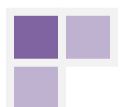


CIRCULATORY SYSTEM BASICS

1. Cardiovascular, lymphatic
2. Deliver blood/O₂/nutrients/hormone, remove wastes, regulate temp/clotting/immune
3. Picks up excess fluid filtered out in the capillary beds and returns it to veins
4. Systemic circulation
5. Pulmonary veins, left atrium
6. Arteries, veins
7. Systemic circuit, pulmonary circuit
8. SA node → A. intermodal tract → AV node → Bundle of His → R & L Bundles → Purkinje fibers
9. Short, branched, gap junctions
10. Myocardium or functional syncytium
11. Because APs originating in any cell will be transmitted to all others
12. AP, C-duction of AP, Excite/Refract periods, ANS of HR, C-duction velocity & excitability, ECG
13. Pacemaker SA node
14. SA node, AV tract, AV node, Bundle of His, Purkinje fibers

CARDIAC ACTION POTENTIALS

15. Atrial and Ventricular myocytes and in Purkinje Fibers
16. SA node & AV node
17. Relative conductance to Ions, concentration gradients of permanent ions
18. Ca²⁺ & Na⁺
19. The conductance of an ion
20. Sustained period of depolarization, long duration of AP & Long Refractory period
21. Conductance (E.G. Potassium conductance = G_k)
22. -60mV, -40mV, Pacemaker Potential
23. I_F, I_k, I_{Ca}
24. HCN
25. Epinephrine, NE, cAMP
26. Ectopic Pacemaker Potential
27. -90mV, AP from SA node
28. SA node Vagal stimulation, damaged, or inhibition by drugs, blocked SA conduction, slow rate
29. Sodium channels open
30. -15mV, Long Plateau (200-300ms)
31. Slow (.04ms), Fast (5ms)
32. .1-.2 seconds after
33. Sympathetic cardioacceleratory center, Parasympathetic cardioinhibitory center



34. V-gated Ca^+ channels open in sarcolemma & sarcoplasmic reticulum leading to contraction
35. Atrial depolarization
36. Ventricular depolarization
37. Ventricular repolarization

FAST RESPONSE CARDIAC POTENTIAL

38. Long : 150ms (atria), 250ms (ventricles), 300ms (Purkinje)
39. Long refractory periods
40. The upstroke (rapid depolarization by Na^+ influx through Voltage gated channels)
41. Initial repolarization, voltage gated Na^+ channels, transient K^+ efflux (I_{Kto})
42. Chemical and electrical forces at peak AP
43. Fast Na^+ channels, phase 0
44. Ca^{2+} conductance, Ca^{2+} influx (I_{Ca}), L-type Ca^{2+} channels
45. Phase 2, Potassium efflux balanced by Sodium influx
46. Phase 4
47. Long lasting
48. Calcium stores to release their calcium
49. G_{Ca} , B-adrenergic receptor activation by NE, catecholamines & isoproterenol
50. AC produces cAMP, cAMP cascade leads to L-type Ca^{2+} channel activation
51. Parasympathetic muscarinic receptor activation or calcium channel blockers
52. Verapamil, Diltiazem
53. Repolarization. Na^+ closes, Ca^{2+} stops, large outward delayed rectifier K^+ current (I_{K}) occurs
54. Resting membrane potential. Inwardly rectified K^+ current (I_{KI})
55. Phase 1, Start of Phase 2
56. $\text{Na}^+ \text{K}^+ \text{ATPase}$, $\text{Na}^+/\text{Ca}^{2+}$ exchanger protein, $\text{Ca}^{2+} \text{ATPase}$
57. Exchanges 3 Na out for 2 K in during phases 2 and 3
58. Exchanges 3 Na of 1 Ca during phase 2
59. Digitalis/Ouabain

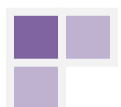
SLOW RESPONSE CARDIAC POTENTIAL

60. Phase 1 & 2
61. $\uparrow G_{\text{Ca}}$ & inward transient Calcium channels (T-type Ca^{2+} channels)
62. Repolarization in SA node due to $\uparrow G_{\text{K}}$ by K^+ efflux
63. Spontaneous Slow Depolarization due to Na^+ channels & Inward Na^+ Current (I_{f})
64. cAMP
65. Repolarization of previous AP, ensures another AP



CARDIAC CYCLE

66. Contraction phase, highest arterial pressure
67. Atria
68. About .1-.2 seconds after the atria
69. Mid-late diastole, Low Heart BP as Atrial systole occurs and AV valves are open
70. Atria relax, Raised Ventricular BP closes AV valves, Isovolumetric contraction, SL valves open
71. Ventricular Ejection Phase, when BP in ventricle is greater than in Aorta
72. Contraction with all valves closed
73. Early Diastole, Isovolumetric Relaxation
74. Blood is pushed into the ventricles (atria contract)
75. brief rise in aortic pressure caused by backflow of blood rebounding off semilunar valves
76. Mitral Valve closing (1st), Aortic valve closes (2nd)
77. Backflow of blood in aorta
78. End-diastolic volume (140ml)
79. Amount of blood ejected from ventricles during diastole (70ml)
80. Amount of blood left in the ventricles at the end of systole (70ml)
81. Amount of blood pumped by each ventricle during one minute (5000ml)
82. Heart Rate, Stroke Volume
83. Cardiac Reserve
84. Preload, Contractility, and Afterload
85. Law of conservation of mass
86. $CO = O_2 \text{ Consumption} / ([O_2]_{\text{pulmonary vein}} - [O_2]_{\text{pulmonary artery}})$
87. Amount ventricles are stretched by contained blood
88. Cardiac cell contractile force due to other factors other than EDV
89. Back pressure exerted by blood of the large arteries
90. Index of contractility, $EF = \text{Stroke volume} / \text{EDV}$
91. Frank-Starling Law of the Heart
92. As EDV increases, myocardium is stretched causing greater contraction and Stroke Volume (SV)
93. Sympathetic nerve stimulation
94. Blood loss and Very Rapid HB
95. Rate of displacement of blood flowing through a vessel per a unit of time $v = q_{\text{flow}}/a_{\text{area}}$
96. Millimeter per minute, CO
97. Force per unit area exerted on vessel walls
98. In mm Hg, Referenced to systemic major arterial BP
99. Variation of BP
100. Systemic opposition of flow due to vesicular blood friction



101. Blood viscosity, total blood vessel length, blood vessel diameter : Poiseuille Equation
102. Diameter (change effects to the 4th power)
103. Arterioles
104. Elasticity, amount of blood force into them at any given time
105. Pulsatile
106. High pressure during ventricular contraction, Low pressure during relaxation
107. Systolic-diastolic pressure
108. Pressure that propels blood into tissues, MAP = Diastolic + 1/3 pulse pressure
109. 20 to 40 mmHg
110. Enough to force filtrate, not high enough to rupture capillaries
111. 20 mmHg
112. Steady flow as opposed to spurting of arteries
113. Cardiac output, peripheral resistance, blood flow
114. Lub, AV valves
115. Dub, Semilunars
116. Abnormal sounds produced by abnormal blood flow in the heart
117. Congenital, Rheumatic fever
118. Thickened mitral valve reducing blood flow from L. atrium into L. ventricle
119. Hypertension
120. Incompetent, don't close properly
121. Holes in septum allowing blood flow between sides, congenital

REGULATION OF HEART RATE

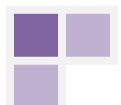
122. Chronotropic factors (pos & neg)
123. NE & epinephrine, Pacemaker HCN channels
124. Ach, K⁺ channels, slows depolarization
125. cAMP, Ca⁺, Na⁺
126. Cardiac control center of medulla oblongata
127. Increased
128. Out
129. Increased strength of contraction
130. Increased conduction : Reduced conduction
131. Phospholamban protein, Calcium pump
132. Baroreceptors, Aortic arch & Carotid sinus
133. APs, vasodilator & cardiac control center
134. Decreases and sudden changes in BP



135. Sympathetic reflex initiated by increased blood in atria
136. SA node, Baroreceptors (thus increasing SNS stimulation)
137. Tachycardia
138. Decrease
139. ADH, Atrial natriuretic peptide
140. Epinephrine & Thyroxine
141. Intra- & extracellular ion concentrations
142. Blood distribution based on need, regulates MAP by altering blood vessel diameter
143. Baroreceptors, vascular smooth muscle, vasomotor centers and fibers
144. Baro & chemoreceptors, hormones, blood-chemicals, hormones, higher-brain function
145. O₂, CO₂, and H⁺
146. Sympathetic neurons of medulla that can vasoconstrict vessels (especially arterioles)
147. Vasomotor & Cardiac control centers intergrated to control BP via diameter and CO
148. Cardioinhibitory center : ↑ diameter, ↓ HR CO PR
149. Cardioaccelatory center (↑ CO PR) & Vasomotor center (↓ diameter)
150. Carotic & Aortic bodies
151. Cortex, hypothalamus
152. Atrial natriuretic peptide, NO, alcohol, histamine, kinins, prostacyclin
153. NE & Epi, ADH, Aldosterone, Angiotensin II, Endolothium & Prostaglandin
154. Blood volume (↓Water by kidneys, ↓BP ... and vice versa)
155. ↓BP → Renin → Angiotensin → Aldosterone → ADH

DIGESTIVE SYSTEM BASICS

156. Anabolism
157. Catabolism (Digestion)
158. Polysaccharides → Disaccharides → Disacc + Water → Monosaccharides
159. Fat + Water → Fatty acids & Glycerol
160. Teeth, tongue, salivary glands, liver, gallbladder, pancreas
161. Mucosa(absorb/secrete), Submucosa(Absorb/Glands/ANS), Muscularis externa, serosa
162. Parasympathetic
163. Esophagus, Stomach, S. Intestine, L. Intestine, Appendix, Anus
164. HCL and pepsin
165. Between submucosa & muscularis : between muscularis & serosa
166. Ach, NE, VIP, Substance P
167. Parasympathetic release of Ach, Ach opens K⁺ channels, IP3-mediated signal transduction
168. Sympathetic release of NE, cAMP signal transduction



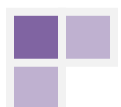
169. $IP_3 + DAG$: IP_3 depletes Ca^{+} stores initiating calcium dependent mechanism
170. Ingestion, Mastication, Deglutition (swallowing), Peristalsis, Segmentation
171. Small intestine, intestinal walls squeezes inward promoting mixing
172. Directly into the bloodstream
173. HCl, H_2O , HCO_3^- , bile, lipase, pepsin, amylase, trypsin, elastase, histamine
174. Neutralize acidity
175. Hormones

GASTROINTESTINAL TRACT FUNCTIONS

176. GI Peptides
177. Endocrine cells, blood to reach their target
178. Neurons, directly
179. Cells close to the target cells, directly
180. Secretion of enzymes/fluids/electrolytes
181. Mucosa & submucosa of stomach, intestine, and pancreas
182. Secretory and motor function of the GI tract
183. Extrinsic or ANS (Symp, parasymp)
184. Intrinsic of Enteric Nervous System
185. Myenteric & Submucosal
186. Peristalsis, Secretion
187. Cholinergic, peptidergic
188. Upper GI tract, upper third of esophagus, wall of stomach, small intestine, ascending colon
189. Lower GI tract, striated muscle of ext. anal canal, walls of all other colons, motility & secretion
190. Intrinsic or Enteric Nervous System
191. GI movements, Longitudinal muscle, Circular muscle
192. Ach, Substance P
193. VIP, NO
194. Contractile, secretory, endocrine
195. Interstitial cells of Cajal
196. Smooth muscle cells
197. Sodium and Calcium (Ca initiates the contraction too)

STOMACH

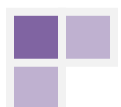
198. Parietal & Chief
199. HCO_3^- , epithelial cells
200. Prostaglandins



201. Tight junctions, rapid rate of cell division (3 days replaced)
202. Bicarbonate
203. Glycoprotein
204. Salivary amylase is inactivated by the stomach acidity
205. Ach, Histamine, & Gastrin
206. Secretagogues, receptors on membrane of parietal cells
207. Store food, initial protein digestion, kill bacteria, move chyme to intestine
208. Mucus
209. HCL & Intrinsic factor (for B12)
210. Pepsinogen
211. Histamine & Serotonin
212. Gastrin, Somatostatin
213. Kills bacteria, denature proteins, turns pepsinogen into pepsin
214. HCO_3^-
215. Cl/HCO countertransporter (Facilitated diffusion)
216. Hormone (Gastrin), Neurotransmitter (Ach from Vagus)
217. Increased cCamp
218. Ca Efflux
219. Islets of Langerhans secreting insulin & glucagon
220. Digestive enzymes & bicarbonate solution
221. Protease, α -amylase, lipase, nuclease
222. \uparrow phosphatidyl inositol, \uparrow cellular Ca, \uparrow cGMP
223. \uparrow cCAMP

INTESTINES

224. Small intestine, long length & surface area via microvilli
225. Is not, brush border enzyme
226. Chyme
227. Glucose & fructose
228. Glucose & galactose
229. Glucose
230. Aminopeptidase, Enterokinase
231. Amino acids, dipeptides & tripeptides
232. Activates trypsin : deficiency results in protein malnutrition
233. Phosphatase group \rightarrow Ca^{2+} , Mg^{2+} , and ATPase
234. Removes phosphate groups : Vitamin D



- 235. H₂O, Electrolytes, Vit B, Vit K, Folic acid
- 236. Villa, microflora, folic acid, Vit K, fatty acids
- 237. Indigestible foods
- 238. 90% of the water left over
- 239. Osmotic gradient, Na⁺/K⁺ pumps
- 240. Aldosterone
- 241. Water secreted into the lumen
- 242. External anal sphincter

KIDNEY, LIVER, GALL BLADDER

- 243. Liver, hepatic portal system
- 244. Enterohepatic circulation
- 245. Metab. regulation, protein synth., store vits. & iron, degrade hormones, bile, inactivate toxins
- 246. Bilirubin, spleen, bone marrow, liver
- 247. Glucuronic acid, conjugated bilirubin
- 248. Conjugated bilirubin converted by bacteria (gets reabsorbed 40%)
- 249. Lipids, lipolytic enzymes, micelles
- 250. Cholesterol
- 251. Improve the product transport of lipid digestion for absorption
- 252. When bile is supersaturated with insoluble cholesterol
- 253. Albumin

DIGESTION AND ABSORPTION

- 254. Oligosaccharides, SI brush border enzymes
- 255. Cleave interior polypeptide bonds, (Trypsin, Chymotrypsin, elastase)
- 256. Cleave ends of polypeptide bonds, (Carboxypeptidase, aminopeptidase)
- 257. Amino acids, dipeptides, & tripeptides, di & tripeptides are broken into AA's within SI cells
- 258. Triglycerides, free fatty acids & monoglycerides
- 259. Phospholipids, Fatty acids & Lysolecithin
- 260. Mixed Micelles
- 261. Converted into triglycerids & phospholipids → combine to form chylomicrons
- 262. Cholesterol & tri's, liver, carry triglycerides to cells
- 263. Cholesterol to organs/vessels, Cholesterol to liver
- 264. SI, Vitamin D, Calbindin protein
- 265. Intestinal membrane calcium-binding protein (IMCa)
- 266. Ferritin, Mobilferrin, transports Iron in portal blood

