HUMAN ANATOMY AND PHYSIOLOGY-I, BP-101(T)

UNIT-V (Cardiovascular system)

CLASS:5

TOPIC – Heart beat, its regulation by autonomic nervous system, cardiac output

Heart Rate:

- The supply oxygen and other nutrients and to remove waste products. cardiovascular system circulates blood throughout the body in order to
- Each time the heart beats; blood is pumped out of the heart and into the body to supply oxygen to working muscles or to the lungs for re-oxygenation.
- Heart rate refers to the number of times the heart beats per minute, and is directly related to the workload being placed on the heart.
- When the body is in a resting state (i.e. lying down in a quiet area for at least five minutes), resting heart rate is measured.
- A normal resting heart rate ranges from 60-100 beats per minute (bpm).
- Resting rates higher than 100 bpm suggest that the heart is working too hard to circulate blood, and thus may indicate a serious problem that should be monitored by a physician.
- Resting rates lower than 60 bpm occur more often with endurance-trained athletes whose bodies are more efficient at utilizing oxygen from the blood.

Regulation:

- Heart rate is controlled by the two branches of the autonomic (involuntary) nervous system.
- The sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS).
- The sympathetic nervous system (SNS) releases the hormones (catecholamines - epinephrine and norepinephrine) to accelerate the heart rate.
- The parasympathetic nervous system (PNS) releases the hormone acetylcholine to slow the heart rate. Such factors as stress, caffeine, and excitement may temporarily accelerate your heart rate, while meditating or taking slow, deep breaths may help to slow your heart rate.

- Exercising for any duration will increase your heart rate and will remain elevated for as long as the exercise is continued.
- At the beginning of exercise, your body removes the parasympathetic stimulation, which enables the heart rate to gradually increase. As you exercise more strenuously, the sympathetic system "kicks in" to accelerate your heart rate even more.
- Regular participation in cardiovascular exercise over an extended period of time can decrease your resting heart rate by increasing the hearts size, the contractile strength and the length of time the heart fills with blood.
- The reduced heart rate results from an increase in activity of the parasympathetic nervous system, and perhaps from a decrease in activity of the sympathetic nervous system.
- Higher heart rates may be an indication of poor heart function and higher than usual stress being placed on the hearts ability to circulate blood. This may further indicate heart disease conditions.

Cardiac output:

- Cardiac output is the product of heart rate (HR) and stroke volume (SV) and is measured in liters per minute.
- HR is most commonly defined as the number of times the heart beats in one minute.
- SV is the volume of blood ejected during ventricular contraction or for each stroke of the heart.
- Not all of the blood that fills the heart by the end of diastole (end-diastolic volume or EDV) can be ejected from the heart during systole.
- Thus the volume left in the heart at the end of systole is the end-systolic volume (ESV).
- Thus, the stroke volume is not equal to the end-diastolic volume but the EDV- ESV. HR and VS are simultaneously affected by several factors.
- Cardiac output in humans is generally 5-6 L/min in an at-rest to more than 35 L/min in elite athletes during exercise.
- HR is determined by signals from the sinoatrial node, which automatically depolarizes at an intrinsic rate of 60 to 100 times each minute.

- SV is the other major determinant of cardiac output and is also affected by several factors.
- The amount of blood ejected each beat depends on preload, contractility, and afterload.
- Preload represents all of the factors that contribute to passive muscle tension in the muscles at rest.
- Preload is proportional to the end-diastolic ventricular volume, or the amount of blood in the ventricles immediately before systole.
- Greater end-diastolic volumes of blood returned to the heart, increase the passive stretching of the heart muscles.
- This in turn results in the ventricles contracting with more force- a phenomenon called the Frank-Starling law of the heart.
- Contractility describes the force of myocyte contraction, also referred to as inotropy. As the force of contraction increases, the heart is able to push more blood out of the heart, and thus increases the stroke volume.
- The final determinant of stroke volume is afterload.
- Afterload represents all the factors that contribute to total tension during isotonic contraction.
- As such afterload can be related to the amount of systemic resistance the ventricles must overcome to eject blood into the vasculature.
- Afterload is proportionate to systemic blood pressures and is inversely related to stroke volume, unlike preload and contractility.
- Cardiac output can be increased by a variety of signaling methods including enhancement of sympathetic tone, catecholamine secretion, and circulation of thyroid hormone.
- These mechanisms increase HR by exerting positive effects via chronotropy (timing), dromotropy (conduction speed), and lusitropy (myocardial relaxation rate).
- These influences also increase preload through increased venous return via receptor-mediated vasoconstriction.
- Additionally, contractility is improved through the Frank-Starling mechanism and also by direct catecholamine stimulation. The opposite

effects on HR and SV occur when the parasympathetic tone is strengthened in response to decreased oxygen requirements.

IMPORTANT QUESTIONS:

2M QUESTIONS:

1) Define Heart and its functions.
2) Define ECG.
3) Define Cardiac Output.

5M QUESTIONS:

1) Explain the physiology and anatomy of heart.
2) Explain in details about blood circulation of heart with the help of diagram and conduction system of heart

10M QUESTIONS:

1) Explain the physiology and anatomy of heart.
2) Explain in details about blood circulation of heart with the help of diagram and conduction system of heart