

# Hemodynamics Summary

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## ❖ Vessel Types and Their Role in Resistance and Flow:

### 1. Elastic Vessels (Aorta and Large Arteries):

- Rich in elastic tissue, they have low resistance and smooth out pressure changes through expansion and recoil.

### 2. Resistance Vessels (Small arteries and Arterioles):

- Small radius with smooth muscle control; vasoconstriction increases resistance, while vasodilation decreases it, Mainly the Arterioles.

### 3. Exchange vessels (capillaries).

### 4. Capacitance Vessels (Veins):

- Store large blood volumes and regulate venous return.

## ❖ Blood Distribution:

- Systemic circulation holds the majority of blood (84%), with veins accounting for 64%.

## ❖ Forces Impacting Blood Flow

- **Pressure Gradient ( $\Delta P$ ):** Drives blood flow; higher pressure ensures movement from arteries to veins, directly proportional to flow.
- **Resistance (R):** Opposition to flow, Inversely proportional to flow; determined by vessel radius (most critical), viscosity, and length (constant)

## ❖ Viscosity and its Effects

### ○ Viscosity is influenced by hematocrit and plasma proteins:

#### ○ In Anemia (Low Hematocrit):

- Decreased viscosity reduces resistance, increasing velocity, which can lead to turbulence (e.g., murmurs).

#### ○ In Polycythemia (High Hematocrit):

- Increased viscosity raises resistance, reducing flow efficiency and adding cardiac strain.

Proportionality	Factor	Relationship to Flow
Directly Proportional	Longitudinal Pressure Gradient ( $\Delta P$ )	Higher pressure gradient increases flow.
	Radius of the Vessel (r)	Flow increases with the fourth power of the radius (primary effect).
Inversely Proportional	Length of the Tube (L)	Longer vessels increase resistance, reducing flow.
	Viscosity ( $\eta$ )	Higher viscosity reduces flow efficiency.

## ❖ Blood Velocity and Cross-Sectional Area:

### ○ Velocity:

- Inversely related to the vessel's cross-sectional area.
- Fastest in the aorta (small area) and slowest in capillaries (large area) to optimize exchange.

### ○ Types of Flow:

- **Laminar Flow:** Smooth, with the highest velocity at the center of the vessel.
- **Turbulent Flow:** Occurs with high velocity or low viscosity, atherosclerosis (narrowing), causing audible sounds (murmurs, bruits).