ARRHYTHMIA

- **Definition of Arrhythmia:**

  The Origin, Rate, Rhythm, Conduct velocity and sequence of heart activation are abnormally.

Anatomy of the conducting system

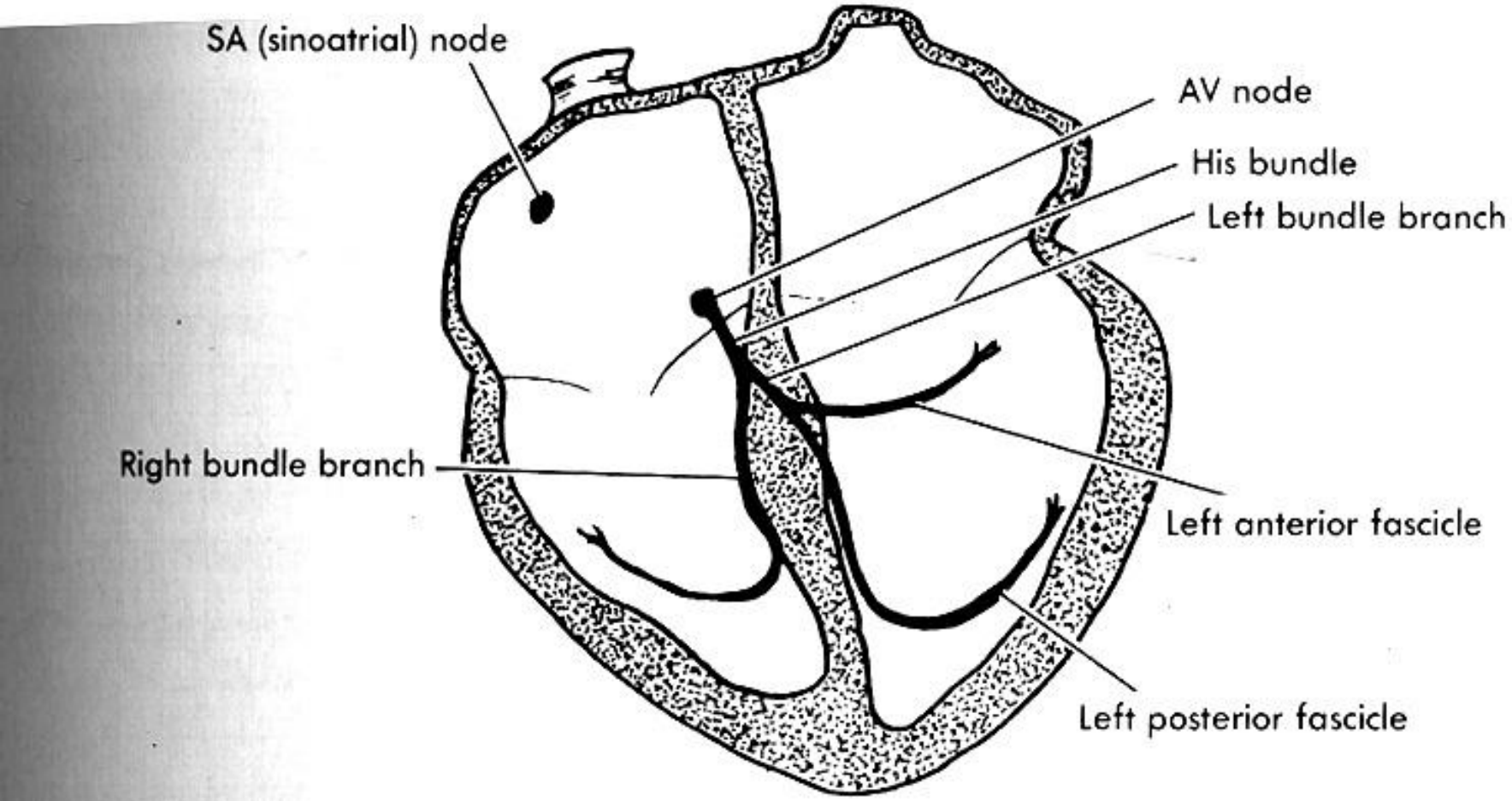


Fig. 7-9. Trifascicular conduction system. Note that the left bundle branch subdivides into a left anterior fascicle and a left posterior fascicle. This diagram is a revision of the original drawing of the conduction system in Fig. 1-1.

Pathogenesis and Inducement of Arrhythmia

- Some physical condition
- Pathological heart disease
- Other system disease
- Electrolyte disturbance and acid-base imbalance
- Physical and chemical factors or toxicosis

Mechanism of Arrhythmia

- **Abnormal heart pulse formation**

1. Sinus pulse
2. Ectopic pulse
3. Triggered activity

- **Abnormal heart pulse conduction**

1. Reentry
2. Conduct block

Classification of Arrhythmia

- **Abnormal heart pulse formation**

1. Sinus arrhythmia
2. Atrial arrhythmia
3. Atrioventricular junctional arrhythmia
4. Ventricular arrhythmia

- **Abnormal heart pulse conduction**

1. Sinus-atrial block
2. Intra-atrial block
3. Atrio-ventricular block
4. Intra-ventricular block

- **Abnormal heart pulse formation and conduction**

Diagnosis of Arrhythmia

- Medical history
- Physical examination
- Laboratory test

Therapy Principal

- **Pathogenesis therapy**
- **Stop the arrhythmia immediately if the hemodynamic was unstable**
- **Individual therapy**

Anti-arrhythmia Agents

- Anti-tachycardia agents
- Anti-bradycardia agents

Anti-tachycardia agents

1. I class: Natrium channel blocker
2. II class: ß-receptor blocker
3. III class: Potassium channel blocker
4. IV class: Calcium channel blocker
5. Others: Adenosine, Digital

Anti-bradycardia agents

1. ß-adrenic receptor activator
2. M-cholinergic receptor blocker
3. Non-specific activator

Clinical usage

Anti-tachycardia agents:

- **Ia class: Less use in clinic**

1. **Guinidine**
2. **Procainamide**
3. **Disopyramide**

Anti-tachycardia agents:

- **Ib class: Good for ventricular tachyarrhythmia**

1. **Lidocaine**
2. **Mexiletine**

Anti-tachycardia agents:

- **Ic class: Can be used in ventricular and/or supra-ventricular tachycardia and extrasystole.**

Propafenone

Anti-tachycardia agents:

- **II class: ß-receptor blocker**

1. **Propranolol:** **Non-selective**
2. **Metoprolol:** **Selective $ß_1$-receptor blocker, good for hypertension and coronary artery disease patients associated with tachyarrhythmia.**

Anti-tachycardia agents:

- **III class: Potassium channel blocker, extend-spectrum anti-arrhythmia agent.**
- **Amioarone: good for coronary artery disease and heart failure patients**
- **Sotalol: Has ß-blocker effect**
- **Bretylium**

Anti-tachycardia agents:

- **IV class: be used in supraventricular tachycardia**

1. **Verapamil**
2. **Diltiazem**

- **Others:**

  Adenosine: be used in supraventricular tachycardia

Anti-bradycardia agents

- Isoprenaline
- Epinephrine
- Atropine
- Aminophylline

Non-drug therapy

- **Cardioversion: For tachycardia especially hemodynamic unstable patient**
- **Radiofrequency catheter ablation (RFCA): For those tachycardia patients (SVT, VT, AF, AFL)**
- **Artificial cardiac pacing: For bradycardia, heart failure and malignant ventricular arrhythmia patients.**

Sinus Arrhythmia

Sinus tachycardia

- Sinus rate > 100 beats/min (100-180)
- **Causes:**

1. Some physical condition: exercise, anxiety, exciting, alcohol, coffee
2. Some disease: fever, hyperthyroidism, anemia, myocarditis
3. Some drugs: Atropine, Isoprenaline

- **Needn’t therapy**

Sinus Bradycardia

- Sinus rate < 60 beats/min
- Normal variant in many normal and older people
- **Causes:** Trained athletes, during sleep, drugs (ß-blocker) , Hypothyriodism, CAD or SSS
- **Symptoms:**

1. Most patients have no symptoms.
2. Severe bradycardia may cause dizziness, fatigue, palpitation, even syncope.

- **Needn't specific therapy**, If the patient has severe symptoms, planted an pacemaker may be needed.

Sinus Arrest

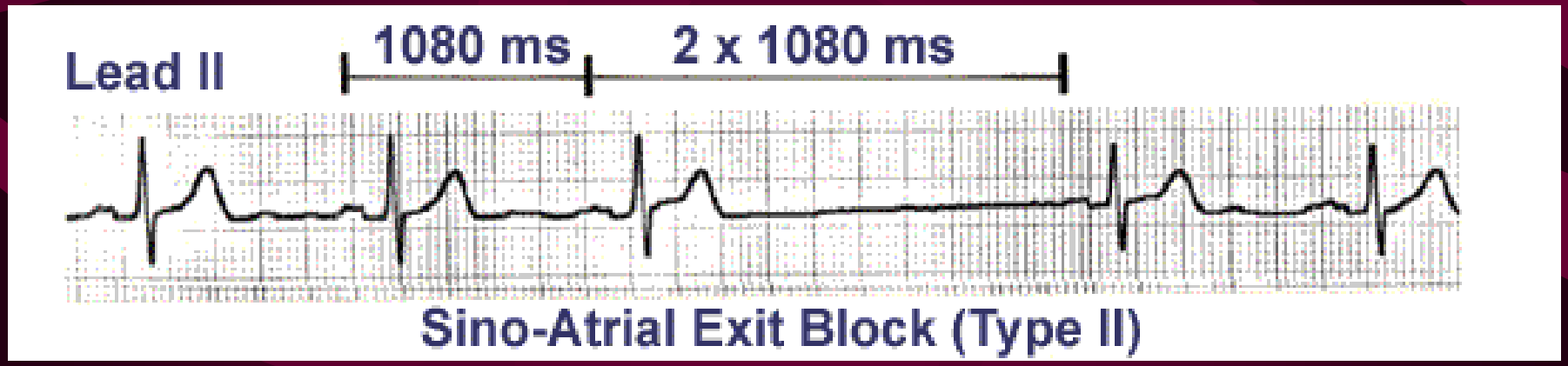
- Sinus arrest is recognized by a pause in the sinus rhythm.
- **Causes:** myocardial ischemia, hypoxia, hyperkalemia, higher intracranial pressure, sinus node degeneration and some drugs (digitalis, ß-blocks).
- **Symptoms:** dizziness, syncope
- **Therapy** is same to SSS

Sinoatrial exit block (SAB)

- SAB: Sinus pulse does not active the atrium.
- Causes: CAD, Myopathy, Myocarditis, digitalis toxicity, et al.
- Symptoms: dizziness, fatigue, syncope
- Therapy is same to SSS

Sinoatrial exit block (SAB)

- **Divided into three types: Type I, II, III**
- **Only type II SAB can be recognized by EKG.**



Sick Sinus Syndrome (SSS)

- SSS: The function of sinus node was degenerated. SSS includes both disordered SA node automaticity and SA conduction.
- Causes: CAD, SAN degeneration, myopathy, connective tissue disease, metabolic disease, tumor, trauma and congenital disease.
- With marked sinus bradycardia, sinus arrest, sinus exit block or junctional escape rhythms
- Bradycardia-tachycardia syndrome

Sick Sinus Syndrome (SSS)

- **EKG Recognition:**

1. **Sinus bradycardia, ≤40 bpm;**
2. **Sinus arrest > 3s**
3. **Type II SAB**
4. **Nonsinus tachyarrhythmia (SVT, AF or Af).**

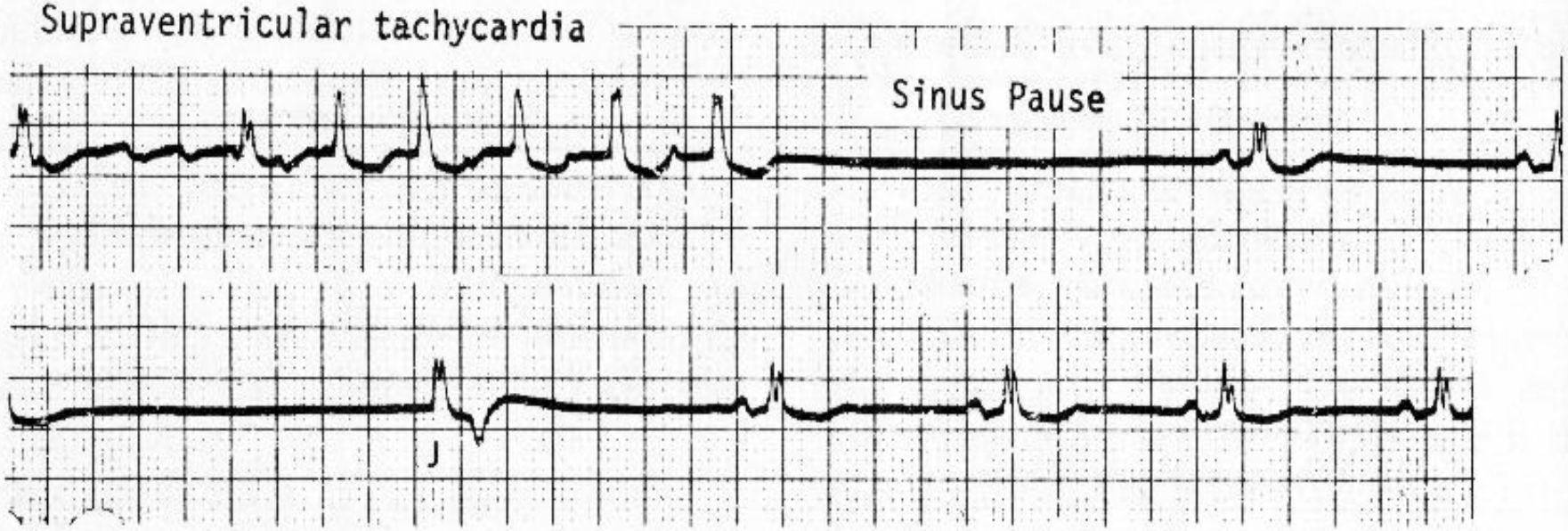


Fig. 18-13. Brady-tachy (sick sinus) syndrome. This rhythm strip shows supraventricular tachycardia (probably atrial flutter) followed by a sinus pause, an AV junctional escape beat *(J)*, and then sinus rhythm.

Sick Sinus Syndrome (SSS)

- **Therapy:**

1. **Treat the etiology**
2. **Treat with drugs: anti-bradycardia agents, the effect of drug therapy is not good.**
3. **Artificial cardiac pacing.**

Atrial arrhythmia

Premature contractions

- The term “premature contractions” are used to describe non sinus beats.
- Common arrhythmia
- The morbidity rate is 3-5%

Atrial premature contractions (APCs)

- APCs arising from somewhere in either the left or the right atrium.
- **Causes:** rheumatic heart disease, CAD, hypertension, hyperthyroidism, hypokalemia
- **Symptoms:** many patients have no symptom, some have palpitation, chest incomfortable.
- **Therapy:** Needn't therapy in the patients without heart disease. Can be treated with ß-blocker, propafenone, moricizine or verapamil.

Atrial tachycardia

- Classify by automatic atrial tachycardia (AAT); intra-atrial reentrant atrial tachycardia (IART); chaotic atrial tachycardia (CAT).
- Etiology: atrial enlargement, MI; chronic obstructive pulmonary disease; drinking; metabolic disturbance; digitalis toxicity; electrolytic disturbance.

Atrial tachycardia

- May occur transient; intermittent; or persistent.
- Symptoms: palpitation; chest uncomfortable, tachycardia may induce myopathy.
- Auscultation: the first heart sound is variable

Intra-atrial reentry tachycardia (IART)

- **ECG characters:**

1. Atrial rate is around 130-150bpm;
2. P’ wave is different from sinus P wave;
3. P’-R interval ≥ 0.12”
4. Often appear type I or type II, 2:1 AV block;
5. EP study: atrial program pacing can induce and terminate tachycardia

Automatic atrial tachycardia (AAT)

- **ECG characters:**

1. **Atrial rate is around 100-200bpm;**
2. **P’ wave is different from sinus P wave;**
3. **P’-R interval≥ 0.12”**
4. **Often appear type I or type II, 2:1 AV block;**
5. **EP study: Atrial program pacing can’t induce or terminate the tachycardia**

PAROXYSMAL ATRIAL TACHYCARDIA WITH BLOCK

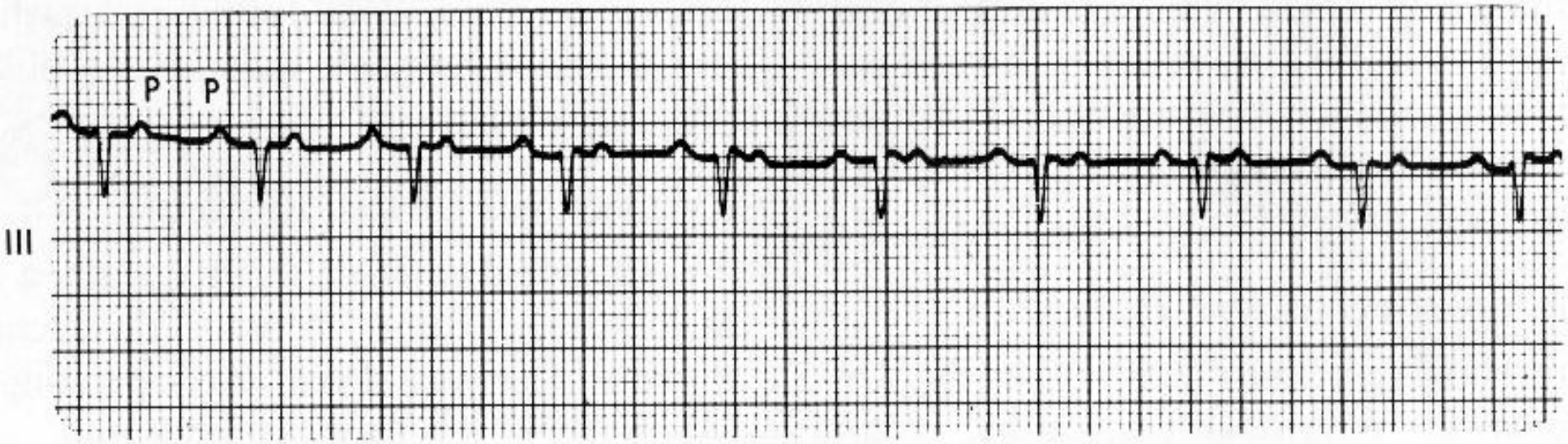


Fig. 16-3. This rhythm strip shows PAT (atrial rate about 200 beats/min) with 2:1 block, producing a ventricular rate of about 100 beats/min.

Chaotic atrial tachycardia (CAT)

- Also termed “Multifocal atrial tachycardia”.
- Always occurs in COPD or CHF,
- Have a high in-hospital mortality (25-56%). Death is caused by the severity of the disease.
- **ECG characters:**

1. Atrial rate is around 100-130bpm;
2. The morphologies P’ wave are more than 3 types.
3. P’-P’, P’-R and R-R interval are different.
4. Will progress to AF in half the cases
5. EP study: Atrial program pacing can’t induce or terminate the tachycardia

MULTIFOCAL ATRIAL TACHYCARDIA

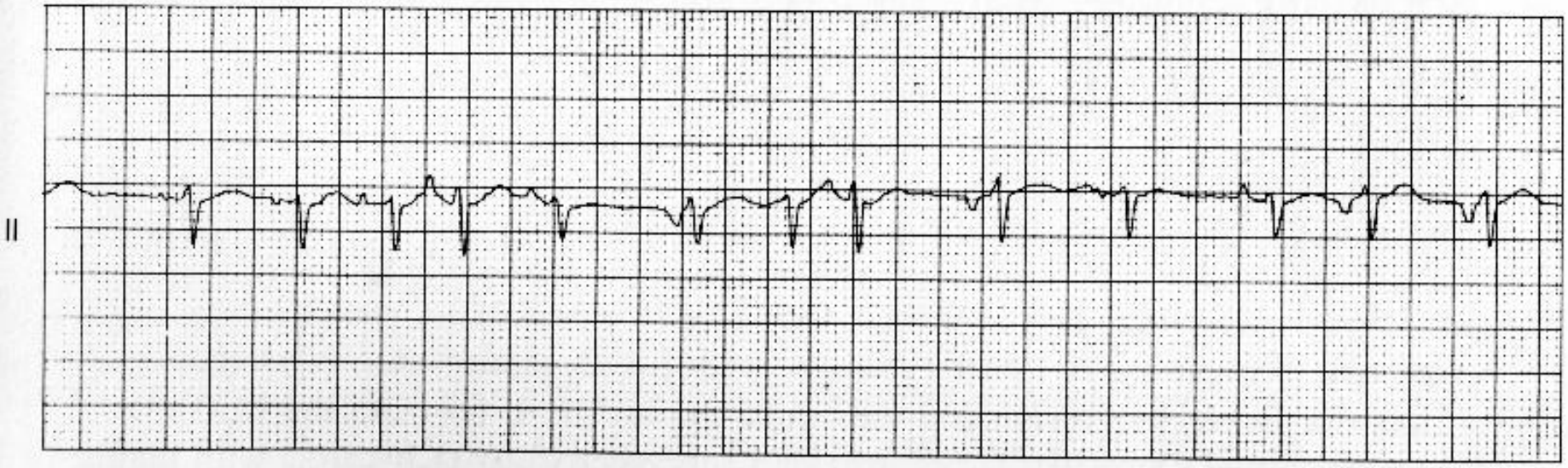


Fig. 18-8. The P waves show variable shapes or variable PR intervals, or both.

Therapy

- **IRAT (intra-atrial reentrant atrial tachycardia): Esophageal Pulsation Modulation, Ic and IV class anti-tachycardia agents**
- **AAT (atrial tachycardia): Digoxin, IV, II, Ia and III class anti-tachycardia agents;**
- **CAT(chaotic atrial tachycardia): treat the underlying disease, verapamil or amiodarone.**
- **Associated with SSS: Implant pace-maker.**

Atrial flutter

- **Etiology:**

1. It can occur in patients with normal atrial or with abnormal atrial.
2. It is seen in rheumatic heart disease (mitral or tricuspid valve disease), CAD, hypertension, hyperthyroidism, congenital heart disease, COPD.
3. Related to enlargement of the atria
4. Most AF have a reentry loop in right atrial

ATRIAL FLUTTER

Fig. 13-3. Note the variable ventricular rate in this patient with atrial flutter.

Atrial flutter

- **Symptoms:** depend on underlying disease, ventricular rate, in the patient in rest or in the exersice
- With rapid ventricular rate: palpitation, dizziness, shortness of breath, weakness, faintness, syncope, may develop angina and CHF.

Atrial flutter

- **Therapy:**

1. **Treat the underlying disease**
2. **To restore sinus rhythm: Cardioversion, Esophageal Pulsation Modulation, RFCA (right frequency catheter ablation), Drug (III, Ia, Ic class).**
3. **Control the ventricular rate: digitalis. CCB, ß-block**
4. **Anticoagulation**

Atrial fibrillation

- Subdivided into three types: paroxysmal, persistent, permanent.
- **Etiology:**

1. Morbidity rate increase in older patients
2. Etiology just like atrial flutter
3. Idiopathic

- **Mechanism:**

1. Multiple wavelet re-entry;
2. Rapid firing focus in pulmonary vein, vena cava or coronary sinus.

ATRIAL FIBRILLATION

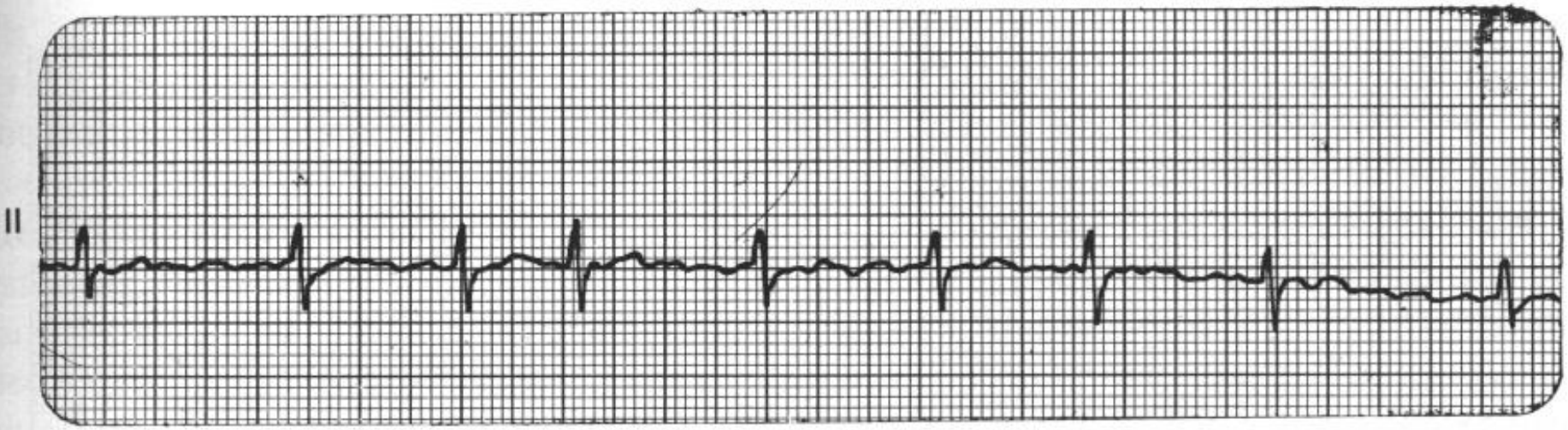


Fig. 13-4. Irregular undulation of the baseline because of fibrillatory (f) waves. There are no true P waves, and the ventricular (QRS) rate is irregular.

Atrial fibrillation

- **Symptoms:**
- **Depend on underlying diseases, ventricular rate and heart function.**
- **May develop embolism in left atrial. Have high incidence of stroke.**
- **The heart rate, S1 and rhythm is irregular.**
- **If the heart rhythm is regular, it may depend on (1) normal sinus rhythm; (2) AF with constant the ratio of AV conduction; (3) junctional or ventricular tachycardia; (4) slower ventricular rate may have complete AV block.**

Atrial fibrillation

- **Therapy:**

1. **Treat the underlying disease**
2. **Restore sinus rhythm: Drug, Cardioversion, RFCA, Maze surgery**
3. **Rate control: digitalis. CCB, ß-block**
4. **Antithrombotic therapy: Aspirine, Warfarin**

Atrioventricular Junctional arrhythmia

Atrioventricular junctional premature contractions

- Etiology and manifestation is like APCs
- Therapy the underlying disease
- Needn’t anti-arrhythmia therapy.

Nonparoxysmal AV junctional tachycardia

- **Mechanism:** relate to hyper-automaticity or trigger activity of AV junctional tissue
- **Etiology:** digitalis toxicity; inferior MI; myocarditis; acute rheumatic fever and postoperation of valve disease
- **ECG:** the heart rate ranges 70-150 bpm or more, regular, normal QRS complex, may occur AV dissociation and wenckebach AV block

Nonparoxysmal AV junctional tachycardia

- **Therapy:**
- **Treat underlying disease; stopping digoxin, potassium, lidocaine, phenytoin or propranolol.**
- **Not for DC shock**
- **It can disappear spontaneously. If had good tolerance, does not need therapy.**

Paroxysmal tachycardia

- Most PSVT (paroxysmal supraventricular tachycardia) is due to reentrant mechanism.
- The incidence of PSVT is higher in AVNRT (atrioventricular node reentry tachycardia) and AVRT (atrioventricular reentry tachycardia), the most common is AVNRT (90%)
- Occur in any age individuals, usually no structure heart disease.

Paroxysmal tachycardia

- **Symptoms:**
- **Occur and terminal abruptly.**
- **Palpitation, dizziness, syncope, angina, heart failure and shock.**
- **The sever degree of the symptom is related to ventricular rate, persistent duration and underlying disease**

Paroxysmal tachycardia

- **ECG characteristic of AVNRT** (atrioventricular node reentry tachycardia)

1. **Heart rate is 150-250 bpm, regular**
2. **QRS complex is often normal, wide QRS complex is with aberrant conduction**
3. **Negative P wave in II III aVF, stay in or followed by the QRS complex.**

Paroxysmal tachycardia

- **ECG characteristic of AVRT** (atrioventricular reentry tachycardia)

1. **Heart rate is 150-250 bpm, regular**
2. **Retrograde P’ wave, R-P’>110ms.**

Paroxysmal tachycardia

- **Therapy:**
- **AVNRT** (atrioventricular node reentry tachycardia)

1. **Increase vagal tone: carotid sinus massage, Valsalva maneuver.if no successful,**
2. **Drug: verapamil, adrenosine, propafenone**
3. **DC shock**

- **AVRT** (atrioventricular reentry tachycardia)**:**

1. **Should not use verapamil, digitalis, and stimulate the vagal nerve.**
2. **Drug: propafenone, sotalol, amiodarone**

- **RFCA**

Pre-excitation syndrome (W-P-W syndrome)

- There are several type of W-P-W:

1. Kent: extra atrial and ventricular
2. James: extra atrial and his bundle
3. Mahaim: extra lower part of the AVN and ventricular

- Usually no structure heart disease, occur in any age individual

WPW syndrome

- **Symptoms:**
- **Palpitation, syncope, dizziness**
- **Arrhythmia: 80% tachycardia is AVRT, 15-30% is AFi, 5% is AF.**
- **May induce ventricular fibrillation**

WPW syndrome

- **Therapy:**

1. **Pharmacologic therapy: AVRT or AF, may use Ic and III class agents.**
2. **AVRT can’t use digoxin and verapamil.**
3. **DC shock: WPW with SVT, AF or Afi produce agina, syncope and hypotension**
4. **RFCA**

Ventricular arrhythmia

Ventricular Premature Contractions (VPCs)

- **Etiology:**

1. Occur in normal person
2. Myocarditis, CAD, valve heart disease, hyperthyroidism, Drug toxicity (digoxin, quinidine and anti-anxiety drug)
3. electrolyte disturbance, anxiety, drinking, coffee

VPCs

- **Symptoms:**

1. palpitation
2. dizziness
3. syncope
4. Absence of the second heart sound

PVCs

- **Therapy: treat underlying disease, antiarrhythmia**
- **No structure heart disease:**

1. **Asymptom: no therapy**
2. **Symptom caused by PVCs: antianxiety agents, ß-blocker and mexiletine to relief the symptom.**

- **With structure heart disease (CAD, HBP):**

1. **Treat the underlying diseas**
2. **ß-blocker, amiodarone**
3. **Class I especially class Ic agents do not use because of proarrhytmia and no benefit in prophylaxis**

Ventricular tachycardia

- **Etiology: often in organic heart disease**

  CAD, MI, DCM, HCM, HF, long QT syndrome

  Brugada syndrome
- **Sustained VT (>30s), Nonsustained VT**
- **Monomorphic VT, Polymorphic VT**

Ventricular tachycardia

- **Torsades de points (Tdp):** A special type of polymorphic VT,
- **Etiology:**

1. congenital (Long QT),
2. electrolyte disturbance,
3. antiarrhythmia drug proarrhythmia (IA or IC),
4. antianxiety drug,
5. brain disease,
6. bradycardia

Ventricular tachycardia

- **Accelerated idioventricular rhythm:**

1. **Related to increase automatic tone**
2. **Etiology: Often occur in organic heart disease, especially AMI reperfusion periods, heart operation, myocarditis, digitalis toxicity**

VT

- **Symptoms:**

1. **Nonsustained VT with no symptom**
2. **Sustained VT : with symptom and unstable hemodynamic, patient may feel palpitation, short of breathness, presyncope, syncope, angina, hypotension and shock.**

VT

- **ECG characteristics:**

1. **Monomorphic VT: 100-250 bpm, occur and terminate abruptly,regular**
2. **Accelerated idioventricular rhythm: a runs of 3-10 ventricular beats, rate of 60-110 bpm, tachycardia is variable, often seen AV dissociation, fusion or capture beats**
3. **Tdp (torsades de points): rotation of the QRS axis around the baseline, the rate from 160-280 bpm, QT interval prolonged > 0.5s, marked U wave**

Treatment of VT

1. Treat underlying disease
2. Cardioversion: Hemodynamic unstable VT (hypotension, shock, angina, CHF) or hemodynamic stable but drug was no effect
3. Pharmacological therapy: ß-blockers, lidocain or amiodarone
4. RFCA, ICD or surgical therapy

Therapy of Special type VT

- **Accelerated idioventricular rhythm:**
- **usually no symptom, needn't therapy.**
- **Atropine increased sinus rhythm**
- **Tdp (torsades de points):**

1. **Treat underlying disease,**
2. **Magnesium iv, atropine or isoprenaline, ß-block or pacemaker for long QT patient**
3. **temporary pacemaker**

Ventricular flutter and fibrillation

- Often occur in severe organic heart disease: AMI, ischemia heart disease
- Proarrhythmia (especially produce long QT and Tdp), electrolyte disturbance
- Anaesthesia, electric shock, heart operation
- It’s a fatal arrhythmia

Ventricular flutter and fibrillation

- **Symptoms:**

  Significant, convulsion, no blood pressure and pulse, going to die

- **Therapy:**

1. **Cardio-Pulmonary Resuscitate (CPR)**
2. **ICD**

Cardiac conduction block

- **Block position:**

  Sinoatrial; intra-atrial; atrioventricular; intra-ventricular
- **Block degree**

1. **Type I: prolong the conductive time**
2. **Type II: partial block**
3. **Type III: complete block**

Atrioventricular Block

- **AV block is a delay or failure in transmission of the cardiac impulse from atrium to ventricle.**
- **Etiology:**

  Atherosclerotic heart disease; myocarditis; rheumatic fever; cardiomyopathy; drug toxicity; electrolyte disturbance, collagen disease, lev's disease.

AV Block

- AV block is divided into three categories:

1. First-degree AV block
2. Second-degree AV block: further subdivided into type I and type II
3. Third-degree AV block: complete block

AV Block

- **Symptoms:**
- **First-degree AV block: almost no symptoms;**
- **Second degree AV block: palpitation, weakness**
- **Third degree AV block: Dizziness, angina, heart failure, and syncope may cause by slow heart rate, Adams-Stokes Syndrome may occurs in sever case.**
- **First heart sound varies in intensity, will appear booming first sound**

AV Block

- **Treatment:**

1. I or II degree AV block needn't antibradycardia agent therapy
2. II degree II type and III degree AV block need antibradycardia agent therapy
3. Implant Pace Maker

Intraventricular Block

- **Intraventricular conduction system:**

1. **Right bundle branch**
2. **Left bundle branch**
3. **Left anterior fascicular**
4. **Left posterior fascicular**

Intraventricular Block

- **Etiology:**
- **Myocarditis, valve disease, cardiomyopathy, CAD, hypertension, pulmonary heart disease, drug toxicity, Lenegre disease, Lev's disease et al.**
- **Manifestation:**
- **Single fascicular or bifascicular block is asymptom; tri-fascicular block may have dizziness; palpitation, syncope and Adams-stokes syndrome**

Intraventricular Block

- **Therapy:**

1. **Treat underlying disease**
2. **If the patient is asymptom; no treat,**
3. **bifascicular block and incomplete trifascicular block may progress to complete block, may need implant pace maker if the patient with syncope**