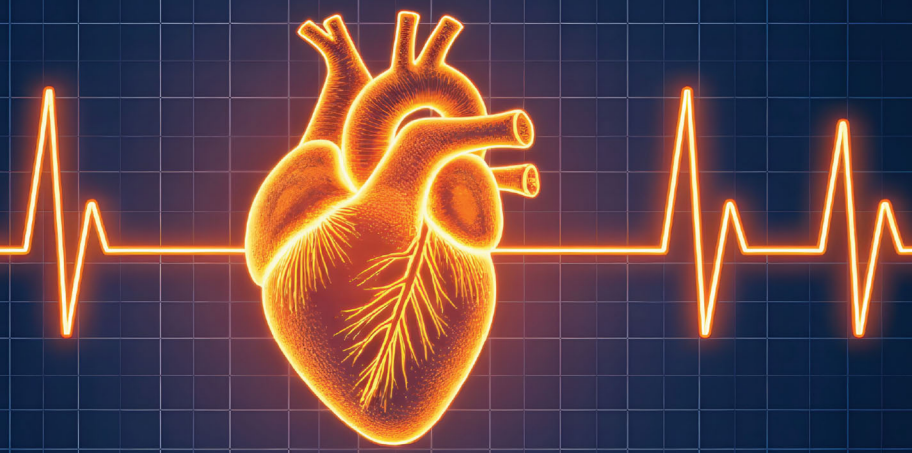
ECG

for Medical Diagnosis



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Contents

Abbreviations

ACS	Acute coronary syndrome
AES	Atrial extrasystole
AF	Atrial fibrillation
APC	Atrial premature contraction
AR	Aortic regurgitation
AS	Aortic stenosis
ASD	Atrial septal defect
AV block	Atrioventricular block
AV junction	Atrioventricular junction
AV node	Atrioventricular node
B.D. or b.d.	Twice daily
BP	Blood pressure
CHB	Complete heart block
COPD	Chronic obstructive pulmonary disease
CPR	Cardiopulmonary resuscitation
CVA	Cerebrovascular accident
DC shock	Direct current shock
Dig. toxicity	Digitalis toxicity
ECG	Electrocardiogram
HCM	Hypertrophic cardiomyopathy
HR	Heart rate
IHD	Ischemic heart disease
IM	Intramuscular
Inj	Injection
IV	Intravenous
JPC	Junctional premature contraction
LAD	Left axis deviation
LAFB	Left anterior fascicular block
LAH	Left atrial hypertrophy
LAHB	Left anterior hemiblock
LBBB	Left bundle branch block
LGL syndrome	Lown-Ganong-Levine syndrome
LPFB	Left posterior fascicular block
LPHB	Left posterior hemiblock
LVH	Left ventricular hypertrophy
MAT	Multifocal atrial tachycardia
MR	Mitral regurgitation
MS	Mitral stenosis
mV	Millivolt
PAT	Paroxysmal atrial tachycardia
PDA	Patent ductus arteriosus
q.d.s	Four times daily
RAD	Right axis deviation
RAH	Right atrial hypertrophy

RBBB	Right bundle branch block
RVH	Right ventricular hypertrophy
SA block	Sinoatrial block
SA node	Sinoatrial node
SBE	Subacute bacterial endocarditis
SC	Subcutaneous
SOS	If necessary
SVT	Supraventricular tachycardia
Tab.	Tablet
t.d.s.	Three times daily
TOF	Tetralogy of Fallot
VAT	Ventricular activation time
VES	Ventricular extrasystole
VPC	Ventricular premature contraction
VF	Ventricular fibrillation
VSD	Ventricular septal defect
VT	Ventricular tachycardia
WPW syndrome	Wolff-Parkinson-White syndrome

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Anatomy and Physiology

ANATOMY OF THE HEART (FIG. 2.1)

The heart is a highly specialized muscular organ that contracts rhythmically, pumping the blood through the circulatory system. It consists of four chambers.

1. The right atrium
2. The left atrium

(Upper chamber)

3. The right ventricle
4. The left ventricle

(Lower chamber)

Right and left atrium are separated from each other by interatrial septum, and right and left ventricles are separated by an interventricular septum. The atria communicate with the ventricles through the atrioventricular orifices. The orifice between the right atrium and right ventricle is known as tricuspid orifice which is guarded by the tricuspid valve. The orifice between left atrium and left ventricle is known as mitral orifice which is guarded by mitral or bicuspid valve.

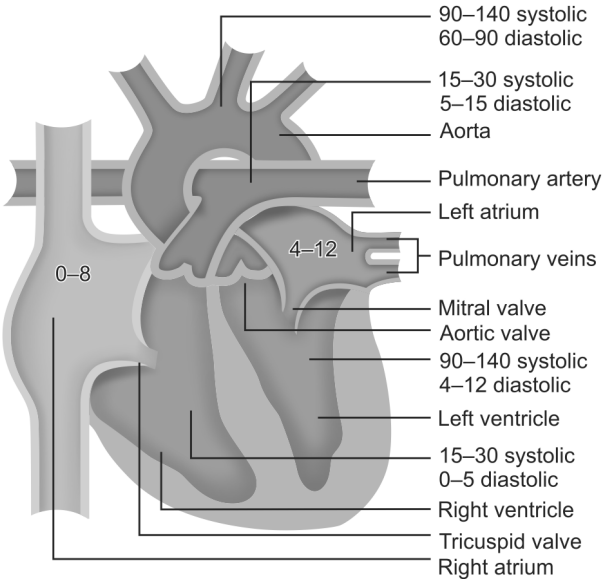


Fig. 2.1 Heart with normal resting pressures in mm Hg

The upper chambers are thin walled and propel blood to the right and left ventricles, respectively. The lower chambers are thick walled. The right ventricle pumps blood into the lungs (pulmonary circulation). The left ventricle pumps blood into body (systemic circulation).

A normal heartbeat consists of contraction of both atria followed by contraction of both ventricles. The orderly process of contraction is initiated and maintained by the hearts electrical forces which are recorded the electrocardiogram (ECG).

Layers of the Heart Wall

- Epicardium
  - External layer of the heart
  - Coronary arteries
  - Blood capillaries lymph capillaries
  - Nerve fibers, nerves and fat are found
- Myocardium
  - Middle and thickest layer of the heart
  - Responsible for hearts pumping action
- Endocardium
  - Innermost layer of the heart
  - Lines hearts inner chambers
  - Valves, chordae tendineae and papillary muscles
  - Continuous with innermost layer of arteries, veins, and capillaries of body

CORONARY CIRCULATION

The coronary arterial system (Fig. 2.2) consists of:

- *Right coronary artery (RCA)*: Starts from anterior aortic sinus
  - SA nodal branch
  - Conus branch
  - Right ventricular branch
  - Right marginal branch
  - Posterior descending (PD) branch
  - AV nodal branch.
- *Left coronary artery (LCA)*: Starts from left posterior aortic sinus
  - Left main artery (LMA)
  - Left circumflex (LCX) artery
  - Left anterior descending (LAD) artery
  - Obtuse marginal branches—from LCX
  - SA nodal branch—from LCX
  - AV nodal branch—from LCX
  - Diagonal branch—from LAD
- *Right coronary artery supplies:*
  - Right atrium and right ventricle
  - Posteroinferior 1/3rd of the interventricular septum
  - Posterior left ventricular wall

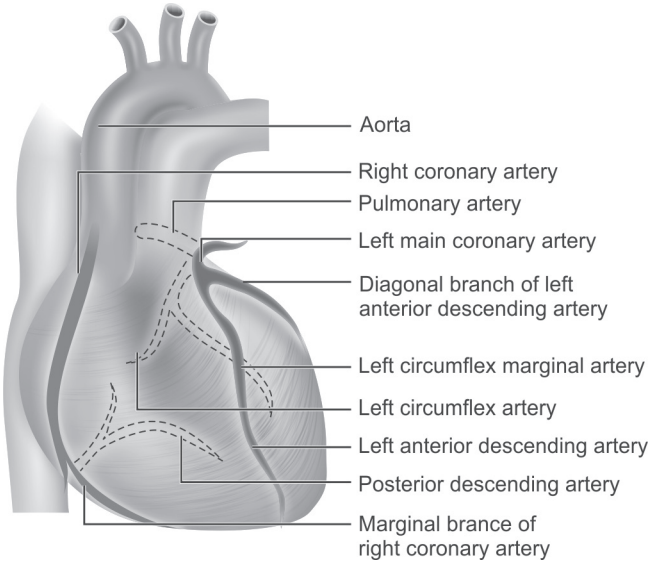


Fig. 2.2 The normal coronary arterial anatomy

  - SA node (65%) and AV node (35%)
  - Bundle of His (before bifurcation).
- Left coronary artery supplies:
  - Left atrium and left ventricle
  - Anterosuperior 2/3 of the interventricular septum
  - Anterior left ventricular wall
  - Left bundle branch and most of right bundle branch
  - SA node (80%), AV node (20%).

Coronary Arteries

Coronary artery and its branches	*Portion of myocardium supplied*	*Portion of conduction system supplied*
Right CA Posterior descending	Right atrium right ventricle	SA node (60%)
Right marginal	Inferior surface of LV (85%). Posterior surface of LV (85%)	AV node (85–90). Proximal portion of bundle of His. Part of posterior-inferior fascicle of LBB.
Left CA Anterior descending (LAD)	Anterior surface of LV. Part of lateral surface of LV. Most of the inter-ventricular septum	Most of RBB. Anterior superior fascicle of LBB. Part of posterior-inferior fascicle of LBB.
Left circumflex A (LCX)	Left atrium. Part of lateral surface of LV inferior surface of LV (15%). Posterior surface of LV (15%)	

CONDUCTIVE SYSTEM OF THE HEART (JUNCTIONAL TISSUES OF THE HEART) (FIG. 2.3)

The normal site of impulse formation in the heart is SA (sino-atrial) node. The atria are then depolarized. The impulse then spreads thought the AV (atrioventricular) node and bundle of His to the left bundle branch (LBB) and right bundle branch (RBB) and then to the ventricular muscle through the Purkinje fibers, leading to ventricular depolarization.

Atria Conducting System (Table 2.1)

Primary pacemaker of the heart (SA node) is located in the upper part of the right atrium SA node initiates 60–100 beats/min. The impulses travel thought 3 main internodal conduction pathways named anterior, middle and posterior, in and around both atria and in a pathway called 'Bachmann's bundle' leading to the left atrium. Stimulation of the slower-conduction muscle cells of both atria produces P wave in the ECG. The P wave represents electrical excitation of the atrial muscle cells.

Electrical impulses enter the AV node junction which acts as a way station, a delay area where impulses from both atria are slowed down. This delay gives time for the atria to contract and propel (kick) their contents into their respective ventricles.

Ventricular Conducting System

After the brief delay in the AV node, the impulses proceed down in the bundle of His which divides into two pathways: RBB, which traverses the right ventricles, and LBB, which

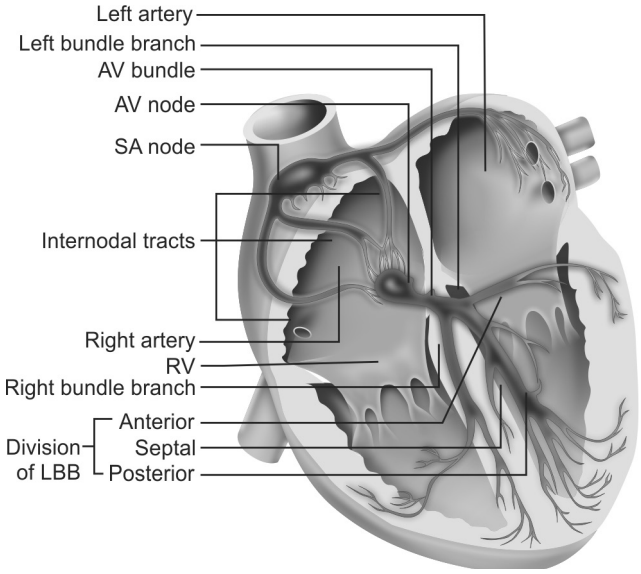


Fig. 2.3 The conductive system of the heart

Table 2.1 | Summary of the conduction system

Structure	*Location*	*Function*	*Intrinsic pacemaker*
SA node	RT atrial wall just inferior to opening of superior vena cava (SVC)	Primary pacemaker initiates impulse that is normally conducted throughout the LT and RT atria	60–100 bpm
AV node	Floor of the RT atrium immediately behind the tricuspid valve and near the opening of the coronary sinus	Receives impulse from SA node and delays relay of the impulse to the bundle of His	
Bundle of His	Superior portion of interventricular septum	Receives impulse from AV node and relays to RT and LT bundle branch	40–60 bpm
RT and LT bundle branches	Interventricular septum	Impulse from bundle of His and relays it to Purkinje fibers	
Purkinje fibers	Ventricular myocardium	Impulse from bundle branch and relays to ventricular myocardium	20–40 bpm

traverses left ventricles. Automatic firing rate of bundle of his is 40–60 beats/min.

The LBB divides into anterior and posterior fascicles which supply the anterior superior and posterior inferior regions of the left ventricle, respectively.

Both LBB and RBB divided into smaller branches and finally into terminal conducting system in the ventricles called Purkinje cells, whose firing rate 15–40 beats/min.

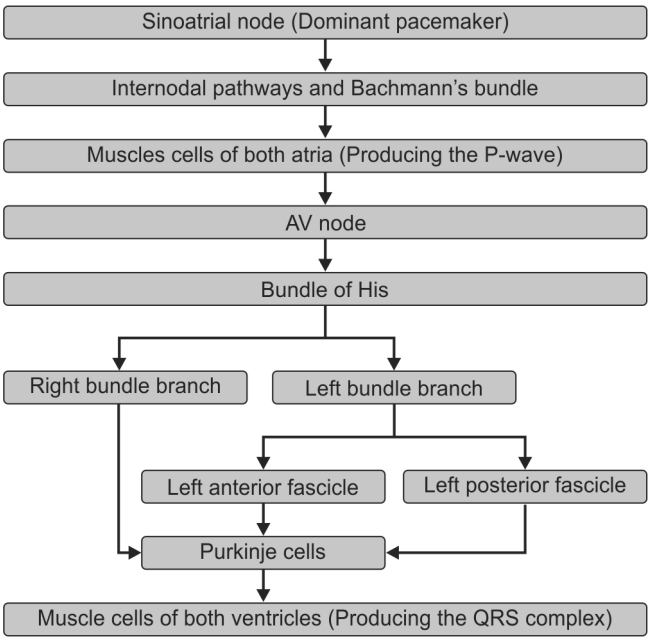
From the Purkinje cells, the muscle cells of both ventricles are stimulated, which produces the QRS complex in the ECG. The QRS complex represents electrical excitation of the ventricular muscles cells.

Impulse Formation and Conduction

In this process, three types of heart cells are involved:

1. *Pacemaker cells:* SA node, which initiates electrical impulses, at first.
2. *Specialized conducting cells:* Conduct electrical impulse, e.g. SA node, atrial internodal pathways, AV node, bundle of His, LBB, left anterior and posterior fascicles, Purkinje fibers.
3. *Muscle cells:* Have the functions of electrical conduction and mechanical contraction which produces the normal heart beat.

SEQUENCE OF HEART ACTIVATION



Note: Sinus rhythm: The normal heart rhythm with electrical activation beginning in the SA node, is called sinus rhythm if any disturbance of this sequence occurs, there is rhythm disturbance, called arrhythmia or abnormality of conduction, called heart block.

PROPERTIES OF CARDIAC CELLS

The inherent properties are:

- *Autorhythmicity:* Ability to spontaneously initiate and it maintain a rhythmic beat completely independent of neurologic input.
- *Conductivity:* Ability to conduct impulses to next cells.
- *Excitability:* Ability to respond to a stimulus inherent in both pacemaker and no-pacemaker cells.
- *Contractility:* Ability to contract after depolarization.
- Refractory period.

NERVE SUPPLY OF THE HEART

The heart is supplied by both:

- Parasympathetic nerve
- Sympathetic nerve

] in cardiac plexus

Parasympathetic

Inhibitory nerve fibers supply the SA node, atrial muscle and AV junction of the heart by means of the vagus nerves.

Acetylcholine is a chemical messenger (neurotransmitter) that is released when parasympathetic nerves are stimulated. It binds to parasympathetic receptors Nicotinic and muscarinic receptors.

Nicotinic receptors are located in skeletal muscle. Muscarinic receptors are located in smooth muscle.

Parasympathetic Stimulation

- Slows the rate of discharge of the SA node
- Slows conduction through the AV node
- Decreases the strength of atrial contraction
- Can cause a small decrease in the force of ventricular contraction.

Sympathetic: Adrenergic receptors sites are alpha receptors, beta and dopaminergic receptors. Dopaminergic receptor sites are located in the coronary arteries, renal, mesenteric and visceral blood vessels stimulation of dopaminergic receptor sites results in dilatation.

Sympathetic (accelerator) nerves supply specific areas of the hearts electrical system, atrial muscle and ventricular myocardium.

When this nerves are stimulated norepinephrine is released. Then it results:

- Increased force of contraction
- Increased heart rate
- Increased BP.

ECG
for Medical Diagnosis

Salient Features

- A highly informative and student-oriented book
- Includes chapters on exercise electrocardiography, exercisetolerance test (ETT) and pacemakers
- Provides expanded information on interpretation of ECG
- Involves tables and schematic diagrams to facilitate the learning process
- Explains diagnostic criteria for common ECG diagnosis
- Useful for undergraduate and postgraduate medical students.

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Shelving Recommendation
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