

# Quantitative analysis of the cardiovascular system lab



### **Cardiac Cycle**

- Systole
- Diastole



## Cardiac Output

- Volume of blood ejected per minute
- Averages between 4–8L/min
- CO = Stroke volume X heart rate
  - =70 ml X 60 beats/min

=4,200 ml/min



#### Stroke Volume Is Determined By Three Factors

- Preload
- Afterload
- Contractility



#### Preload

- Degree of stretch of myocardial fibers
- Determined by the volume of blood in left ventricle (LV) at end of diastole
- Increased volume -> increased preload-> increased cardiac output (CO)
- Decreased volume -> decreased preload -> decreased cardiac output (CO)
- Compliance of myocardial cells also affects preload



#### Factors Which Increase Preload

- IV fluids
- Blood
- Vasoconstriction



### Factors Which Decrease Preload

- Diuretics
- Dehydration
- Hemorrhage
- Vasodilation



#### Afterload

- Resistance or pressure the ventricles must overcome to pump blood out
- Left ventricle affected by systemic vascular resistance (SVR)
- Right ventricle affected by pulmonary vascular resistance (PVR)



- Related to arterial pressure or diameter of arteries
- As pressure increases, resistance increases, afterload increases
- As pressure decreases, resistance decreases, afterload decreases



## Contractility

- Force generated by the myocardium when it contracts – inotropic property
- Ejection fraction (EF) percentage of LV enddiastolic volume that is ejected with each contraction
- ► EF normally approximately 50–55%



$$\mathsf{EF} = \frac{70\mathsf{cc}}{140\mathsf{cc}}$$

#### EF = .5 or 50%



## Cardiac Auscultation

#### ► **S**1

- Caused by closure of mitral and tricuspid valves
- Signifies beginning of systole
- Best heard over apical area (left, midclavicular, 5<sup>th</sup> ICS)
- ► **S**2
  - Caused by closure of aortic and pulmonic valves
  - Signifies beginning of diastole
  - Best heard over base area ("A" and "P" areas, 2<sup>nd</sup> ICS)





"Joyce, write this down in Mr. Cutler's file: "thump . . . thump-thump . . . thumpety thump . . . boink.'"

# **Gallop Sounds**

- S3 Ventricular gallop
  - Heard in early diastole right after S<sub>2</sub>
  - Normal in children and young adults
  - Characteristic of LV failure
- S4 Atrial gallop
  - Heard in late diastole right before S1
  - Heard during atrial contraction as atria force blood into resistant ventricles
  - Characteristic of HTN, heart failure, pulmonary disease





## **Snaps and Clicks**

- Abnormal valve sounds
  - Snap stenosis of mitral valve
  - Click stenosis of aortic valve



#### Murmurs

- Caused by turbulent blood flow
  - Narrowed or stenosed valve
  - Incompetent or regurgitant valve
  - Atrial or ventricular septal defect
  - Increased metabolic states
- Classified based on timing in cardiac cycle
  - Systolic
  - Diastolic
- Quality of murmur blowing, rumbling or whistling

#### Loudness or intensity is graded

- Grade I/VI
- Grade II/VI
- Grade III/VI
- Grade IV/VI
- Grade V/VI
- $\circ$  Grade VI/VI

