Introduction:
Current size-based assessments of AAA rupture potential do not accurately identify all patients at risk, as diameter alone cannot accurately assess real-time aortic tissue stress.

LaPlace Law:
Wall Tension \( T = \frac{pR}{2} \) Wt
True AAA rupture potential is related to:
- Hemodynamics Pressure
- Geometric Factors:
  - Vessel Diameter
  - Vessel Wall Thickness

Hypothesis:
2D ultrasound strain analysis, gated with real-time pressure, can quantify dynamic hoop stress, in a vessel phantom, at the specific location of maximum compliance mismatch.

Methods:

- A. Homogenous Wall Thickness Phantom Under Pulsatile Test Load (MAP 235)
- B. Heterogeneous Wall Thickness Phantom Under Pulsatile Test Load (MAP 235)
- C. Heterogeneous Phantom Maximum Systolic Diameter of 2.2 cm (MAP 235)
- D. Heterogeneous Phantom Maximum Diastolic Diameter of 2.2 cm (MAP 235)

Methods (Continued):

- Figure #1: Overview of Ultrasound Test Fixture
- Computer Controlled Pneumatic Compression Chamber
- Blood Mimicking Fluid
- Transonic Flow Meter
- Solid State Pressure Transducer
- Gate strain analysis
- 2D Ultrasound Imaging
- Transducer Sharing Mismatch

Results:

- Figure #4: Comparison of maximum hoop stress variance in adjacent segmental areas of the homogenous (Figure #4.A) and heterogeneous (Figure #4.B) wall thickness phantoms during systolic loading. With significant loading the homogenous phantom begins to show disproportionate strain sharing.

Conclusions:
Pressure gated transcutaneous 2D ultrasound of AAA phantom provides:
- Quantification of dynamic hoop stress
- Likely location of aneurismal failure
- A predictive model of aneurismal behavior with hemodynamic loading

Limitations:
- Current experimental model has greater strength then human tissue

Future Work:
- Develop a phantom with tissue like mechanical properties
- Integrate pressure gated strain in AAA patient cohort
- Study potential 3D pressure gate strain analysis