

Exam Copy 82

NROSCI/BIOSC 1070 and MSNBIO 2070

Exam # 1

September 26, 2014

Total POINTS: 100	20% of grade in class
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- 1) Heart cells are removed from an animal and placed into a tissue bath to keep them alive. Electrical stimulation of the heart muscle cells (*pacing*) induces their contraction.
- a) When the rate of electrical stimulation of the heart cells increases by 10%, will the amount of shortening of the cells be altered? Discuss the physiological mechanism that accounts for your answer. **(5 points)**.
- b) When the rate of electrical stimulation of the heart cells increases by 10%, will the cardiac action potential be altered? Discuss the physiological mechanism that accounts for your answer. **(5 points)**.

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2) The following measurements are made for an individual:

Systemic vascular resistance = 20 mm L⁻¹ min⁻¹

Heart rate = 100 beats/min

End diastolic volume = 150 ml

Systolic arterial pressure = 140 mmHg

Diastolic arterial pressure = 95mmHg

Right atrial pressure = 1 mmHg

Venous compliance is 16 times arterial compliance

Myocardial oxygen consumption is 35 ml/min

a) Determine the individual's ejection fraction; show your calculations. (8 points).

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- b) Determine the individual's mean systemic filling pressure (P_{sf}); show your calculations. **(7 points)**.

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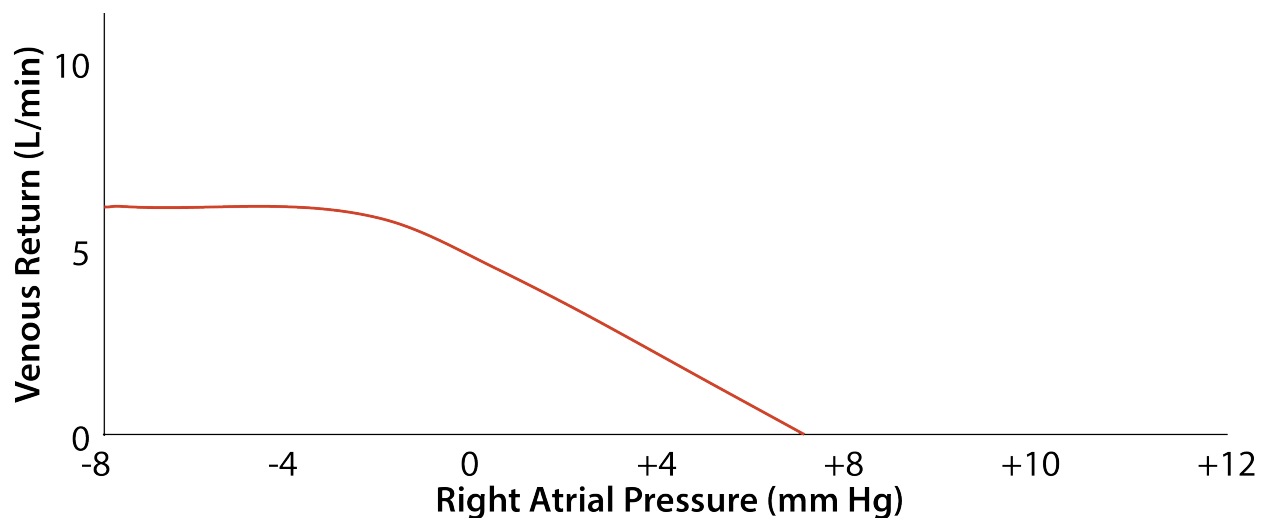
- c) The vascular function curve for a “normal” individual with the following cardiovascular parameters is plotted below. Plot (or indicate in words) how the vascular function curve would differ for the individual whose cardiovascular data are discussed above from this normal individual. **(5 points).**

Mean arterial pressure = 102 mmHg

Central venous pressure = 2 mm Hg

Cardiac output = 5 L/min

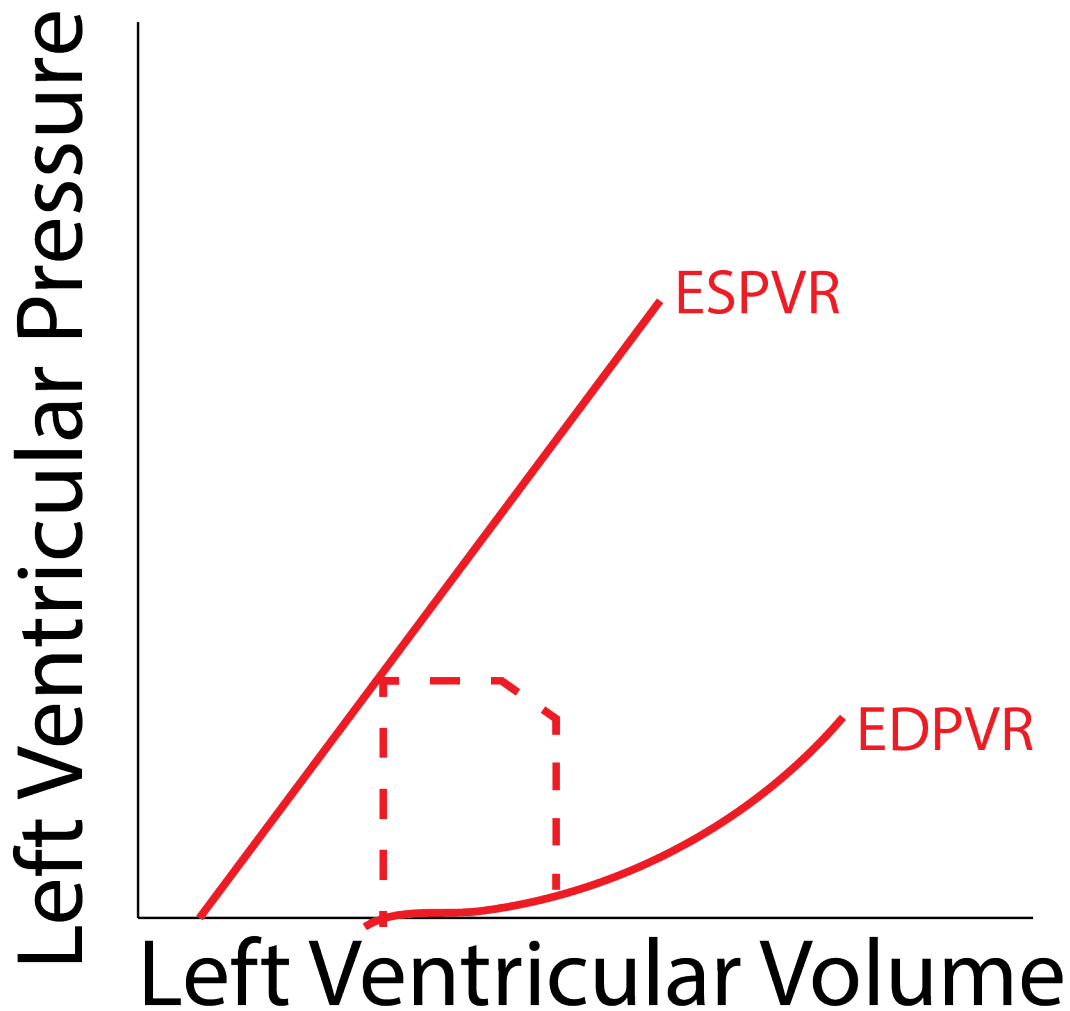
Venous compliance = 19 times arterial compliance



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- 3) An unfortunate patient is diagnosed with severe aortic valve stenosis. As part of the evaluation of the patient a pressure-volume relationship is constructed for their left ventricle.

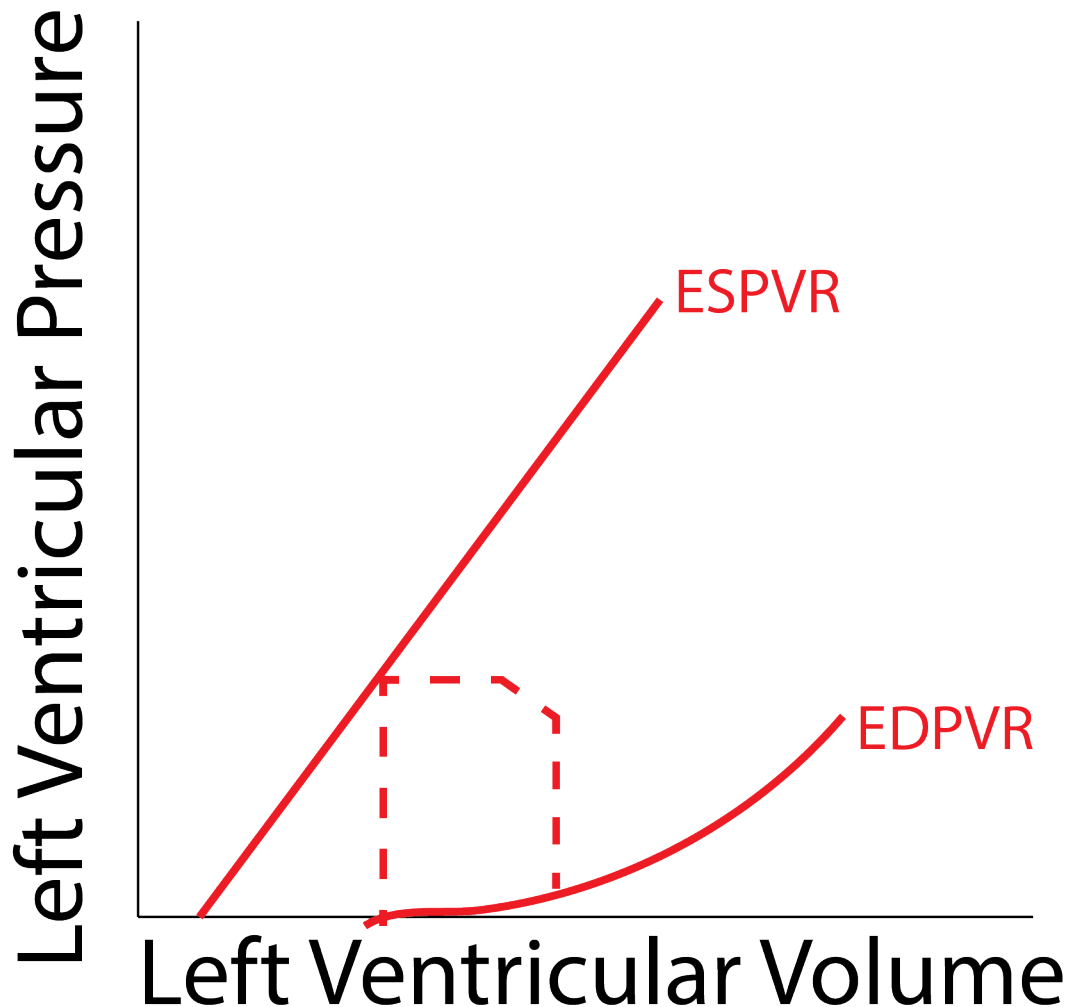
Dashed lines below show a normal pressure-volume relationship for the left ventricle. Draw how the relationship differs in a patient with severe aortic valve stenosis. (5 points).



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- 4) An experimental animal is adrenalectomized (the adrenal glands are removed), and the nerves innervating the heart are cut. One week later, an experiment is conducted where the left ventricular pressure-volume relationship is monitored while an alpha-receptor agonist is injected intravenously.

Dashed lines below show a normal pressure-volume relationship for the left ventricle. Draw how the relationship differs in the experimental animal following injection of the alpha-receptor agonist. **(5 points)**.



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- 5) Gonadotropin-releasing hormone (GnRH) antagonists are available, and are used to treat a variety of medical conditions.
- a) Would GnRH antagonists serve as effective contraceptives (birth-control treatments) in women? Provide a brief justification for your answer. **(5 points)**.
- b) In fact, GnRH antagonists are rarely administered to reproductive age women because they are associated with an undesired side effect. Discuss the major side effect of administration of GnRH antagonists in reproductive age women. **(5 points)**.

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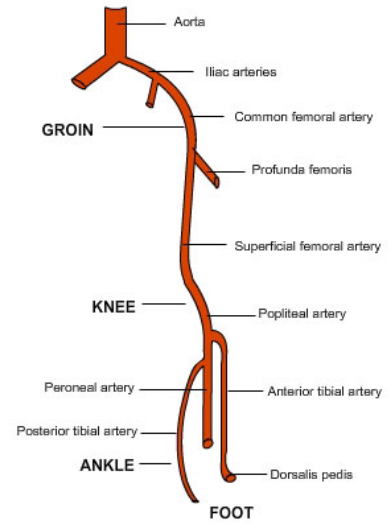
- 6) Generally in the body, blood flow is laminar. However, under some conditions laminar flow can be disrupted and become turbulent. When this occurs, blood does not flow linearly and smoothly in adjacent layers, but instead the flow can be described as being chaotic.

Turbulent flow can occur in large arteries at branch points. Provide the physiological rationale why branch points in large vessels can generate turbulent flow. **(5 points)**.

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- 7) The femoral artery, a large artery in the leg, is a tributary (branch) of the aorta. The femoral artery has a much smaller diameter than the aorta.

Assuming that an individual is lying down (and there is no gravitational gradient between the aorta and femoral artery), would one vessel have a higher surface tension along the inner wall than the other? Provide a brief explanation for your answer. **(5 points).**



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- 8) During aging, a number of changes occur in the large arteries and veins. The changes alter the compliance of the vessels. The following questions relate to changes in blood vessel compliance that occur during aging.
- a) Discuss how compliance changes in large arteries during aging. As part of your answer, indicate how these compliance changes affect arterial blood pressure. **(7 points)**.
- b) Discuss how compliance changes in large veins during aging. As part of your answer, discuss how these changes affect the ability of an older individual to maintain stable blood pressure. **(8 points)**.

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- 9) Would a muscarinic receptor antagonist have any effect on the contraction of skeletal muscle? Provide a brief explanation for your answer. **(5 points)**.
- 10) Would creatine phosphate levels be higher, lower, or the same in skeletal muscle following an intense bout of exercise than at rest? Provide a brief explanation for your answer. **(5 points)**.

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- 11) In 1962, Sir James W. Black discovered propranolol, the first pharmacological treatment for hypertension. Propranolol blocks all beta-receptors, and produces a number of unwanted side effects. Today, selective beta-1 antagonists (such as metoprolol) are used as antihypertensive treatments, since most of the negative side effects of propranolol are avoided.

In the table below, indicate for each function the possible negative effect (*if any*) that might result in a patient taking propranolol, but not one taking metoprolol. **(15 points).**

Vision	
Micturition	
Digestion	
Skeletal muscle performance	
Breathing	

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