Chapters 14&15 – Cardiovascular System

Outline:
Components of the CV system
Heart anatomy
   Layers of the heart wall
   Pericardium
   Heart chambers, valves, blood vessels, septum
      Atrioventricular and semilunar valves
   Fibrous skeleton
Left and right “pumps”
   Systemic and pulmonary circulations
Circuit of blood flow through the heart
Coronary circulation
Cells of the myocardium
   Autorhythmic cells
      Where are they located?
      How do they spontaneously produce APs?
      What happens at each “phase” of an autorhythmic cell action potential?
      How does this change with autonomic input?
      Conduction of electrical activity through the heart
Contractile cells
   Differences between cardiac and skeletal muscle fibers
   Action potential production
   How does electrical activity translate to mechanical activity (contraction)?
   Refractory period of cardiac muscle
Electrocardiogram (ECG)
   Normal waveforms and intervals
      P wave
      PR interval
      1st, 2nd, and 3rd degree heart block
      QRS complex
      QT interval
      T wave
      TQ interval
      What does an ECG tell us?
Cardiac cycle
   Ventricular Systole
      Isovolumetric contraction
      Ejection phase
      Ventricular relaxation
   Ventricular Diastole
      Isovolumetric relaxation
Rapid & reduced filling phases

What is cardiac output?
2 major determinants: HR & SV

Determinants of HR
Parasympathetic and sympathetic input

Determinants of SV
Preload
Frank-Starling law of the heart
What factors alter venous return?

Contractility
Positive & negative inotropic agents
Norepinephrine & epinephrine

Afterload
Blood pressure

Vascular Tree
Blood vessel structure

Arteries
Pressure reservoirs

Arterioles
Blood pressure regulation
Blood flow to capillaries of tissue
Vasoconstriction vs. vasodilation
Arteriolar diameter is dependent on . . .
Myogenic autoregulation
Active & reactive hyperemia
Sympathetic NS

Capillaries
Types of capillaries
Exchange across capillary walls
Diffusion
Bulk Flow
Hydrostatic pressure
Colloid osmotic pressure

Edema

Venules and Veins
Highly distensible
Unidirectional valves
Varicose veins

Blood flow is dependent on . . .
Pressure
Pressure gradients
Resistance – opposition to blood flow
Poiseuille’s Law
Resistance influenced by radius, length of tube, blood viscosity

Velocity of blood flow
Dependence on cross-sectional area and blood flow
Blood Pressure (MAP)
  Taking blood pressure
    Korotkoff sounds – sounds of turbulent blood flow
Factors that affect MAP
  Blood volume
  Cardiac output
  Resistance
  Distribution of blood between arterial and venous vessels
Short-term regulation of bp
  Baroreceptor reflex
Long-term regulation of bp
  Renin-angiotensin system
  Aldosterone
  ADH
  ANP
Hypertension
  Description
  Pre-hypertension
  Causes
  Consequences
  Treatments

Objectives
1. What are the three major components of the cardiovascular system?
2. Describe the layers of the heart wall. What is the pericardium? What are the layers of the pericardium?
3. Know basic heart anatomy (chambers and valves). What are the major blood vessels that enter and leave the heart?
4. What is the fibrous skeleton? What is its function?
5. Describe the operation of the atrioventricular and semilunar valves. How do they promote unidirectional blood flow? What is the stimulus for the valves to open or close? Describe the differences in structure between the two valve types.
6. Know the circuit of blood flow through the heart.
8. What is the purpose of the coronary circulation? Where is it found?
9. Describe the different types of cells present in the myocardium. What are their functions?
10. What are autorhythmic cells? Describe how action potentials are generated in the SA node. Describe the path of conduction through the heart.
11. Why is the SA node considered the pacemaker of the heart?
12. How do norepinephrine and acetylcholine affect the rate of depolarization in autorhythmic cells?
13. What is the importance of intercalated discs in the myocardium?
14. What population of cells will determine heart rate if the SA node fails? If the AV node fails?
15. How is cardiac muscle different from skeletal and smooth muscle?
16. Describe action potential production in cardiac contractile cells. What happens at each stage of the action potential? What ions/channels are involved?
17. Describe excitation-contraction coupling in cardiac muscle.
18. What is the refractory period? What is the physiological basis for this period? What does it protect against?
19. What is an ECG? What does “ECG” stand for? What do the waveforms and intervals in an ECG represent?
20. What is heart block? What does it indicate?
21. What is Einthoven’s triangle?
22. What is a Wiggers diagram? What does it show us?
23. Describe the electrical and mechanical events occurring during systole.
24. Describe the periods of isovolumetric contraction, ejection phase and ventricular relaxation.
25. Describe the electrical and mechanical events occurring during diastole.
26. Describe the periods of isovolumetric relaxation and the filling phases.
27. When does atrial systole occur during the cardiac cycle?
28. What is cardiac output? What is the formula for cardiac output?
29. What are the major determinants of cardiac output?
30. What is the major determinant of heart rate?
31. How does heart rate change in response to sympathetic and parasympathetic input? Why?
32. How does sympathetic input alter ventricular contractility?
33. What are the major determinants of stroke volume?
34. What determines preload?
35. What is the Frank-Starling law of the heart?
36. What is afterload?
37. What are positive and negative inotropic agents? How do they work?
38. How are elastic arteries able to serve as pressure reservoirs? How are these different from muscular arteries?
39. What are the major resistance vessels of the vascular tree? What determines the diameter of these vessels? What is reactive hyperemia? Active hyperemia? Myogenic autoregulation? How do these mechanisms work?
40. Where do gas, nutrient, and waste exchange occur in the vascular tree?
41. Describe the structural differences between continuous and fenestrated capillaries and sinusoids. Where is each type of capillary found?
42. Describe diffusion and transcytosis across capillary walls.
43. Describe bulk flow across capillary walls. How do you determine whether filtration or reabsorption is occurring? What pressures are involved? What is the net pressure formula? How do you use it?
44. Understand how the veins are able to serve as “reservoirs” of blood.
45. What is edema? What are some causes of edema.
46. What are varicose veins? Spider veins?
47. What are the major determinants of blood flow?
48. What structures set up the pressure gradients for blood flow?
49. What are the three factors that influence resistance to blood flow?
50. What determines the velocity of blood flow?
51. What are the determinants of MAP? How is it calculated? How is pulse pressure calculated?
52. What is the difference between systolic and diastolic blood pressure? What are Korotkoff sounds?
53. What is the scientific name for the blood pressure cuff? Be able to spell it correctly!
54. Describe short- and long-term regulation of blood pressure.
55. What is orthostatic hypotension? What causes it? How does the body compensate for this?
56. What is hypertension? What causes it? What kinds of problems can it cause?
57. What is atherosclerosis?