

## Tachyarrhythmias

### Definition of tachycardia

- Cardiac arrhythmia with a rate >100 beats per minute (bpm)

### Differential diagnosis of tachycardia

- Narrow complex tachycardias
  - Regular (supraventricular tachycardia [SVT])
    - Sinus tachycardia
      - Physiological response to insult. Impulse originates from sino-atrial (SA) node.
    - Atrial tachycardia
      - Aberrant atrial focus producing impulse independent of SA node
    - Atrioventricular nodal re-entry tachycardia (AVNRT)
      - Re-entry circuit within or near AV node
    - AV re-entry tachycardia (AVRT)
      - Re-entry circuit conducted from atria to ventricles via abnormal accessory pathway; usually due to Wolff-Parkinson-White (WPW) syndrome
    - Atrial flutter with regular AV block (eg 2:1, 3:1)
      - Re-entry circuit within the atria
  - Irregular
    - Atrial fibrillation (AF)
      - Atria twitch instead of beating in a coordinated manner
- Broad complex tachycardias
  - Regular
    - Ventricular tachycardia (VT)
      - Generated by a single ventricular focus
    - SVT with bundle branch block (BBB)
      - This is rare. Any broad complex tachycardia should be treated as VT unless there the patient has an old ECG with clear previous bundle branch block of unchanged morphology.
  - Irregular
    - Polymorphic VT (Torsades de pointes)
      - Sinusoidal morphology usually due to abnormal ventricular repolarisation (long QT)
    - AF with bundle branch block

### Aetiology of tachyarrhythmias (pathological as opposed to physiological)

- Cardiac
  - Post-cardiac arrest
  - Post-myocardial infarction (MI)
  - Long QT syndrome
  - Valvular heart disease
  - Cardiomyopathy
- Non-cardiac
  - Hypoxia
  - Hypovolaemia
  - Electrolyte abnormalities
    - Especially hypo/hyper-kalaemia, -calcaemia or -magnesaemia

- Hypoglycaemia
- Hypo/hyperthermia
- Hypo/hyperthyroidism
- Sepsis
- Drug-induced
  - Cocaine
  - Amphetamines
  - Tricyclic antidepressants
  - Beta blockers
  - Digoxin
  - Amiodarone

### Clinical features of tachycardias

- Adverse features
  - Shock
    - Hypotension, diaphoresis, pallor, increased capillary refill time (CRT)
  - Syncope
    - Transient loss of consciousness
  - Myocardial ischaemia
    - Ischaemic chest pain and/or ischaemic electrocardiogram (ECG) changes
  - Cardiac failure
    - Orthopnoea, paroxysmal nocturnal dyspnoea (PND), bibasal crepitations, raised jugular venous pressure (JVP)
- Non-adverse features
  - Palpitations
  - Dyspnoea
  - Anxiety

### Initial investigation of tachycardia

- Bloods
  - Full blood count
  - Urea & electrolytes
  - Magnesium
  - Bone profile (particularly noting calcium and phosphate)
  - Thyroid function tests
  - Other: liver function (useful pre-medication); coagulation (may need anticoagulation)
- Chest radiograph (CXR)

### Further investigation of tachycardia

- Echocardiogram (echo)

### Initial management of tachycardia

- Assess patient from an ABCDE perspective
- Maintain a patent airway
  - Use manoeuvres, adjuncts, supraglottic or definitive airways as indicated
- Controlled oxygen
  - Maintain saturations ( $S_pO_2$ ) 94-98%

- Attach monitoring
  - Pulse oximetry
  - Non-invasive blood pressure
  - Three-lead cardiac monitoring
  - Defibrillator pads
- 12 lead ECG
- Obtain intravenous (IV) access and take bloods
- Give IV fluid challenge if appropriate and repeat as necessary
- Identify and treat any reversible causes e.g. electrolyte abnormalities on initial VBG
  
- If adverse features are present [shock, syncope, myocardial ischaemia, heart failure] prepare for DC cardioversion under general anaesthesia or conscious sedation
  - Once ready, warn all those nearby to stand clear and remove any oxygen delivery device whilst the defibrillator is set to synchronised mode and charged to 120 J
  - Once the defibrillator is charged and all are clear, deliver the shock
  - Should this fail, two subsequent shocks at increasing increments may be tried
  - Should this fail, give a loading dose of amiodarone 300 mg IV over 10-20 minutes and repeat DC cardioversion followed by amiodarone 900 mg IV over 24 hours
  
- If adverse features are not present, assess the rhythm:
- Narrow complex tachycardias (QRS duration <0.12 s)
  - Regular: likely SVT
    - Attempt vagal manoeuvres
      - Valsalva (ask patient to blow into syringe); carotid sinus massage.
        - If this fails then:
    - Adenosine 6 mg IV
      - Rapid bolus ideally into a large-bore cannula in the antecubital fossa
      - Warn patients of transient unpleasant side effects: flushing, nausea and chest tightness, 'feeling of impending doom'
      - Avoid in patients with asthma, WPW syndrome, and denervated hearts
      - Caution in taking throphylline, dipyridamole or carbamazepine
      - If 6mg unsuccessful:
    - Adenosine 12 mg IV
      - If first 12mg unsuccessful:
    - Further adenosine 12 mg IV
    - If adenosine is contraindicated, consider verapamil 2.5-5.0 mg IV, or flecainide 2 mg/kg IVI over 20-30 min if no evidence of structural heart disease
  - Irregular: likely AF
    - Onset <48 hours
      - Aim for rhythm control
        - Flecainide 2 mg/kg IVI over 20-30 min if no evidence of structural heart disease or amiodarone 300 mg IV over 20-30 min and 900 mg over 24 hours if flecainide contraindicated
        - Anticoagulate with enoxaparin 1.5 mg/kg subcutaneous (SC) prior to this
    - Onset >48 hours
      - Aim for rate control
        - Metoprolol 5 mg IV OR bisoprolol 5 mg orally (PO) OR verapamil 5 mg IV
          - If signs of heart failure try digoxin 0.5 mg IVI over 30-60 min
          - Digoxin can be added to the above if beta-blockade unsuccessful

- Anticoagulate with enoxaparin 1.5 mg/kg subcutaneous (SC) prior to this
- Broad complex tachycardias (QRS duration >0.12 s)
  - Regular
    - If likely monomorphic VT
      - Give amiodarone 300 mg IVI over 20-30 min followed by amiodarone 900 mg IVI over 24 hours
      - Any broad complex tachycardia should be treated as VT unless there the patient has an old ECG with clear previous bundle branch block of unchanged morphology.
    - If definitely SVT with BBB
      - Try adenosine as for regular narrow complex tachycardias
  - Irregular
    - If likely AF with BBB
      - Treat as for irregular narrow complex tachycardias
    - If likely polymorphic VT (Torsades de pointes)
      - Magnesium 2 g IV over 10 min
      - Stop any medications which prolong the QT interval
      - Correct any electrolyte abnormalities if not already done so, and give

#### Further management of tachycardia

- Request 12 lead ECG once back in sinus rhythm
  - Look specifically for ischaemic changes (ST elevation, ST depression and T wave inversion), prolonged QT interval ( $QT_c > 440$  ms) and signs of WPW syndrome (shortened PR interval, delta wave and broad QRS complex)
- Identify and correct any underlying cause if not already done so
- Call cardiologist
  - Arrange for an implantable cardioverter defibrillator (ICD) if appropriate

#### Common questions concerning tachycardia

- List the adverse features which signify an unstable tachyarrhythmia
- What is the appropriate management of a tachyarrhythmia if one or more adverse features are present?
- What procedure must be performed in a conscious patient in order to facilitate this management?
- If no adverse features are present, outline your approach to the assessment of a stable tachyarrhythmia
- How would you manage a patient in stable SVT?
- How would you manage a patient in stable AF of onset <48 hours?
- How would you manage a patient in stable AF of onset >48 hours?
- How would you manage a patient in stable VT?
- Once the tachyarrhythmia has reverted back to sinus rhythm, what follow up investigations would you request?