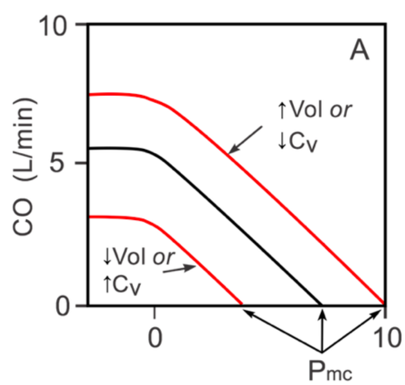
1. [15 points] With reference to the term “mean circulatory pressure” …

    A. What is the definition of the term?

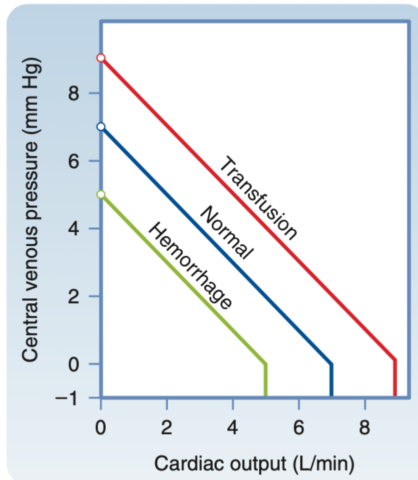
    The mean circulatory pressure is the equilibrium pressure throughout the circulatory system when cardiac output is 0 (no flow).

    B. If all other physiological variables remain the same, how (increase, decrease, remain the same) is mean circulatory pressure affected by a change in venous compliance? Briefly explain.
    If all other physiological variables remain the same, if venous compliance is decreased, there is a shift to the right in the vascular function curve, which leads to an increase in the P_{mc}. The opposite shift occurs with increased venous compliance and a decrease of the mean circulatory pressure P_{mc}.



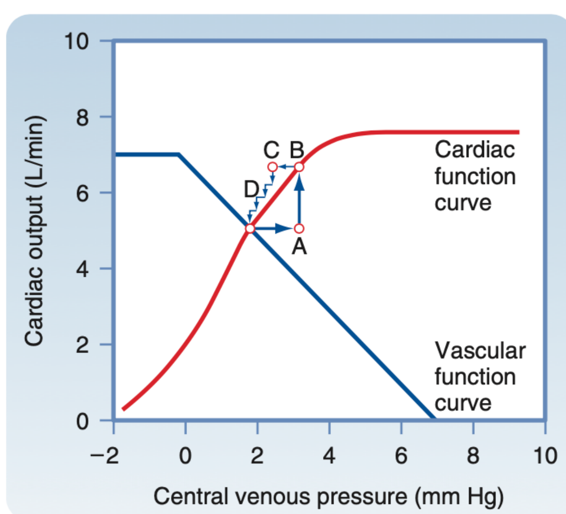
Reference: Mean Systemic Pressure , Cv: venous compliance

    C. If all other physiological variables remain the same, how (increase, decrease, remain the same) is mean circulatory pressure affected by a change in circulating blood volume? Briefly explain.
    If there is more blood volume added to the circulatory system without changes in venous compliance or other physiological variables, the mean circulatory pressure increases (transfusion curve in figure below). Decrease of blood volume shifts the vascular function curve downward (hemorrhage curve in figure below), the mean circulatory pressure goes down.



2. [20 points] If drawn on the same set of axes, what is the significance of the point at which the vascular function curve and the cardiac function curve intersect?

The cardiac function curve focuses on how the heart is driven by venous return or venous pressure. Conversely, the vascular function curve expresses the inverse relationship between cardiac output and venous pressure, that is a rise in in cardiac output diminishes P_v. P_v is the dependent variable (or outcome variable) and cardiac output is the independent variable for the vascular function curve. If these two curves are drawn on the same set of axes, the intersection point between these two curves represent the stable values of cardiac output and central venous pressure, it is an equilibrium point, at which the cardiovascular system operates. For a given pair of vascular and cardiac function curves, any perturbation is transient, as it triggers a sequence of changes in cardiac output and venous pressure to restore these variables to their equilibrium values.



3. [20 points] Sketch a vascular function curve and a cardiac function curve on a common set of axes. Show (sketch) and briefly explain the effect(s) of systemic (i.e., whole body) sympathetic stimulation.

Systemic sympathetic stimulation constricts all the systemic blood vessels.
If both arteries and veins are constricted during systemic sympathetic activation, then the venous function curve will shift to the right (from control black curve to purple curve, and increased P_{mc} due to a decrease in venous compliance) and the slope will decrease due to the increase in SVR (and vice-versa from purple to black once the systemic sympathetic stimulation decreases).
Constriction of venous vessels increases venous blood pressure and cardiac preload and cardiac output by Frank-Starling mechanism (from control curve to “enhanced” curve, and vice-versa from enhanced to normal once the systemic sympathetic stimulation decreases).