Bradycardias: Diagnosis, Management, and Guidelines

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Disclosures

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• Speaker fee / travel assistance – Bayer
Overview

• Question-based approach to bradycardias (and related topics...)
• Based on the core curriculum for EEGC/KBA
• Discussion and review of relevant Guidelines for each Question
• Interactive 😊
A 22 year old lady is brought to the Emergency Department after collapsing at a barbecue. She had been standing for several hours on a hot July day and had consumed two glasses of wine. She experienced sweating and nausea prior to collapsing with brief loss of consciousness. Bystanders reported pallor and a pulse rate <40 bpm whilst unconscious. She made a rapid recovery and her cardiovascular examination and 12-lead ECG are normal. What is the most appropriate management?

A) Admit for cardiac rhythm monitoring and echocardiography
B) Discharge on Fludrocortisone
C) Discharge with referral for out-patient implantable loop recorder
D) Discharge with referral for neurological evaluation
E) Discharge with reassurance and education
A 22 year old lady is brought to the Emergency Department after collapsing at a barbecue. She had been standing for several hours on a hot July day and had consumed two glasses of wine. She experienced sweating and nausea prior to collapsing with brief loss of consciousness. Bystanders reported pallor and a pulse rate <40 bpm whilst unconscious. She made a rapid recovery and her cardiovascular examination and 12-lead ECG are normal. What is the most appropriate management?

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VVS is highly probable if syncope is precipitated by pain, fear, or standing, and is associated with typical progressive prodrome (pallor, sweating, and/or nausea).\textsuperscript{8,13–17}
Question 1b

A 22 year old lady is brought to the Emergency Department after collapsing at a barbecue. She had been standing for several hours on a hot July day and had consumed two glasses of wine. She experienced sweating and nausea prior to collapsing with brief loss of consciousness. Bystanders reported pallor and a pulse rate <40 bpm whilst unconscious. She made a rapid recovery and her cardiovascular examination and 12-lead ECG are normal. She is discharged. She is a Group 2 bus driver. What advice should she be given regarding driving?

A) She must not drive until cleared by the DVLA
B) She can resume driving in 1 week if she has not had further episodes
C) She can resume driving in 1 month if she has not had further episodes
D) She can continue to drive but must inform DVLA
E) She can continue to drive and does not need to inform DVLA
A 22 year old lady is brought to the Emergency Department after collapsing at a barbecue. She had been standing for several hours on a hot July day and had consumed two glasses of wine. She experienced sweating and nausea prior to collapsing with brief loss of consciousness. Bystanders reported pallor and a pulse rate <40 bpm whilst unconscious. She made a rapid recovery and her cardiovascular examination and 12-lead ECG are normal. She is discharged. She is a Group 2 bus driver. What advice should she be given regarding driving?

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With concern for road safety the two most important features of temporary loss of consciousness are:

- prodrome – are there warning signs sufficient in both nature and duration?
- posture – do the episodes of TLoC occur while sitting?

A prodrome must allow time for a driver to find a safe place to stop before losing consciousness. A prodrome is reliable if the signs are clear, consistent across all events and provide sufficient duration to find a safe stop, or unreliable if these are absent.

Licence holders or applicants should be informed that they must notify the DVLA when transient loss of consciousness occurs while sitting.

<table>
<thead>
<tr>
<th></th>
<th>Group 1 car and motorcycle</th>
<th>Group 2 bus and lorry</th>
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</thead>
<tbody>
<tr>
<td><strong>Typical vasovagal syncope with reliable prodrome</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>While standing</td>
<td>□ May drive and need not notify the DVLA.</td>
<td>□ May drive and need not notify the DVLA.</td>
</tr>
<tr>
<td>While sitting</td>
<td>□ Must not drive and must notify the DVLA. Must not drive until annual risk of recurrence is assessed as below 20%.</td>
<td>□ Must not drive and must notify the DVLA. Must not drive until annual risk of recurrence is assessed as below 2%.</td>
</tr>
<tr>
<td><strong>Syncope with avoidable trigger or reversible cause</strong> (for cough syncope see page 24)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>While standing</td>
<td>□ May drive and need not notify the DVLA.</td>
<td>□ May drive and need not notify the DVLA.</td>
</tr>
<tr>
<td>While sitting</td>
<td>□ Must not drive for 4 weeks. Driving may resume after 4 weeks only if the cause has been identified and treated. Must notify the DVLA if the cause has not been identified and treated.</td>
<td>□ Must not drive for 3 months. Driving may resume after 3 months only if the cause has been identified and treated. Must notify the DVLA if the cause has not been identified and treated.</td>
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A 75 year old man has a dual-chamber pacemaker implanted for complete heart block. A recent pacing check shows that he is pacing-dependent with no underlying rhythm. He has been referred for an MRI scan. Which pacing mode would be safest during the scan?

A) DDD  
B) AAI  
C) VVI  
D) VOO  
E) DDI
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C) VVI  
D) VOO  
E) DDI
Implanted PM/ICD

Conventional PM/ICD

- Exclude patients with:
  - leads implanted <6 weeks before
  - abandoned or epicardial leads

  Record devices variables
  (lead impedance/threshold, P/R wave amplitude and battery voltage)

  Not PM-dependent
  - Programme VVI/DDI (inhibited)
  - Deactivate other pacing functions
  - Deactivate monitoring and ATP/shock therapies (ICD)

  PM-dependent
  - Programme VOO/DOO (asynchronous)
  - Monitor ECG and symptoms during MRI

  - Re-check device variables and compare with baseline
  - Restore original programming

MRI-compatible PM/ICD

- Follow manufacturer's instructions
VOO Mode – Asynchronous Pacing

Chamber paced: Ventricle
Chamber sensed: None
Response to sensing: None

VOO results in fixed-rate pacing in the ventricle.

The intrinsic ventricular event cannot be sensed, and thus, does not interrupt the pacing interval.
A 73 year old man experiences an episode of syncope without warning. He is found to have severely impaired LV systolic function (LVEF 33%). He has unobstructed coronary arteries. His ECG is shown.
Question 3

A 73 year old man experiences an episode of syncope without warning. He is found to have severely impaired LV systolic function (LVEF 33%). He has unobstructed coronary arteries. His ECG is shown.

In addition to medical therapy, which is the most appropriate next step:  
A) Implantable loop recorder  
B) Backup VVI permanent pacemaker  
C) Dual chamber permanent pacemaker  
D) Implantable cardiac defibrillator (ICD)  
E) Cardiac resynchronisation therapy defibrillator (CRT-D)
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Figure 4  Therapeutic algorithm for patients presenting with unexplained syncope and bundle branch block (BBB). CRT-D = cardiac resynchronization therapy and defibrillator; CSM = carotid sinus massage; EF = ejection fraction; EPS = electrophysiological study; ICD = implantable cardioverter defibrillator; ILR = implantable loop recorder.
A 42 year old man has an implantable loop recorder in-situ due to unexplained syncope. His resting 12-lead ECG is normal. He experiences a further syncopal episode. The ILR trace during the event is shown.
A 62 year old man has an implantable loop recorder in-situ due to unexplained syncope. His resting 12-lead ECG is normal. He experiences a further syncopal episode. The ILR trace during the event is shown.

The most appropriate pacing prescription is:
A) VVI
B) CRT-P
C) DDDR + AV delay management
D) DDD + no AV delay management
E) VVIR
A 62 year old man has an implantable loop recorder in situ due to unexplained syncope. His resting 12-lead ECG is normal. He experiences a further syncopal episode. The ILR trace during the event is shown.

The most appropriate pacing prescription is:
A) VVI
B) CRT-P
C) DDDR + AV delay management
D) DDD + no AV delay management
E) VVIR
Figure 3  Optimal pacing mode in sinus node disease and AV block. AF = atrial fibrillation; AV = atrioventricular; AVM = AV delay management, i.e. to prevent unnecessary right ventricular pacing by means of manual optimization of AV interval or programming of AV hysteresis; SND = sinus node disease.
A 56 year old lady is diagnosed with dilated cardiomyopathy, with LVEF 40%. She is in NYHA class II and is on optimal medical therapy. Her routine ECG in clinic is shown.
Question 5

A 56 year old lady is diagnosed with dilated cardiomyopathy, with LVEF 40%. She is in NYHA class II and is on optimal medical therapy. Her routine ECG in clinic is shown.

Which of the following is the most appropriate next step:

A) Single chamber ventricular pacemaker
B) Dual chamber pacemaker
C) CRT pacemaker
D) CRT defibrillator
E) Dual chamber chamber defibrillator
A 56 year old lady is diagnosed with dilated cardiomyopathy, with LVEF 40%. She is in NYHA class II and is on optimal medical therapy. Her routine ECG in clinic is shown.

Which of the following is the most appropriate next step:
A) Single chamber ventricular pacemaker
B) Dual chamber pacemaker
C) CRT pacemaker
D) CRT defibrillator
E) Dual chamber chamber defibrillator
Indication for upgraded or de novo cardiac resynchronization therapy in patients with conventional pacemaker indications and heart failure

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Upgrade from conventional PM or ICD. CRT is indicated in HF patients with LVEF &lt;35% and high percentage of ventricular pacing who remain in NYHA class III and ambulatory IV despite adequate medical treatment.</td>
<td>I</td>
<td>B</td>
<td>47, 108-122</td>
</tr>
<tr>
<td>2) De novo cardiac resynchronization therapy. CRT should be considered in HF patients, reduced EF and expected high percentage of ventricular pacing in order to decrease the risk of worsening HF.</td>
<td>IIa</td>
<td>B</td>
<td>123-130</td>
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</table>

Curtis et al., NEJM 2013

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CRT = cardiac resynchronization therapy; HF = heart failure; ICD = implantable cardioverter defibrillator; LVEF = left ventricular ejection fraction; PM = pacemaker; NYHA = New York Heart Association.

*Class of recommendation.

bLevel of evidence.

Reference(s) supporting recommendation(s).

Patients should generally not be implanted during admission for acute decompensated HF. In such patients, guideline-indicated medical treatment should be optimized and the patient reviewed as an out-patient after stabilization. It is recognized that this may not always be possible.

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**Graph: Event-free Rate (%)**

- Biventricular pacing
- Right ventricular pacing

**No. at Risk**

<table>
<thead>
<tr>
<th></th>
<th>Biventricular pacing</th>
<th>Right ventricular pacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 months</td>
<td>349</td>
<td>342</td>
</tr>
<tr>
<td>12 months</td>
<td>161</td>
<td>126</td>
</tr>
<tr>
<td>24 months</td>
<td>87</td>
<td>59</td>
</tr>
<tr>
<td>36 months</td>
<td>62</td>
<td>39</td>
</tr>
<tr>
<td>48 months</td>
<td>38</td>
<td>28</td>
</tr>
<tr>
<td>60 months</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>72 months</td>
<td>3</td>
<td>10</td>
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A 65 year old man undergoes coronary artery bypass grafting for multi-vessel coronary artery disease. On day 2 post-operatively, the epicardial wire thresholds are tested and found to be stable. Epicardial pacing is temporarily withdrawn and the ECG recorded is shown.
Question 6

A 65 year old man undergoes coronary artery bypass grafting for multi-vessel coronary artery disease. On day 2 post-operatively, the epicardial wire thresholds are tested and found to be stable. Epicardial pacing is temporarily withdrawn and the ECG recorded is shown.

The most appropriate action is:
A) Implant a dual chamber pacemaker
B) Observe as in-patient for up to 7 days for recovery of conduction
C) Observe as in-patient for up to 4 weeks for recovery of conduction
D) Implant a single chamber ventricular pacemaker
E) Commence an Isoprenaline infusion
Question 6 - Answer

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Pacing after cardiac surgery, transcatheter aortic valve implantation and heart transplantation

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<tr>
<td>1) High degree or complete AV block after cardiac surgery and TAVI. A period of clinical observation up to 7 days is indicated in order to assess whether the rhythm disturbance is transient and resolves. However, in case of complete AV block with low rate of escape rhythm this observation period can be shortened since resolution is unlikely.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>2) Sinus node dysfunction after cardiac surgery and heart transplantation. A period of clinical observation from 5 days up to some weeks is indicated in order to assess if the rhythm disturbance resolves.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>3) Chronotropic incompetence after heart transplantation. Cardiac pacing should be considered for chronotropic incompetence impairing the quality of life late in the post-transplant period.</td>
<td>IIa</td>
<td>C</td>
</tr>
</tbody>
</table>

*a* Class of recommendation.  
*b* Level of evidence.  
*c* Reference(s) supporting recommendation(s).
A 58 year old woman with a dual chamber pacemaker presented with dizziness and fatigue. Cardiac examination revealed a regular, bradycardic rhythm with an S1 of variable intensity. Cannon A waves were present on neck examination. Her 12-lead ECG is shown.
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The diagnosis is:
A) Ventricular under-sensing
B) Ventricular under-sensing and non-capture
C) Atrial non-capture
D) Ventricular non-capture
E) Atrial under-sensing and non-capture
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A 74 year old man with known heart failure, permanent AF, and CRT-P in-situ is evaluated for persistent breathlessness and reduced exercise tolerance. He does not experience chest pain. His current medication includes Ramipril 10mg OD, Bisoprolol 10mg OD, Spironolactone 25mg OD, Digoxin 125 mcgOD, and Apixaban 5mg BD. His biventricular pacing percentage is 90%.

The most appropriate next step is:
A) Echo-guided CRT optimisation
B) Referral for respiratory evaluation
C) AV junction ablation
D) Myocardial perfusion scan
E) Coronary angiography
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The most appropriate next step is:
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Heart Failure, NYHA class III-IV and EF <35%:

- QRS ≥120 ms
  - CRT*
    - Incomplete BiV pacing: AVJ ablation
    - Complete BiV pacing: No AVJ ablation

- QRS <120 ms
  - Adequate rate control
    - No AVJ abl No CRT*
  - Inadequate rate control
    - AVJ ablation & CRT

Reduced EF and uncontrollable HR, any QRS:

*Consider ICD according to guidelines
Question 9

A 54 year old man with a permanent pacemaker in-situ presents with dizziness. His ECG is shown.
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A 54 year old man with a permanent pacemaker in-situ presents with dizziness. His ECG is shown.

The diagnosis is:
A) Complete heart block with normal pacemaker function
B) Failure of ventricular sensing in single chamber pacemaker
C) Failure of ventricular capture in single chamber pacemaker
D) Failure of ventricular capture in dual chamber pacemaker
E) Failure of atrial sensing in dual chamber pacemaker
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Question 10

A 54 year old man has a permanent pacemaker implanted. He develops palpitations immediately after the procedure. His ECG is shown.
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What is the most appropriate treatment?

A) IV Adenosine
B) Pacemaker lead repositioning
C) PO Beta-blocker
D) Pacemaker reprogramming to VVI
E) Pacemaker reprogramming to extend PVARP
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Example of a too short **PVARP** inducing an Electronic Reentrant Tachycardia (ERT) due to a loss of atrial capture.

The first loss of atrial capture (*) leads to postventricular pacing-induced atrial retrograde depolarization identified into the PVARP (identified as « AR »). The same phenomenon is observed for the second loss of atrial capture (**) but the retrograde atrial activation has been sensed by the A. channel out of the PVARP (identified as « AS » which activates the AVD algorithm): onset of an ERT.