor coronary artery disease: Most common cause of death after 1 year. Immune mediated. Starts distal and works proximal. Do not have angina as denervated!
  - Rejection: Most common in 1st year. Undergo regular biopsies during this time and then as indicated.
  - Risk of atypical infections, including viral illnesses.
  - Also, the stigmata of the original disease may still be apparent. particularly systemic diseases such as sarcoidosis.
- Continued on next slide
Heart transplant

• Physiology and pharmacology:

  • Heart rate is dependant on donor atrial activity. Surgical disruption of this area means that 10% may require a pacemaker. RBBB on ECG is common and generalised AV conduction delay is common.

  • No autonomic innervation! Therefore resting heart rate is 90-100bpm due to no vagal tone. Also, normal responses to stress are lost, i.e. no tachycardia, hypertension with laryngoscopy. Likewise, poor/slow compensation for changes in SVR.

  • Dependancy on catecholamines to change heart rate means a slow increase and decrease in heart rate to exercise.

  • Starling pressure-volume relationship remains intact.

  • Vagolytic drugs (atropine etc) and digoxin cease to have an effect. Adenosine shows increased effectiveness.
Heart transplant

• Preoperative assessment:
  • Will be on a follow up programme, so recent echo, CMV status, rejection status and coronary angiography should be sought. Advice on immunosuppression and antibiotic prophylaxis should also be gained from transplant centre. Check exercise tolerance and presence of orthopnoea. Ensure electrolytes are normal.

• Perioperative care:
  • Conduct of anaesthesia based on surgery type (and can have regional technique). “Scrupulous asepsis” is essential! Maintain normovolaemia. Avoid nasal intubation due to nasal flora. Have direct acting agents such as ephedrine to hand and peripheral vasoconstrictors (i.e. metaraminol). Have external pacing to hand and avoid RIJ cannulation due to approach used for biopsies.

• Postoperative care:
  • Remove lines as soon as appropriate. Maintain contact with transplant team. Void non-steroidal drugs.

• See: BJA education article on this subject available online.
# CHA2DS2-VASC

<table>
<thead>
<tr>
<th>Risk</th>
<th>Score</th>
<th>CHA2DS2-VASc Score</th>
<th>Adjusted stroke rate (% / year)</th>
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<tbody>
<tr>
<td>CHF or LVEF &lt;40%</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Hypertension</td>
<td>1</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Age &gt; 75</td>
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<tr>
<td>Diabetes</td>
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<td>3</td>
<td>3.2</td>
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<tr>
<td>Stroke / TIA / Thromboembolism</td>
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<td>4</td>
<td>4</td>
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<tr>
<td>Vascular Disease</td>
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<td></td>
<td></td>
<td>9</td>
<td>15.2</td>
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CHF = congestive heart failure; TIA - transient ischemic attack; LVEF = left ventricular ejection fraction.
<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Score</th>
<th>HAS-BLED Score</th>
<th>Bleeding Rate (%/year)</th>
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<td>Abnormal renal/hepatic function</td>
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<tr>
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<td>Labile INRs</td>
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<td>≥5</td>
<td>Insufficient data</td>
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<tr>
<td>Drugs or alcohol use</td>
<td>1 (each)</td>
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