Heart

1. General information

A) Located within mediastinum, within the

B) About the size of a

C) Cone-shaped –

D) Main function is to

2. Coverings of the heart

A) Surrounded by the – dual-walled structure

1)

a)

b) Anchors it to surrounding structures

c)

2)

a) 2 layers

i)

(a) Attached to fibrous pericardium

ii)

(a) Integral part of the heart wall

b)

i) Separates parietal and visceral layers

ii) Filled with pericardial fluid; creates friction-free work area

3. Layers of the heart wall

A) (visceral layer of the serous pericardium)

1) Composed of a thin layer of

B)

1) Composed of

C)

1) Composed of

2) is continuous with blood vessels entering & leaving heart

4. Chambers of the heart

A)

1) – exterior extruding surface

2) R & L are separated by the

a) – shallow depression found in right atrium; remnant of

3) Thin-walled – not much contracting

4) Receive blood from

a) Right atrium – receives blood from:

i) – from structures above diaphragm

ii) – from structures below diaphragm

iii) – from heart itself

b) Left atrium – receives blood from:

i) – from the lungs

B)

1) Separated from atria by the

2) R & L separated by

3) Within the ventricles, 2 distinct muscle formations exist

a)

i) Internal ridges

b)

i) Finger-like projections

C) Heart valves

1)

a) Found between atria & ventricles

b) Name refers to the number of cusps (flaps)

i) valve – between atrium & ventricle

ii) valve – between L atrium & ventricle

c) Attached to papillary muscles via

i) The papillary muscles contract and pull on the chordae tendineae to keep the

AV valves closed during ventricular contraction, therefore preventing the

backflow of blood into the atria

d) Remain open when ventricles are relaxed

2)

a) Found between ventricle & its corresponding artery

b) Named according to the corresponding artery

i) valve – between R ventricle & pulmonary trunk

ii) valve – between L ventricle & aorta

c) Remain closed when ventricles are relaxed

5. Pulmonary circulation –

A) De-oxygenated blood moves from the right atrium to right ventricle thru tricuspid

valve

B) Right ventricle into pulmonary trunk thru the pulmonary valve

C) To lungs for gas exchange

1) Occurs in the

D) Oxygenated blood moves back to left atrium via pulmonary veins

6. Systemic circulation –

A) Oxygenated blood moves from the left atrium to left ventricle thru bicuspid/mitral

valve

B) Left ventricle into aorta thru aortic valve

C) To body for gas exchange

1) Occurs in the

D) De-oxygenated blood moves back to right atrium via inferior & superior vena cava

7. Coronary circulation –

A) Aorta receives blood from L ventricle

B) R & L coronary arteries receive blood from the aorta

1)

a) Supplies right atrium

b) 2 main branches

i)

(a) Supplies anterior & lateral portions of the right ventricle

ii)

(a) Supplies posterior side of both ventricles

2)

a) 2 main branches

i)

(a) Supplies anterior side of both ventricles

ii)

(a) Supplies left atrium and all portions of the left ventricle

C) – site of gas exchange

D) Cardiac veins

1)

a) Drains the anterior aspect of the heart

2)

a) Drain the posterior & lateral aspects of the heart

E)

1) Empties into right atrium

8. Cardiac Muscle Contraction

A) Involves autorhythmic cells and cardiac muscle cells

1)

a) Make up the

b) Responsible for

i) Cells have an

ii) Hyperpolarization at the end of an AP causes a closing of channels and

an opening of slow channels = causes movement towards

iii) At threshold, voltage-gated channels open =

iv) At peak voltage, voltage-gated Ca++ channels close and voltage-gated

channels open =

d) Conduction Pathway

i)

(a) Considered the heart’s

(b) Under control of nervous and endocrine systems

(i) Without control it would generate

(ii) With control, it will generate about

(c) Impulses travel to AV node via internodal pathway

(d) Impulses also travel to atrial myocardium via gap junctions (intercalated

discs)

(i) Causes

ii)

(a)

(i)

(ii) Allows for complete atrial contraction (ventricular filling)

(b) Under nervous & endocrine control as well

iii)

(a) Electrically connects atria & ventricles

iv)

(a) Carry impulses to the left and right ventricles

v)

(a) Start near the apex & moves up thru ventricles

(b) Site of synapse between conduction system & ventricular myocardium

2) Cardiac muscle cells

a) Striated, branching & mononucleated

b) – cellular junctions that allow ion movement

between cells

i) Allow the heart to act as a single, coordinated, functional unit

ii) Longer refractory period than skeletal muscle tissue; cannot undergo tetanus

c) AP generation

i) Depolarization caused by an opening of

ii) Repolarization caused by an opening of

iii) Plateau caused by an opening of

3) Process of Contraction

a) AP generated in SA node travels to atrial myocardium and AV node

i) Causes atrial contraction

b) AP travels from AV node to bundle of His then along bundle branches to the

Purkinje fibers

i) Purkinje fibers synapse with the ventricular myocardium

c) AP travels down the sarcolemma and causes voltage-gated Ca++ channels in

sarcolemma to open

d) Ca++ moves into the cell from the ECF and binds to receptors on the SR

e) This causes an opening of Ca++ release channels in the SR, causing larger

amounts of Ca++ to be released from the SR = calcium-induced calcium release

f) Ca++ binds to troponin initiating contraction (sliding filament mechanism)

9. Cardiac Cycle

A) Series of events occurring during one heartbeat; 4 events occur

1)

2)

B) 3 phases

1)

a) Occurs just after blood is ejected from the ventricles

b) Semilunar valves are open & AV valves are

c) Characterized by:

i)

(a) Causes decreased ventricular P

ii)

(a) Causes second heart sound, a.k.a. S2 or “dub”

iii)

2)

a) Begins when

b) Characterized by:

i)

ii)

c)

i) Volume of blood in the ventricle just prior to contraction

3)

a) Characterized by:

i)

(a) Causes increased ventricular P

ii)

(a) Causes first heart sound, a.k.a. S1 or “lub”

iii)

iv) Ventricular ejection

(a)

v) Atrial filling also occurs during this phase

10. – total amount of blood pumped by each ventricle per minute

A)

B) Regulation of Cardiac Output – 2 mechanisms

1) Regulation of Stroke Volume – 3 factors

a) – stretch on the cardiac muscle just before contraction

i) Associated with EDV – end diastolic volume

ii) Frank-Starling Law of the Heart

b) – strength of contraction

i) Positive inotropic agents

(a)

ii) Negative inotropic agents

(a)

c) – pressure the ventricles must overcome to eject blood

2) Regulation of HR

a) ANS Control

i)

(a) Composed of 3 centers

(i)

(ii)

(iii)

(b) Receives input from:

(i) in aortic arch & bifurcation of common

carotid artery

(ii) in aortic arch and carotid sinus

(iii) in skeletal muscles & joints

(c) Sends output signals via:

(i) Sympathetic NS (responds to

(a) Stimulates

(i) Innervate the SA & AV nodes

(ii) Also innervate the ventricular myocardium

(ii) Parasympathetic NS (responds to

(a) Stimulates the

(i) Innervate the SA & AV nodes but not the myocardium

b) Hormonal Control (low BP)

i)

c) Other Factors

i) – blocks Ca++ movement into SA node

ii) – inhibits AP generation

iii) – increases conc. gradient

iv) – decreases conc. gradient

11. Electrocardiogram (ECG or EKG)

A)

1) Atrial depolarization

B)

1) Ventricular depolarization

2) Atrial repolarization is occurring but is masked

C)

1) Ventricular repolarization

12. Heart Disorders

A) Valve disorders

1) Heart murmur – abnormal heart sounds

a) Stenosis – valve flaps become stiff and narrowed thereby restricting normal

blood flow

b) Incompetent valve – valves fail to close properly resulting in a backflow of

blood

c) Mitral valve prolapse (MVP) – chordae tendineae are abnormal and/or the

papillary muscle malfunction resulting in the flaps becoming inverted

B) Arrhythmias – abnormal heart rate

1) Tachycardia – more than 100 beats per minute

a) May be caused by elevated temp, certain drugs, stress, or heart disease

2) Bradycardia – less than 60 beats per minute

a) May be caused by low temp, certain drugs, or parasympathetic activation

3) Fibrillation – uncoordinated or quivering heartbeat

a) caused by damage/defect of conduction system

4) Heart block – inability of impulse to reach ventricles

a) blockage in the AV node, bundle of His or one of the bundle branches

C) Others

1) Myocardial Infarction (MI) – “heart attack”

a) Infarction – tissue death due to loss of blood supply

b) Often presents with an elevated S-T segment on an EKG

2) Ischemia – decreased blood flow; results in hypoxia

3) Angina pectoralis – chest pain related to coronary problems

4) Endocarditis – inflammation of the endocardium usually of the heart valves

a) Often results from a bacterial infection