

Cardiac Arrhythmia

Definition: Any abnormality in cardiac rhythm.

Possible Manifestations:

- May cause sudden death, syncope, heart failure, chest pain, dizziness, palpitations, or **may be asymptomatic**.

Main Types of Arrhythmias:

1. **Bradycardia:** Slow heart rate (< 60 beats/min).
2. **Tachycardia:** Rapid heart rate (> 100 beats/min).

Sinus Node Function

- The cardiac pacemaker is the **sinus node**, which **depolarizes spontaneously**.
- It is under the influence of the **autonomic nervous system**, with **parasympathetic predominance**.

Types of Sinus Rhythm Abnormalities

1 Sinus Arrhythmia

- Change in rhythm during **respiration** due to **fluctuation in autonomic tone**.
- With **inspiration** → **heart rate increases**
With **expiration** → **heart rate decreases**
- This is a **normal variation**.

2 Sinus Bradycardia

- Sinus rate < 60 beats/min during the day or < 50 beats/min at night.
- Usually **asymptomatic** unless the rate is very slow.

3 Sinus Tachycardia

- Sinus rate > 100 beats/min.

Sinus Bradycardia – Causes

A. Extrinsic Causes

- Hypothermia
- Hypothyroidism
- Cholestatic jaundice
- Raised intracranial pressure
- **Neurally mediated syndromes** due to *Besold–Jarisch reflex*
→ causes bradycardia (sinus bradycardia, sinus arrest, AV block) + peripheral vasodilatation

Examples:

- Carotid sinus syndrome
- Vasovagal syncope

- Drugs: **β -blockers, digitalis**

B. Intrinsic Causes

- Acute ischemia and infarction involving the sinus node (e.g., post-MI)
- Chronic degenerative changes (e.g., **Sick Sinus Syndrome**)

Causes include:

- Idiopathic fibrosis of sinus node
- Ischemic heart disease
- Cardiomyopathy
- Myocarditis



Sick Sinus Syndrome Characteristics:

- Episodes of **sinus bradycardia** or **sinus arrest**
- Alternating with **paroxysmal atrial tachycardia**
→ Known as **tachy-brady syndrome**

Treatment

Sinus Bradycardia

- Identify and treat **extrinsic cause**
- **Temporary pacing** for reversible causes
- **Permanent pacing** for chronic degenerative causes

Sick Sinus Syndrome

- **Permanent pacing**
- ± Antiarrhythmic drugs or **ablation therapy** for tachycardia component

Vasovagal Attacks

- Elastic stockings
- β -blockers
- Disopyramide

Heart Block

- **Atrioventricular Block (AV Block)**
- **Bundle Branch Block (BBB)**

Atrioventricular Block (AV Block)

Forms of AV Block

1 First-Degree AV Block

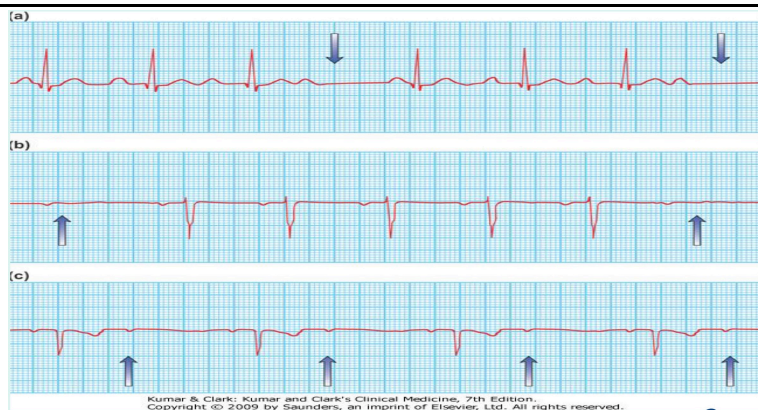
- Simple **prolongation of PR interval** > 0.22 s
- All atrial depolarizations are **conducted to the ventricles but with delay**



2 Second-Degree AV Block

- Some **P waves fail to conduct to the ventricles**
- Types:
 - ◆ **Mobitz I (Wenckebach Phenomenon)**
 - Progressive PR prolongation
 - Eventually, a **P wave fails to conduct**
 - ◆ **Mobitz II**
 - **Dropped QRS complex** without preceding PR prolongation
 - ◆ **2:1 or 3:1 (Advanced Block)**
 - Every **second or third P wave** conducts to ventricles

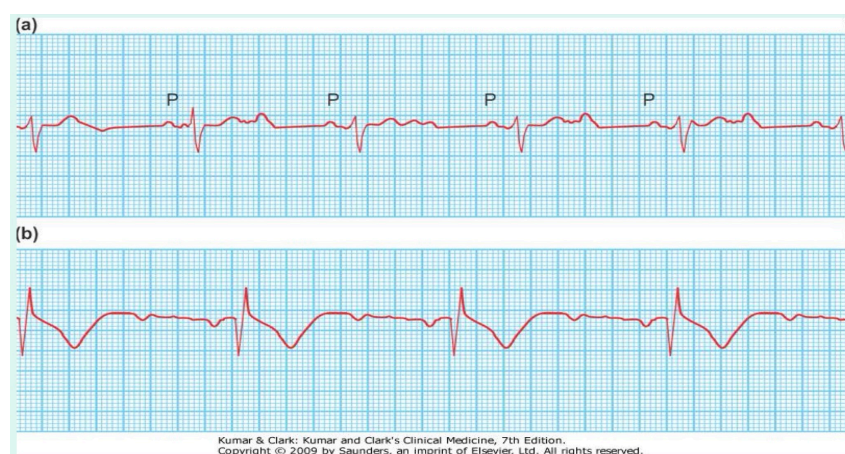
Strip	Diagnosis
(a)	2nd-degree AV block Mobitz I (Wenckebach)
(b)	2nd-degree AV block Mobitz II
(c)	High-grade (advanced) 2nd-degree AV block



3 Third-Degree (Complete) AV Block

- No atrial impulses conduct to the ventricles
- Complete AV dissociation

Quick comparison table			
Feature	(a)	(b)	
Diagnosis	3rd-degree AV block	3rd-degree block	
Escape rhythm	Junctional	Ventricular	
QRS width	Narrow	Wide	
Ventricular rate	40–60 bpm	20–40 bpm	
Prognosis	Better	Worse	



Causes of AV Block

- Congenital (structural or autoimmune)
- Idiopathic fibrosis: **Lev's disease**, **Lenegre's disease**
- Ischemic heart disease (MI, cardiomyopathy)
- Non-ischemic heart disease (calcified aortic stenosis, dilated cardiomyopathy, sarcoidosis)
- Cardiac surgery
- Iatrogenic
- Drugs: **Digoxin**, **Beta-blockers**, **Amiodarone**
- Infection: **Endocarditis**, **Lyme disease**, **Chagas disease**
- Rheumatic autoimmune diseases: **SLE**, **Rheumatoid arthritis**
- Neuromuscular disease: **Duchenne muscular dystrophy**

Bundle Branch Block (BBB)

Anatomy

- His bundle → **Right & Left bundle branches**
- Left branch subdivides into: **Anterior division**, **Posterior division**

Types of BBB

1 Partial Bundle Branch Block

- Slight widening of QRS (≤ 0.11 s)
- Called **incomplete BBB**

2 Complete Bundle Branch Block

- QRS > 0.12 s
- May be **Right BBB** or **Left BBB**

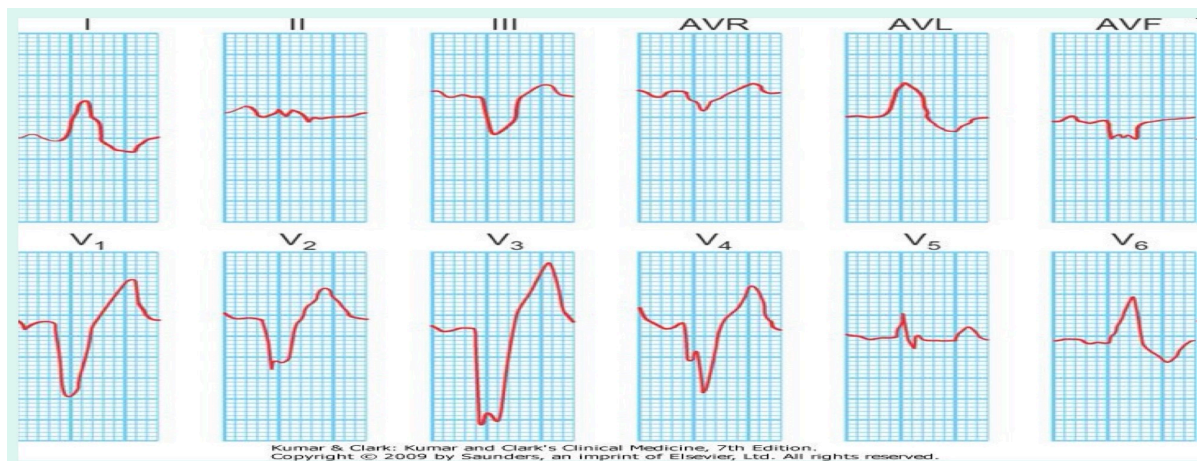
Right Bundle Branch Block (RBBB)

- Late activation of right ventricle
- ECG findings:
 - Deep S wave in Leads I and V6
 - Tall R wave in Lead V1



Left Bundle Branch Block (LBBB)

- Deep S wave in V1
- Tall late R wave in I & V6



Hemiblock

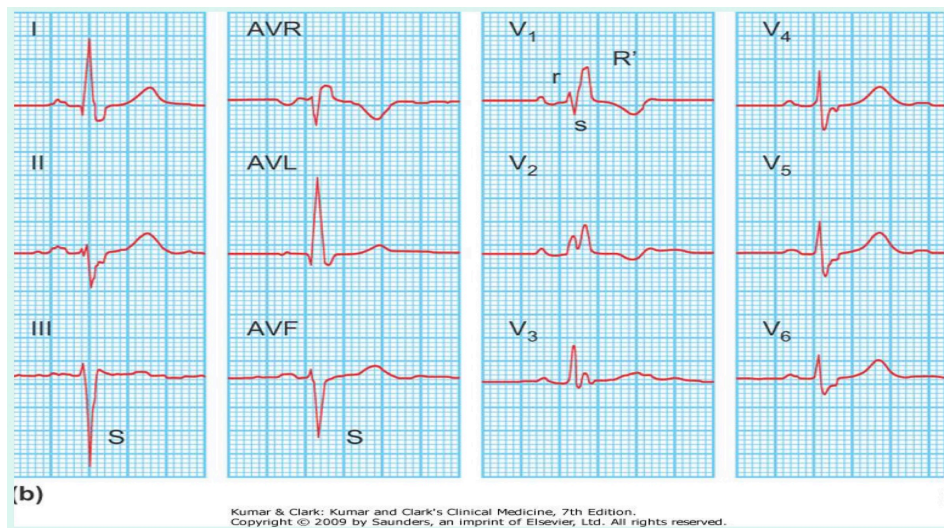
- Block in one division of the left bundle:
 - Anterior hemiblock → **Left axis deviation**
 - Posterior hemiblock → **Right axis deviation**

Bifascicular Block

Block in **two** of the following:

- RBBB
- Left anterior hemiblock
- Left posterior hemiblock

Block in all three → **complete heart block**



Causes of RBBB

- Normal finding in:
 - 1% of young adults
 - 5% of elderly adults
- Congenital heart disease:
 - ASD, Tetralogy of Fallot, Pulmonary stenosis, VSD
- Pulmonary disease:
 - Cor pulmonale, Acute or recurrent pulmonary embolism
- Myocardial disease:
 - Acute MI
 - Conduction system fibrosis
 - Cardiomyopathy
 - Chagas disease

Causes of LBBB

- Left ventricular outflow obstruction:
 - Aortic stenosis
 - Hypertension
- Coronary artery disease:
 - Acute MI
 - Severe coronary disease

Clinical Features of BBB

- Usually **asymptomatic**
- **RBBB**: wide physiological splitting of S2
- **LBBB**: reversed splitting of S2
- **ECG is the only way to diagnose BBB**

Supraventricular Tachycardias

Includes:

- Sinus tachycardia
 - Atrioventricular junctional tachycardia
 - Atrial fibrillation
 - Atrial flutter
 - Multifocal atrial tachycardia
 - Atrial ectopic beats
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Sinus Tachycardia

- Persistent increase in resting sinus beats
- P wave and QRS complex are of **normal morphology**

Causes

Intrinsic sinus node dysfunction is rare

Extrinsic acute causes:

- Exercise
- Emotion
- Pain
- Fever
- Infection
- Acute heart failure
- Acute pulmonary embolism
- Hypovolaemia

Chronic causes:

- Pregnancy
 - Anaemia
 - Hyperthyroidism
 - Catecholamine excess
-

Atrioventricular Tachycardia (Paroxysmal SVT)

- Also referred to as **paroxysmal SVT**
 - P wave is **invisible, inverted, or follows QRS complex**
 - Includes tachycardia associated with **Wolf–Parkinson–White (WPW) syndrome**
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Symptoms of SVT

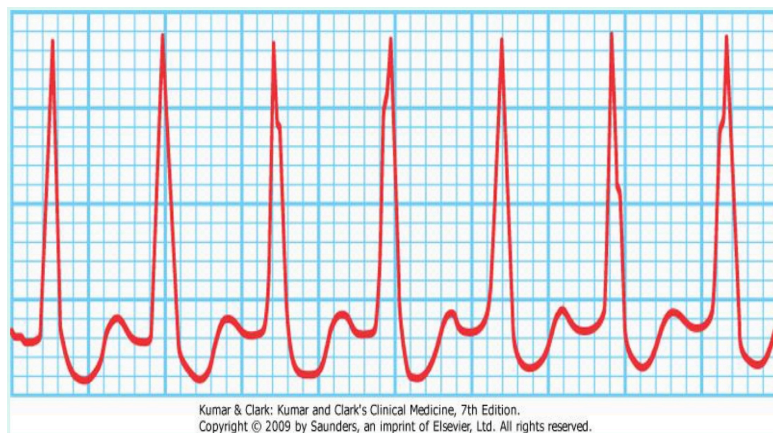
- Palpitation
 - Rapid regular rhythm with **abrupt onset and sudden termination**
 - Occurs spontaneously or may be precipitated by simple movement
 - Anxiety
 - Dizziness
 - Dyspnoea
 - Central chest pain
 - Polyuria
 - Weakness
 - Syncope
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Acute Management of SVT

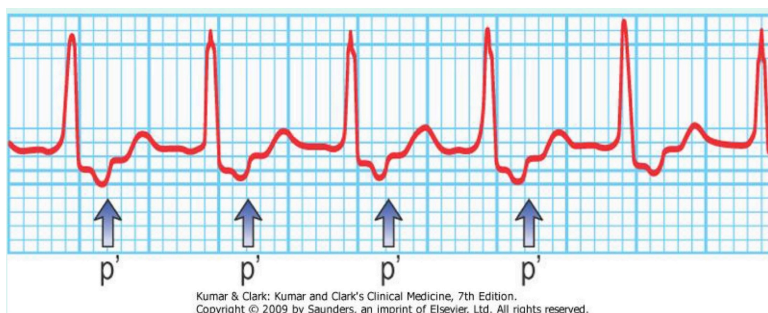
- Patients with **haemodynamic instability** (hypotension, pulmonary oedema) require **emergency cardioversion**
- If patient is stable:
 - **Vagal manoeuvres**: right carotid massage, Valsalva manoeuvre, facial immersion in cold water
- If no effect:
 - **IV adenosine 6 mg** – acts within 1 second causing abrupt termination
Side effects: bronchospasm, flushing, chest pain
Contraindicated in **asthmatics**
- Alternatives:
 - **Verapamil 5–10 mg IV over 10 minutes**
 - **Diltiazem**
 - **Beta-blockers**

Long-term Management

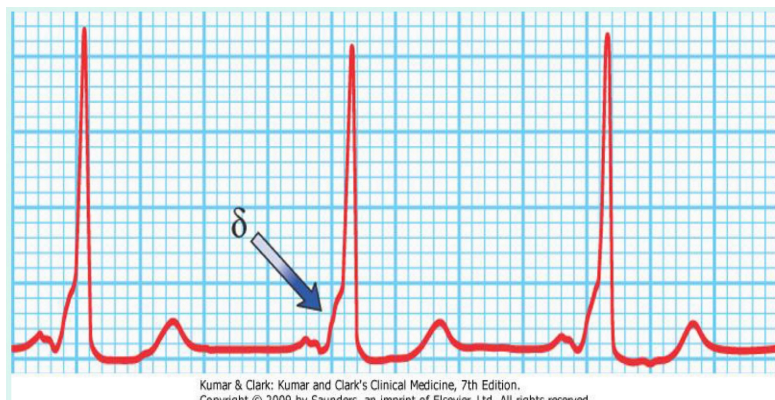
- Refer for **electrophysiological evaluation**
- Drugs: Verapamil, Diltiazem, Beta-blockers, Flecainide, Sotalol, Amiodarone
- Catheter ablation



**Supraventricular
tachycardia (junctional)**



**SVT (Wolf- Parkinson-
White -WPW syndrome)**



Atrial Fibrillation (AF)

- Common arrhythmia, may occur in paroxysmal form in young patients
- Classical causes: **rheumatic heart disease, alcohol intoxication, thyrotoxicosis**
- Other causes: **hypertension and heart failure**
- **Lone AF** = idiopathic (no cause found)
- AF consists of continuous rapid activation of atria (300–600/min) by **multiple re-entry wavelets**
- Electrical atrial response present but **no coordinated mechanical action**

Symptoms and Signs

- Asymptomatic
- Palpitation
- Dyspnoea
- Syncope
- Chest pain
- Worsening of previous cardiac complaint

Examination

- Irregular pulse

ECG

- Fine oscillation of baseline (**f waves**)
- No clear P wave
- QRS: rapid and irregular

Management

- Treat provoking cause
- **Control ventricular rate** with:
 - Digoxin monotherapy or combination
 - Calcium-channel blockers
 - Beta-blockers
- **Cardioversion**:
 - DC shock
 - Drugs:
 - Class Ic (e.g. Flecainide) – for patients **without** significant heart disease
 - Class III (e.g. Amiodarone) – for patients **with** significant heart disease
- **Anticoagulation** indicated in AF + ≥ 1 risk factor

Major risk factors

- Prosthetic heart valve
- Rheumatic mitral valve disease
- Previous history of CVA or TIA

Minor risk factors

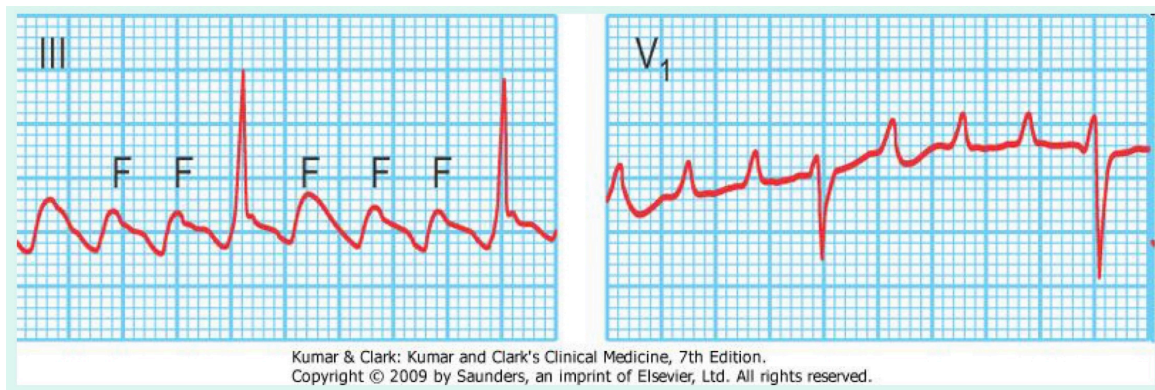
- Age > 75 years
 - Congestive heart failure
 - Diabetes mellitus
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Atrial Flutter

- Usually occurs with AF
- Organized rhythm 250–350/min
- ECG: regular **saw-tooth atrial waves (F waves)** between normal QRS
- Variable AV block

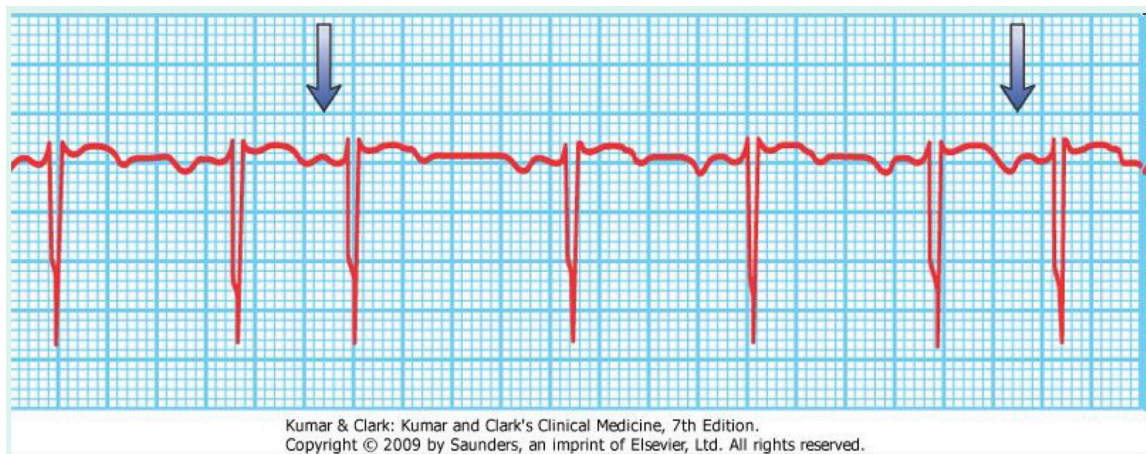
Management

- Cardioversion for acute attack
- Cardioversion preceded by **3 weeks anticoagulation**
- Recurrent prevention: **class Ic or class III drugs**
- AV nodal blocking agents may control ventricular rate
- **Catheter ablation** in resistant cases



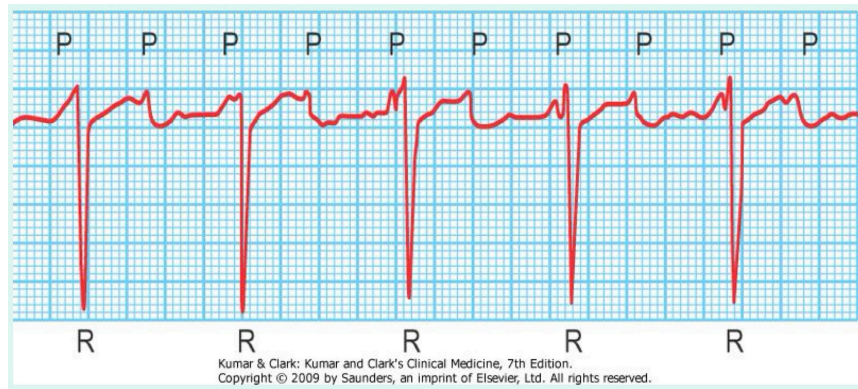
Atrial Ectopic Beats

- Usually asymptomatic
- May require treatment with **beta-blockers**
- ECG: early abnormal P wave followed by normal QRS



Atrial Tachycardia

- Rare, may be idiopathic
- If present with block → often due to **digitalis poisoning**

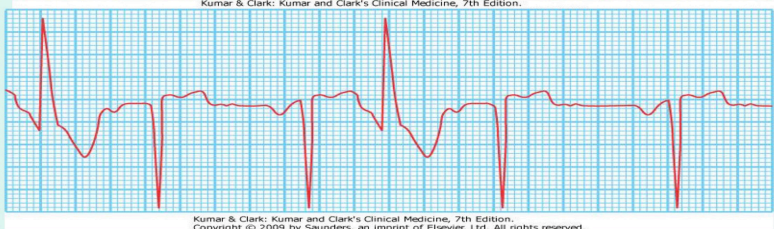
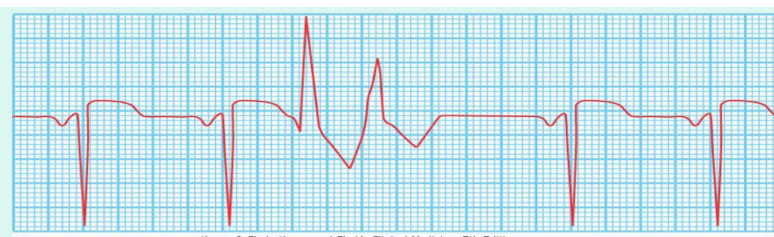
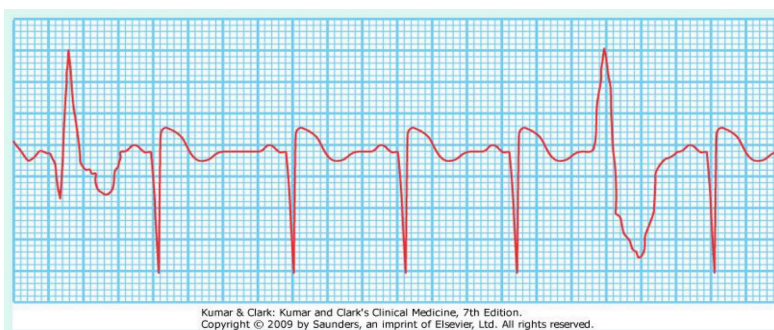


Ventricular Tachyarrhythmias

- Life-threatening group:
 - Sustained ventricular tachycardia
 - Ventricular fibrillation
- Others:
 - Normal heart ventricular tachycardia
 - Non-sustained ventricular tachycardia
 - Ventricular premature beats

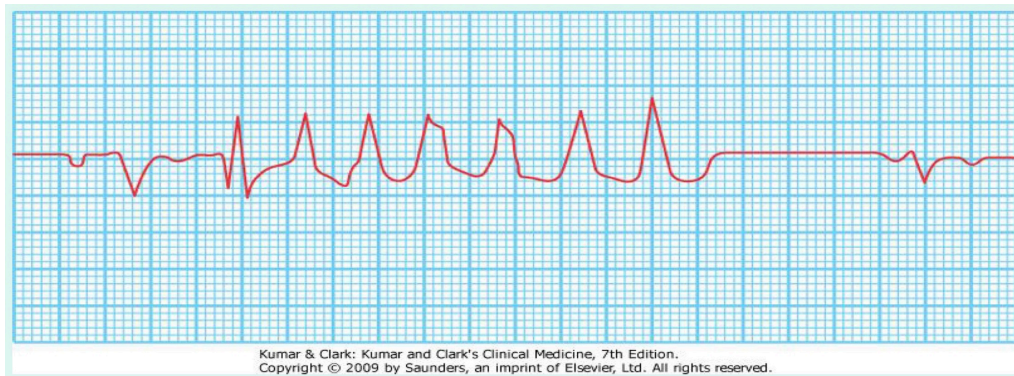
Ventricular Premature Beats

- May be uncomfortable, especially frequent
- Complaints: extra beat, missed beat, heavy beat
- Irregular pulse
- ECG: premature broad (>0.12s) bizarre QRS, followed by compensatory pause



Non-sustained Ventricular Tachycardia (NSVT)

- VT > 5 consecutive beats but lasts < 30 s
- Usually benign; no treatment required



Normal Heart Ventricular Tachycardia

- Usually benign
- Idiopathic, monomorphic
- Excellent long-term prognosis
- If symptomatic: treat with beta-blockers, verapamil, or catheter ablation

Life-Threatening Ventricular Tachyarrhythmia

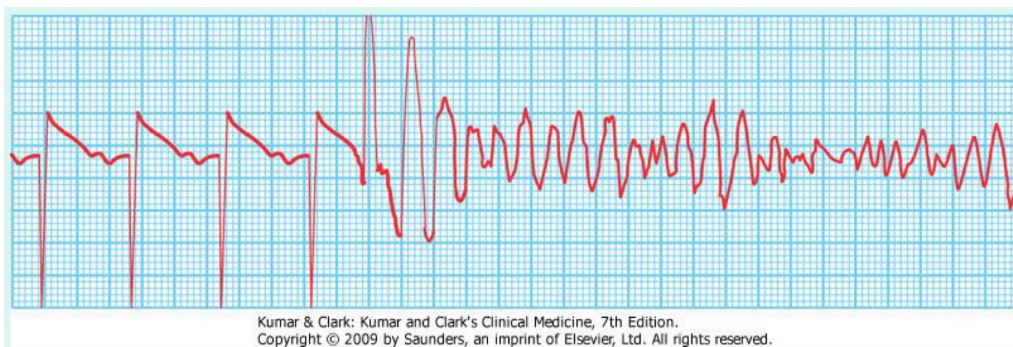
Presenting with haemodynamic instability (syncope, hypotension):

Sustained Ventricular Tachycardia

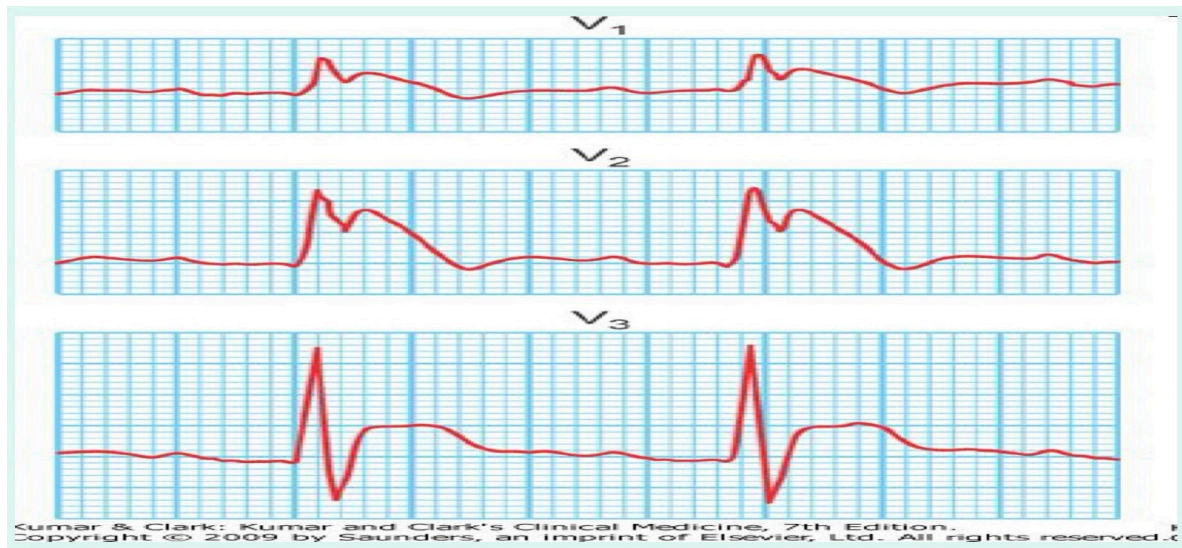
- Lasts > 30 s
- Causes presyncope, syncope, hypotension, cardiac arrest
- Pulse: 120–220 bpm
- AV dissociation → cannon a-wave
- ECG:
 - Rapid ventricular rhythm
 - Broad (≥ 0.14 s) abnormal QRS
 - AV dissociation
 - Occasional P waves
- SVT with BBB may resemble VT on ECG
- **Urgent treatment:** IV class I drugs, IV amiodarone, or DC cardioversion

Ventricular Fibrillation

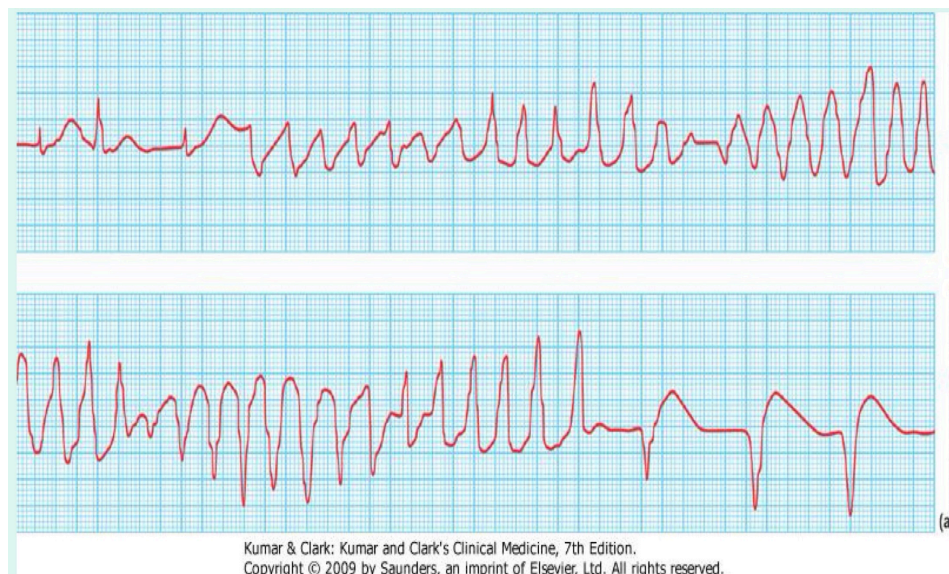
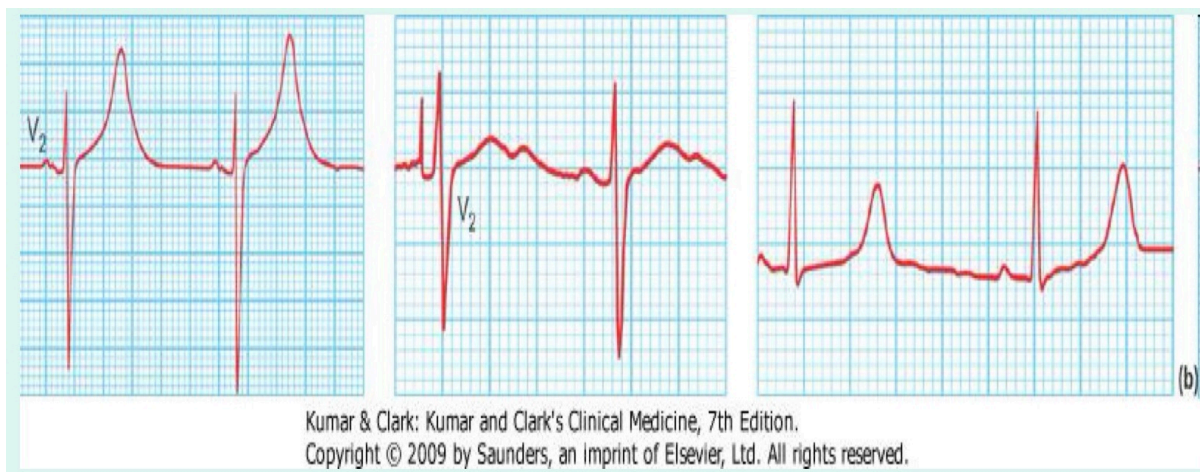
- Rapid, irregular ventricular activation → **no mechanical output**
- Patient pulseless, unconscious, respiratory arrest
- ECG: shapeless rapid oscillations, no complexes
- **Only effective treatment: Defibrillation**



Brugada syndrome



Long QT syndrome



Acquired Causes of Long QT Syndrome

Electrolytes abnormalities:

- Hypokalaemia
- Hypocalcaemia
- Hypomagnesaemia

Drugs:

- Quinidine, Disopyramide
- Sotalol, Amiodarone
- Tricyclic antidepressants
- Phenothiazines (e.g. chlorpromazine)
- Haloperidol, Olanzapam
- Macrolides (e.g. erythromycin)
- Quinolones (e.g. ciprofloxacin)
- Methadone

Poisons:

- Organophosphate insecticides

Miscellaneous:

- Bradycardia
 - Mitral valve prolapse
 - Acute myocardial infarction
 - Diabetes mellitus
 - Prolonged fasting & liquid protein diet
 - CNS disease (e.g. dystrophia myotonica)
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Antiarrhythmic Drug Classification

Class I – Sodium channel blockers

- Ia: Disopyramide
- Ib: Lidocaine, Mexiletine
- Ic: Flecainide, Propafenone

Class II – Beta-blockers

- Examples: Atenolol, Propranolol

Class III – Prolong action potential

- Examples: Amiodarone, Sotalol

Class IV – Calcium-channel blockers

- Examples: Verapamil, Diltiazem

Others:

- Adenosine
- Digoxin