The shear stress on the wall of the pipe in Poiseuille flow is, using \( \nu = \frac{2Q}{\pi R^4} (R^2 - r^2) \frac{1}{2} \frac{1}{dz} \)

\[
2\eta \left( -\frac{1}{dz}, \frac{1}{dz} \right) \quad \text{(evaluating on $-\frac{d}{dz}$ and looking at the $z$-component)}
\]

\[
= 2\eta \cdot \frac{1}{2} \ln |r| \left( -\frac{1}{dz}, \frac{1}{dz} \right)
\]

\[
= \eta \ln \left( -\frac{1}{dz}, \frac{1}{dz} \right)
\]

\[
= \eta \left. \frac{2Q}{\pi R^4} (2r) \right|_{r=R} = \frac{4Q\eta}{\pi R^3}
\]

This is a force per unit area in the $z$-direction.

For data on the aorta \((Q = 10^{-4}, R = 10^{-2}, \eta = 10^{-3})\)

This is \[
\frac{4 \cdot 10^{-4} \cdot 10^{-3}}{\pi \cdot 10^{-6}} = 0.1 \ \text{N/m}^2
\]

It is about one millionth of the normal stress due to atmospheric pressure \((10^5 \text{N/m}^2)\), but that, after all, is quite a large stress by biological standards.