

Exercise Testing and Prescription
EXS 460 – Fall 2001

Cardiopulmonary and Clinical Terminology

1. **Cardiovascular disease** – all diseases of the heart and blood vessels, - the leading cause of death in the U.S. – over million fatalities/year - of deaths from all causes – includes: coronary artery disease, hypertension, stroke, congestive heart failure, peripheral vascular disease, congenital heart defects, valvular heart disease, and rheumatic heart disease.
2. **Coronary artery disease (CAD) – Coronary Heart Disease (CHD) – Ischemic Heart Disease (IHD)** – narrowing and hardening of the coronary arteries – responsible for 56% of cardiovascular disease deaths.
3. **Myocardial Infarction (HEART ATTACK) (MI)** – death and necrosis of the myocardium resulting from:
 - a. Total closing of a coronary artery
 - b. Lodging of a blood clot (thrombus in a coronary artery (most common)
 - c. Coronary artery spasm
 - d. A combination of the above
4. **Angina Pectoris** – chest pain or chest “pressure” radiating to the neck, shoulder, or left arm – indicates ischemic myocardium.
5. **Arrhythmia** – disturbance in the heart “rhythm”
6. **Hypertension (HIGH BLOOD PRESSURE)** – generally speaking, systolic pressure = 140 or diastolic pressure = 90, confirmed by measurement on at least 2 separate occasion, or on antihypertensive medication
7. **Stroke** – obstruction in or hemorrhage of blood vessel in and around the brain, causing death of brain tissue
8. **Congestive Heart Failure (CHF)** – reduced blood delivery (decreased cardiac output) causing fluid accumulation in the body – the disease is characterized by breathlessness, water and sodium retention producing edema and congestion in the lungs and/or peripheral circulation – cardiomyopathy, repeated MIs, or chronic, untreated hypertension may cause CHF.
Cardiac impairments leading to CHF:
 - a. Decreased force of ventricular contraction
 - b. Mechanical failure of ventricular filling
 - c. Overloading (overworking) of ventricles during contraction due to increased resistance to ventricular emptying
9. **Cardiomyopathy** – disease of the myocardium
10. **Aortic stenosis** – a narrowing of the aortic orifice (stenosis = narrowing)
11. **Cardiac linings**
 - a. Pericardium – fibrous sac surrounding the heart
 - b. Epicardium – outer layer of the heart
 - c. Myocardium middle layer of the heart – the heart muscle itself
 - d. Endocardium – inner layer of the heart – forms the heart valves – only layer of heart that is nourished by the blood inside the heart
12. **Frank – Starling Principle** – the myocardium will contract with greater force when stretched to a greater length or dimension
13. **End diastolic volume (EDV)** (preload) – the amount of blood in the left ventricle after it is filled
14. **End systolic volume (ESV)** (after-load) – the amount of blood in the left ventricle after contraction
15. **Ejection fraction (EF)** – the % of the diastolic volume that is expelled upon contraction (LV norms = 62%; RV norms = 52%) – diseased individuals show no change or a decrease in EF upon exercise

- a. Calculation – $(EDV - ESV) / EDV$

16. **Myocardial Contractility** – the degree of fiber shortening (fraction shortening) in response to a stimulus – inotropic state

Regulated by:

- a. Sympathetic nerve activity (most influential)
- b. Circulating catecholamines
- c. Possible loss of contractile mass (as in infarction)
- d. Drugs (those that increase = glycosides, sympathomimetics, caffeine, theophylline, amrine; those that decrease = acidosis, anesthetics, barbiturates)

17. **Stroke volume** ($ml \cdot bt^{-1}$)(SV) – the amount of blood ejected from the left ventricle with each contraction of the heart (EDV – ESV)

18. **Cardiac Output** ($l \cdot min^{-1}$)(Q) – heart rate multiplied by stroke volume (HR • SV)

19. **Preload** – the diastolic filling volume of the left ventricle (reflects the passive stretching of the myocardium)

20. **Afterload** – the resistance to ventricular emptying (measured by systemic vascular resistance or aortic pressure)

21. Myocardial wall motion

- a. Kinesis – movement
- b. Dyskinesis – difficulty of movement
- c. Akinesis – absence of movement
- d. Hypo/hyper-kinesis – decreased/increased movement

22. **Oxygen pulse** – oxygen consumption/ heart rate – measured in $ml \cdot bt^{-1}$

23. **Systolic blood pressure (SBP)** – the pressure measure in the arteris during systole (ventricular emptying or contraction)

24. **Diastolic blood pressure (DBP)** – the pressure measure in the arteries during DIASTOLE (ventricular filling or relaxation)

25. **Pulse pressure** – systolic blood pressure minus diastolic pressure

26. **Oxygen consumption (VO₂)** – the amount of oxygen used in metabolism – measured in absolute terms ($ml \cdot min^{-1}$ or $L \cdot min^{-1}$) or relative terms ($ml \cdot kg^{-1} \cdot min^{-1}$)

27. **Maximum Oxygen Consumption (VO₂ max)** – Peak Oxygen Consumption (VO₂ pk) – the maximum rate at which oxygen can be utilized for aerobic metabolism – maximum aerobic capacity – functional capacity the best indicator of cardiorespiratory fitness – if peak highest VO₂ reached during last minute of the exercise test.

28. **Total peripheral resistance (TPR)** – the sum of all forces that oppose blood flow – determined by:

- a. Length of arterial vasculature
- b. Blood viscosity (thickness)
- c. Hydrostatic pressure (pressure exerted by the flood in the vessels that must be overcome before fluid flow can occur)
- d. Vessel radius (most significant)

$$TPR = MAP / Q \text{ (units in } mmHg \cdot L^{-1} \cdot min^{-1}) \quad \text{or} \quad \frac{(8)(V)(D)}{(p)(r^4)} \text{ (units in dynes)}$$

29. **Mean Arterial Pressure** – the average pressure exerted by the blood against the inner walls of the arteries – Q x TPR – estimated by the formula: $.3(SBP - DBP) + DBP$

30. **Pulmonary Capillary Wedge Pressure (PCWP)** – the pressure measured by a catheter in the distal pulmonary capillaries that is reflective of the Pulmonary artery pressure (PAP). The PAP measured at the end of diastole corresponds to the Left Ventricular End Diastolic Pressure (LVEDP)
31. **Arteriovenous Oxygen Difference (AV-O₂ difference)** – the difference between the oxygen content of the arterial blood and the venous blood – measured in mlO₂/100 ml blood (ml%)
32. **Minute Ventilation – (VE)** – the amount of air passing through the respiratory system in one minute – measured as the amount of air expired in one minute (ml•min⁻¹ or L•min⁻¹)
33. **Pressor response** – an increase in cardiac output without a corresponding decrease in peripheral resistance causing an increase in mean arterial pressure – can be caused by exhaling against a closed glottis as in isometric exercise
34. **Chronotropic** – referring to time or rate (i.e. rate of the heartbeat)
35. **Inotropic** – referring to the force or energy of muscle contraction (i.e. cardiac contractility)
36. **Hypovolemia** – abnormal decrease in circulating plasma fluid (low blood volume)
37. **Cardioversion (countershock)** – the delivery of a synchronized electrical current into the heart muscle to convert a tachycardia to a normal slower rhythm
38. **Cardiac Tamponade** – acute compression of the heart due to effusion of fluid into the pericardium or rupture of the heart
39. **Pulsus Alternans** – regular alteration in weak and strong pulses without a change in cycle length (a classic sign of LV dysfunction)
40. **Respiratory Exchange Ratio (RER)** – The amount of carbon dioxide expired at the lungs divided by the amount of oxygen extracted by the lungs (VCO₂/VO₂)
41. **Respiratory Quotient (RQ)** – The amount of carbon dioxide produced at the cellular level divided by the amount of oxygen consumed at the cellular level (QCO₂/QO₂) (RER = RQ only when steady state metabolism exists)
42. **Vaso-vagal response** – a decrease in heart and/or blood pressure at maximal exercise caused by the overriding of the sympathetic nervous system by the parasympathetic nervous system – this “protective” response may cause syncopal type symptoms but is not diagnostic of coronary artery disease
43. **Catecholamines** – neural hormones associated with sympathetic nervous system and adrenergic nerve receptors
- Epinephrine (adrenaline, norepinephrine, dopamine)
 - When released caused an increase in HR (caused increased rate of SA node discharge and contractility)
44. **Acetylcholine** – neural hormones associated with the parasympathetic nervous system and cholinergic nerve receptors
- When released causes a decrease in heart rate – the effect is mediated through the vagus nerve. (vagal stimulation has not effect on myocardial contractility)

45. Adrenergic receptor types –

Responses to Adrenergic Receptor Stimulation

(from *Pathophysiology of Heart Disease*. Lilly, Leonard. 1998.)

Receptor Type	Distribution	Response
Alpha 1	Vascular smooth muscle (arterioles and veins)	Vasoconstriction
Alpha 2	Presynaptic adrenergic nerve terminals Vascular smooth muscle (coronary and renal arterioles)	Inhibition of NE release Vasoconstriction
Beta 1	Heart Kidney (JG cells) Presynaptic adrenergic nerve terminals Adipose tissue	Increase HR Increase contractility Speed AV node conduction Increase renin release Increase NE release Stimulates lipolysis
Beta 2	Vascular smooth muscle (arterioles, except skin and cerebral) Bronchial smooth muscle Liver	Vasodilation Bronchodilation Stimulates glycogenolysis

Note – receptors at the sympathetic nerve ending bind NE and provide feedback: the B-receptor stimulates, and the alpha2 receptor inhibits, further NE release.

46. **Annulus Fibrosis** – fibrotic non-conducting tissue surrounding the bicuspid and tricuspid valve apparatus between the artia and the ventricles

47. **Chordae Tendinea** – fibrous bands that attach eh leaflets of the tricuspid and mitral valves to the papillary muscles

48. **Bachman’s Bundle** – the chief conducting pathway from the SA node to the left atrium

49. **Isovulemic Contraction** – the period of ventricular systolic during which muscle fiber shortening occurs but blood is not ejected (between the closure of the mitral valve and the opening of the aortic semilunar valve

50. **Bruit** – an abnormal sound or murmur heard in auscultation

51. **Thrill** – a vibration sensation felt by an examiner, as in over an incompetent heart valve (sometimes seen in aortic stenosis, ventricular septal defect, and pulmonary stenosis)

52. **Systolic click** – short dry clicking sound heard during ventricular systole (sometimes heard in mitral stenosis and mitral valve prolapse)

53. Gallop rhythm – an auscultatory finding of “extra” heart sounds, usually in diastole

54. **Xanthoma** – a small nodule or plaque of skin that is yellowish color distributed around the eyelids or other parts of the body – indicative of hyperlipidemia

55. **Glubbing** - a proliferative change in the soft tissues around the terminal phalanges of the fingers and toes

56. **Rales** – an abnormal respiratory sound heard during auscultation

57. **Afebrile** – with fever

58. **Stenosis** – narrowing

59. **Afferent** – going toward the center

60. **Efferent** – going away from the center
61. **Syncope** – temporary lightheadedness or unconsciousness due to cerebral ischemia
62. **Apnea** – cessation of breathing
63. **Dyspnea** – breathing difficulty
64. **Hyperpnea** – an increase in the rate and depth of breathing
65. **Hyperemia** – an excess of or engorgement with blood
66. **Respiratory Alkalosis** – an increase in blood pH due to excess CO₂ loss (can result from hyperventilation)
67. **Respiratory Acidosis** – a decrease in blood pH due to CO₂ retention
68. **Orthostatic Hypertension** – a decrease in blood pressure resulting from going from a supine to an erect position
69. **Glycogenolysis** – the splitting up of glycogen yielding in glucose
70. **Glycolysis** – The anaerobic enzymatic conversion of glucose to lactate and pyruvate resulting in energy stored in the form of ATP
71. **Gluconeogenesis (glyconeogenesis)** – the formation of glucose from amino acids, lactate, and the glycerol portion of fat
72. **Osmosis** – the passage of a pure solvent from a solution of lesser to one of greater solute concentration when the two solutions are separated by a selectively permeable membrane which prevents the passage of solute molecules.
73. **Osmolarity** – the concentration of osmotically active particles in a solution
74. **Functional Aerobic Impairment** – $(\text{predicted VO}_2 \text{ max} - \text{attained VO}_2 \text{ max}) / \text{predicted VO}_2 \text{ max}$
- | | | |
|----|-----------|----------|
| a. | 27% - 40% | mild |
| b. | 41% - 54% | moderate |
| c. | 55% - 68% | marked |
| d. | = 69% | severe |
75. **PNF Stretching** – isometric contraction of a muscle being stretched followed by a slow static stretch of the same muscle. An induced reflex facilitation and contraction of the agonist suppresses contractile activity of the antagonist, allowing for a better stretch. Isometric contractions should be held 4–6 seconds with the regular stretch held 6–10 seconds.
76. **Reciprocal Innervation** – simultaneous activation of an agonist and inhibition of the antagonist
77. **Stretch Reflex** – the contraction of extra fusial fibers in response to an afferent signal sent to the intrafusial fibers in the muscle spindle. This allows adjustment to load differences
78. **Beta oxidation** – the transformation of fatty acids to acetyl-coenzyme A in the mitochondria
79. **Oliguria** – secretion of too little urine in proportion to fluid intake (symptom of hypovolemic shock)
80. **Oximetry** – the determination of arterial oxygen saturation by bichromate photoelectric colorimetry
81. **Palliative** – to afford relief but not cure
82. **Parenteral** – not introduced to the body via the alimentary canal (subcutaneous, intravenous, etc)
83. **Percutaneous** – performed through the skin

84. **Myalgia** – muscle pain

85. **Pyretic** – pertaining to a fever

86. **Sepsis** – the presence (or the condition associated with the presence) of pathogenic microorganisms or their toxins. It may be caused by IV catheterization)