BMSN1601 – Anatomy

|  |
| --- |
| What is Cardiovascular System |

* Through Hemodynamics 🡪 Deeper understanding in Cardiovascular System
  + Hemodynamics = Study of Blood flow by physical methods
  + Visualization of Hemodynamics can be done by 3D MRI

|  |
| --- |
| Introduction to definition of CO, HR, SV, Q and BP |

* CO is Cardiac Output
  + Amount of blood pumped by **each ventricle** in **1 minute**
* HR is Heart Rate
  + Number of Heart beat in 1 minute
* SV is Stroke Volume
  + Volume of Blood Pumped out by **a ventricle** with each beat.
* Q is Blood Flow
  + Volume of blood flowing through a vessel, an organ or the entire circulation in each period
* BP is Blood Pressure
  + Force per unit area exerted on the wall of a blood vessel by its contained blood.
    - Like e.m.f 🡪 Provide Driving Force to the Blood
  + Unit: mmHg
  + Site of measurement: **brachial artery** (large arteries near the heart)

|  |  |
| --- | --- |
| 💥 | Blood Flow is not equivalent to the Cardiac Output.  Blood Flow in the entire circulation per minute = Cardiac Output. |

|  |
| --- |
| Introduction to Blood Pressure |

* Difference in BP within vascular system 🡪 Driving force to blood 🡪 Blood Flows
  + From High Pressure to Low Pressure Area
  + Aorta (大動脈) 🡪 Arteries (動脈) 🡪 Arterioles (小動脈) 🡪 Capillaries (毛細血管)   
    🡪 Venules (小靜脈) 🡪 Veins (靜脈) 🡪 Venae Cava (大靜脈)
* Arterial Blood Pressure – Systolic Pressure
  + Arterial Pressure **during ventricular contraction**
* Arterial Blood Pressure – Diastolic Pressure
  + Arterial Pressure **during ventricular filling**
* Pulse Pressure
* Mean Arterial Pressure
  + Average arterial pressure during **a single cardiac cycle**.

|  |  |
| --- | --- |
| 💦 | Examination Technique:  Systolic Pressure @ Highest Level in cardiac cycle  Diastolic Pressure @ Lowest Level in cardiac cycle |

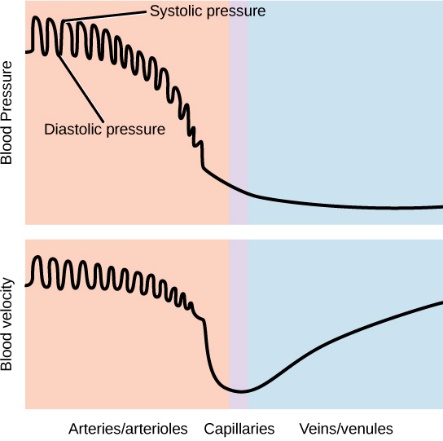
|  |
| --- |
| The Common Formula For Cardiovascular System |

|  |
| --- |
| Entire Circulation Formula: |
| #Blood circulation Formula:  #:The Formula is similar to the Ohm’s Law, where |
| Formula for velocity of Q:  \* The Formula is assume that there is no resistance in the blood vessel  \* Important Idea: Current in = Current Out, when there is no branches, the blood flow will always be the same |
| Poiseuille’s Law:  \* Regulation of blood vessel radius  \* is not subject to **significant short-term regulation**, in other word, t cannot  \* and not subject to **significant regulation** by body, where t cannot 0   |  |  | | --- | --- | | ❔ | * Do notice that the Blood Pressure decrease over the time   + From Aorta to Venae Cava * There is no change in the radius of blood vessel within the length L * Smaller the radius, Larger the Resistance, Smaller the speed.   + Do compare this relationship with the above formula , where the above formula omit the resistance. – For Detailed Information, Plz Refer to the next page | |

|  |
| --- |
| Poiseuille’s Law v.s. Q-v Formula |

* Poiseuille’s Law can only be applied when is not significant.
* Q-v Formula can only be applied when there is no resistance

*According to the Following Graph:*



|  |
| --- |
| * Do notice that the in Aorta (大動脈), Arteries (動脈) are significant.   + The formula cannot be applied because the heart keeps bumping bloods (keep doing work on the blood flow) to against the resistant.  🡪 The force acted by resistance on the blood flow is not constant (tends to zero). 🡪 The Q (Blood Flow) tends to be unchanged. 🡪 Thus, the velocity of fluid cannot be found by the Poiseuille’s Law * Q-v Formula should be applied in Aorta and Arteries, where the resistance is tends to zero due to the effect of bumping of heart. * That’s why the beginning of velocity of fluid is tends to unchanged.   **We have , Larger the radius, Lower the Velocity of Fluid.** |

|  |
| --- |
| * Do notice that the in each region of Arterioles, Capillaries and veins/venules **are not significant.** * However, it is far apart from the heart, **the resistance cannot be cancelled by the work done by heart**.   + The Resistance is significant & Lots of Branches 🡪 Thus, the **Q is not constant** and **Q-v formula cannot be applied.** * We should applied Poiseuille’s Law in those cases.   + We have: and * Region Arterioles & Capillaries   + **Smaller the Radius, Lower the Velocity of Fluid.** * Region Venules (小靜脈) ,Veins (靜脈) ,Venae Cava (大靜脈)   + **Larger the Radius, Higher the Velocity of Fluid.**   + The Blood Flow is gradually increased from Venules to Venae Cava. |

|  |  |
| --- | --- |
| ❗ | There is no direct relationship between velocity of blood, blood pressure and blood flow. |

|  |
| --- |
| Blood Vessel – Laminar Flow & Turbulent Flow |

|  |
| --- |
| Laminar Flow |
|  |
| * Requirement:   + Fluid flows in layers parallel to vessel wall   + Without disruption between layers * #Characteristic:   + **The layer of fluid in contact with the wall has lower velocity**   + **The layer of fluid that moves along the axis of the tube has maximal velocity**   #: This can be explained by the resistance act on the layer of fluid in contact with the wall |

|  |  |
| --- | --- |
| Problematic: Turbulent flow | |
|  |  |
| * Requirement:   + Irregular Movement * Characteristic:   + Q is decreased 🡪 Heart Need to Bump more vigorously 🡪 Great Work load   + v is decreased | |

|  |
| --- |
| Some Example to demonstrate the importance of Hemodynamics |

图示

描述已自动生成

* Hypertension / Hypotension
* Stroke
* Aneurysms 🡪 Enlargement of an artery 🡪 Thin artery wall. 🡪 Risk of Apoplexy (内出血) / Intracranial bleed (腦出血)

|  |
| --- |
| Introduction to Respiratory System |

|  |  |  |
| --- | --- | --- |
| Upper Tract | * **Filter & humidify incoming air** | **Nose** |
| **Pharynx** |
| Frontal Sinus |
| Sphenoidal Sinus |
| Nasal Cavity |
| Internal Nares |
| Lower Tract | * + **Delicate conduction passages**  (精緻的傳導通道)   + **Gas Exchange – Refer to Respiratory Zone** | **Larynx** |
| **Trachea** |
| **Bronchi** |
| **Lung** |
| Bronchioles |
| Diaphragm |
| Alveoli |

|  |
| --- |
| Zone in Respiratory System |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Conducting Zone**   * Provide Rigid conduits for air to reach Respiratory Zone | | | | | |
| Nose | Pharynx | Frontal Sinus | Sphenoidal Sinus | Nasal Cavity | Internal Nares |
| Larynx | | Trachea | | Bronchi | |

|  |  |  |  |
| --- | --- | --- | --- |
| **Respiratory Zone**   * Site of Gas Exchange | | | |
| Bronchioles | Alveolar Ducts | Alveoli | Alveolar Sac |

|  |
| --- |
| **Respiratory muscle**   * Promote ventilation |
| Diaphragm |

|  |
| --- |
| Terms used in Respiratory System |

|  |  |
| --- | --- |
| * Respiratory System   + To supply the body with O2   + To dispose of CO2 * Pulmonary ventilation   + Movement of air into & out lungs * Transportation   + Transport of CO2 and O2: Lung & Blood | * External Respiration   + Gas Exchange (GE): lung & blood * Internal Respiration   + GE: systemic blood vessels & tissues * Inspiration (inhalation)   + Air flows into the lungs * Expiration (exhalation)   + Gases exit the lungs |