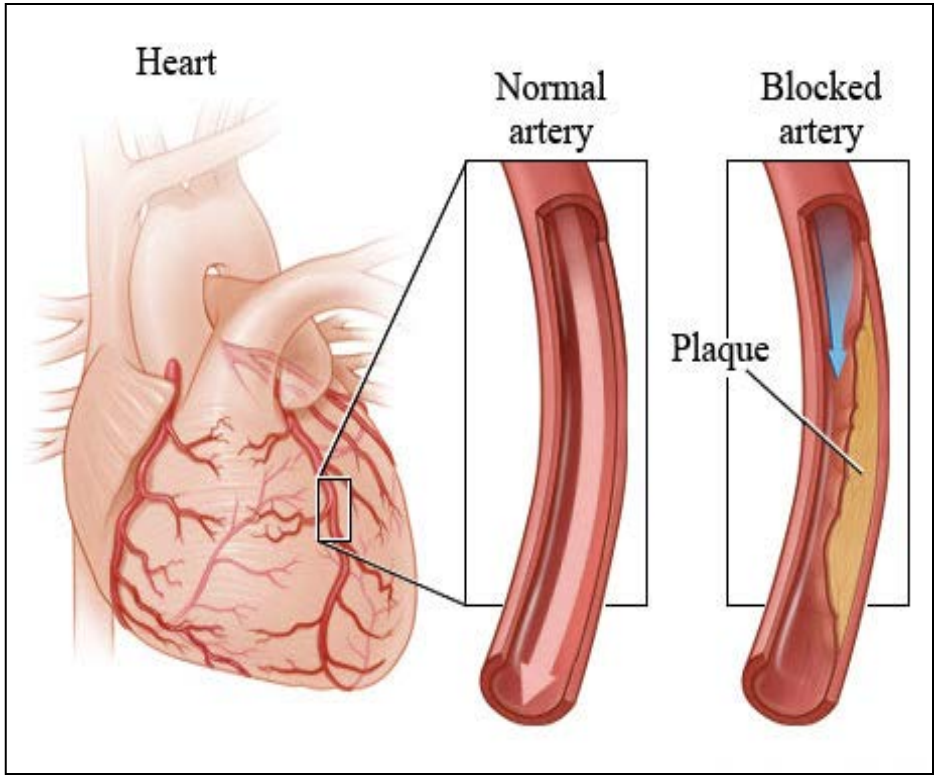
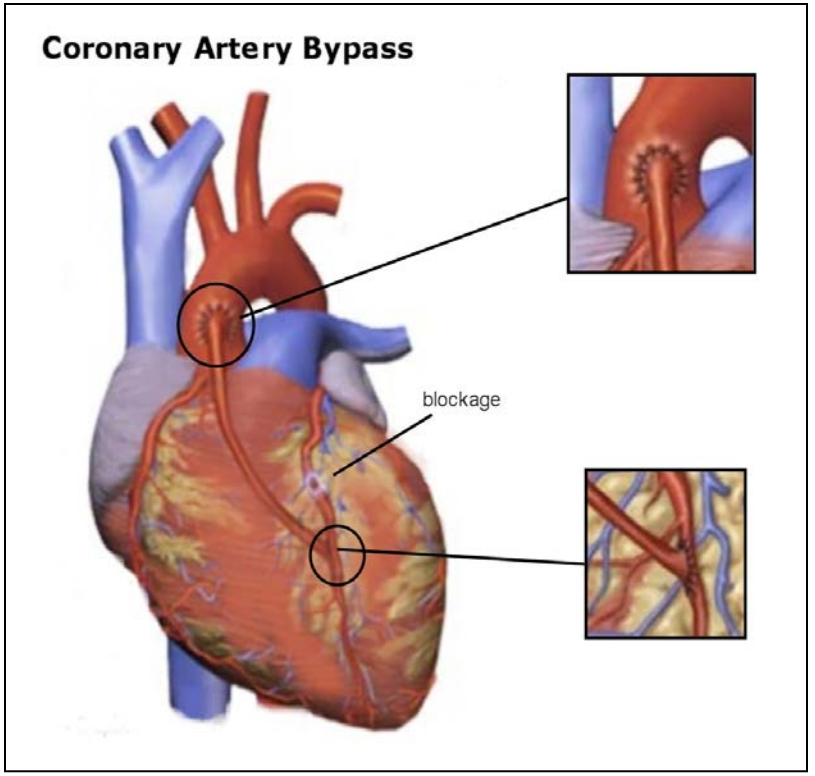
Fluid Mechanics of Arteriosclerotic Obstructions and Arterial Bypasses

ME 241 Fluid Mechanics Final Project

Yoke Peng Leong
Ismael E. Abdala

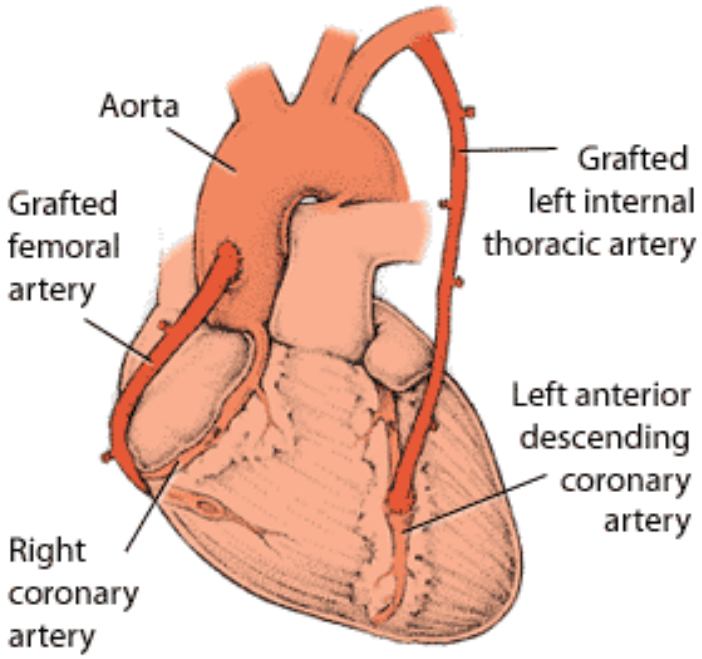
Introduction





Research Question

How is blood flow rate through coronary arteries affected by arteriosclerotic obstructions and arterial bypasses inserted to relieve it?



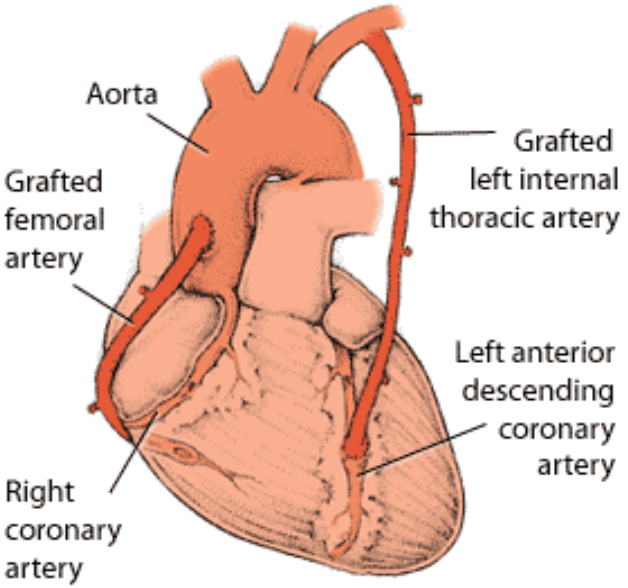
Methodology

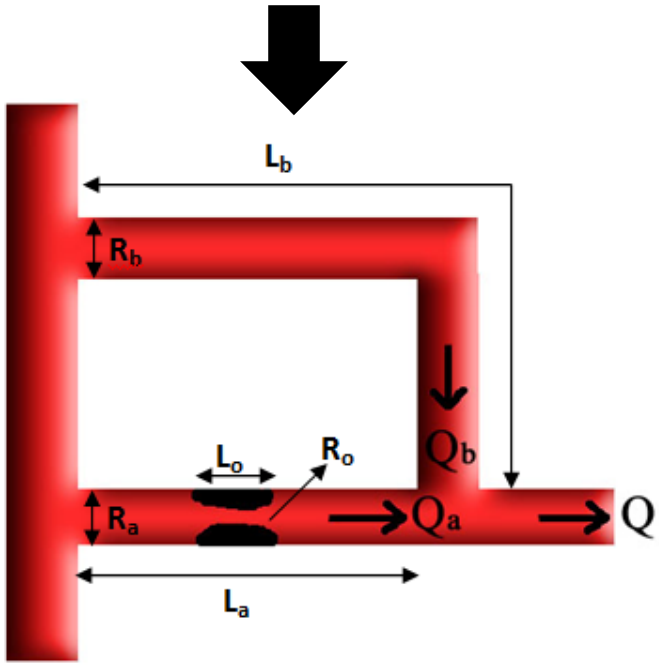
- Assumptions
  - Steady laminar flow
  - Conservation of mass

- Poiseuille´s law

$$Q = \frac{\Delta P}{\frac{8\mu L}{\pi r^4}}$$

$$R = \frac{8\mu L}{\pi r^4}$$

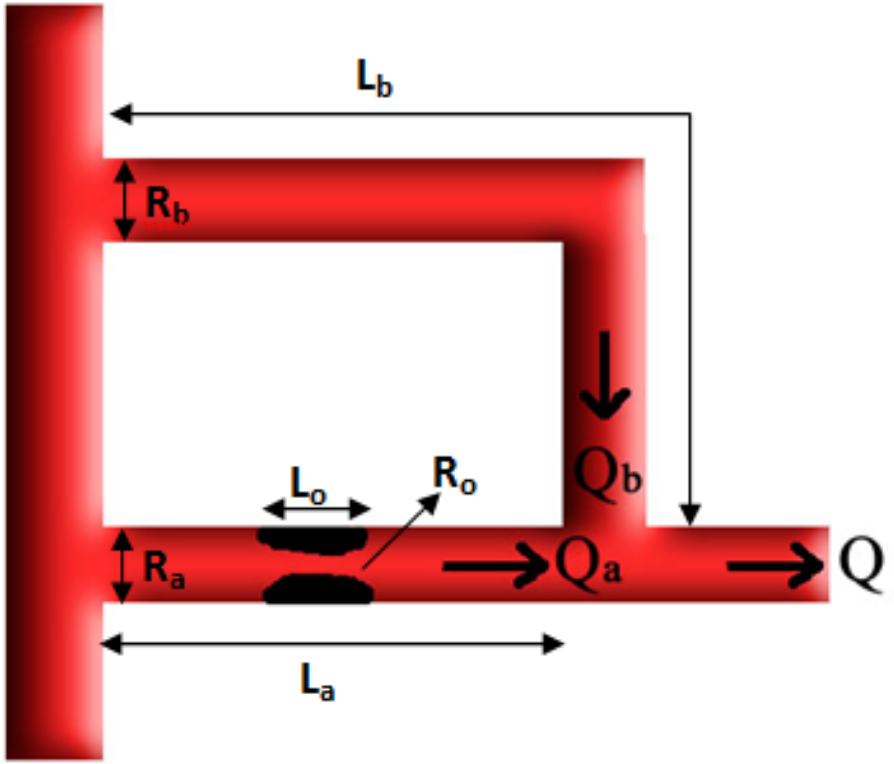




Methodology

$$\frac{Q_a}{Q} = \frac{1}{1 + \frac{r_{ba}^4}{l_{ba}}\left(1 + \frac{l_{oa}}{r_{oa}^4}\right)}$$

$$\frac{r_{ba}^4}{l_{ba}} = \frac{\left(\frac{Q}{Q_a} - 1\right)}{\left(1 + \frac{l_{oa}}{r_{oa}^4}\right)}$$

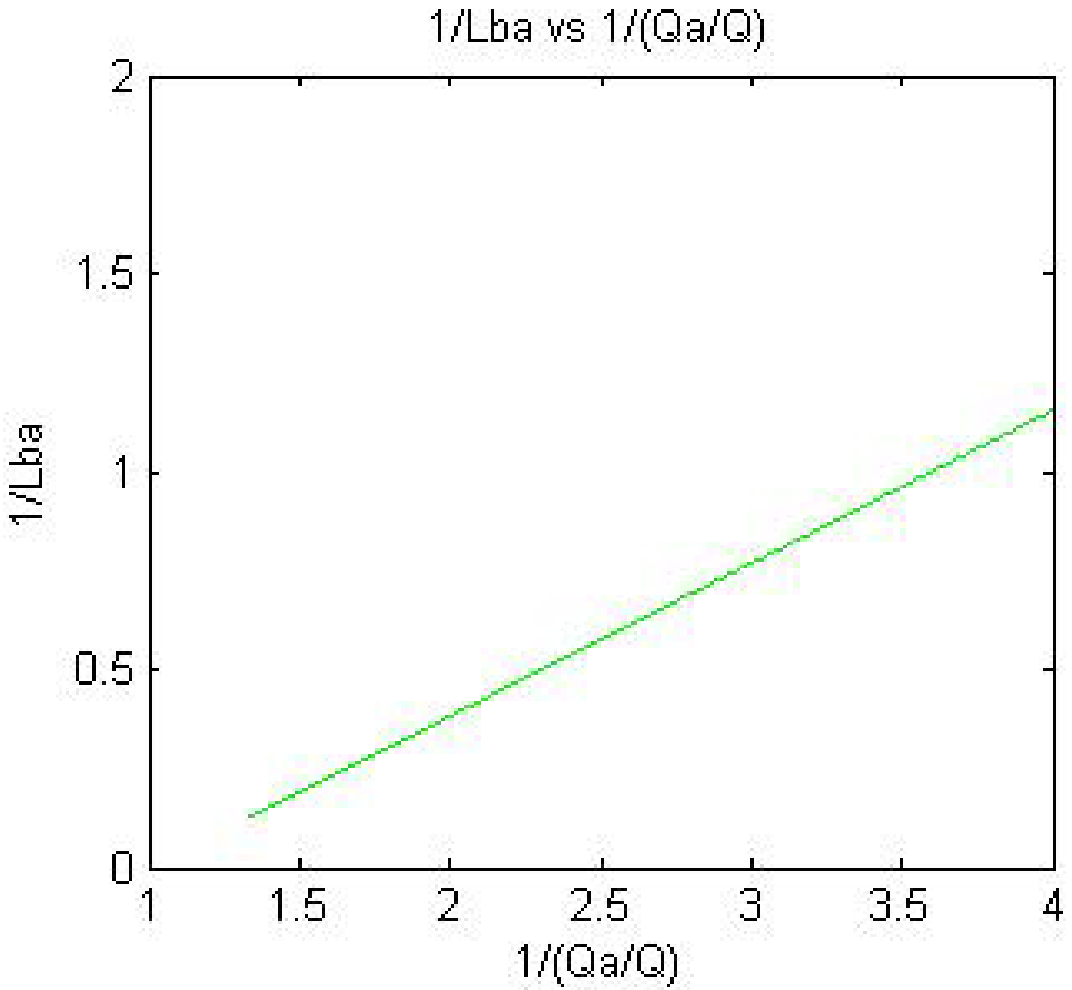


$$r_{ba} = \frac{r_b}{r_a} \qquad l_{ba} = \frac{L_b}{L_a}$$

Results

$r_a = 5$ mm
$l_a = 50$ mm
$r_o = 2.5$ mm
$l_o = 10$ mm
$r_b = 5$ mm

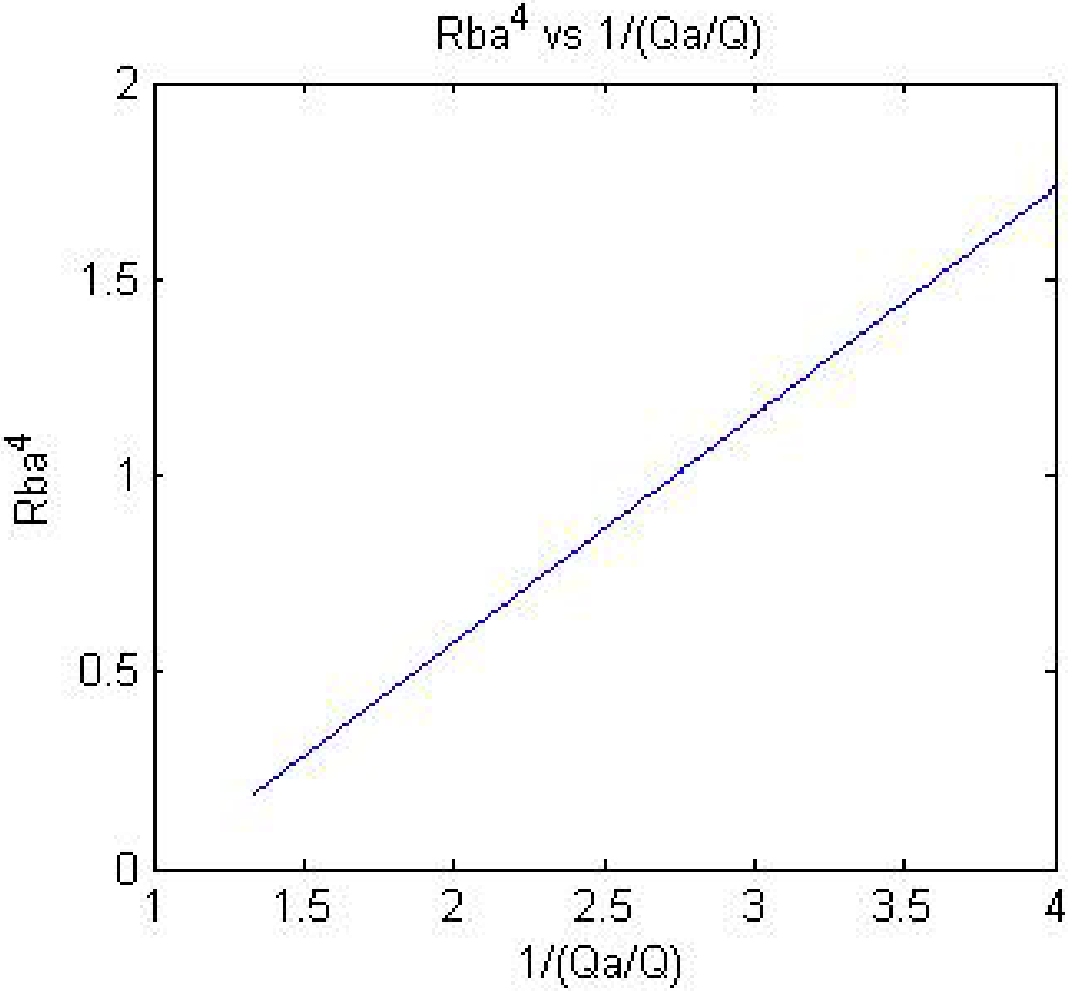
$$\frac{r_{ba}^4}{l_{ba}} = \frac{\left(\frac{Q}{Q_a} - 1\right)}{\left(1 + \frac{l_{oa}}{r_{oa}^4}\right)}$$



Results

$r_a = 5$ mm
$l_a = 50$ mm
$r_o = 2.5$ mm
$l_o = 10$ mm
$l_b = 100$ mm

$$\frac{r_{ba}^4}{l_{ba}} = \frac{\left(\frac{Q}{Q_a} - 1\right)}{\left(1 + \frac{l_{oa}}{r_{oa}^4}\right)}$$



Conclusion

- Problems in investigation
  - Complexity of blood flow
- Two main factors affecting the blood flow rate through an arterial bypass
  - Radius of the graft
  - Length of the graft
- Effect of radius >> length

The End

Thank You