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658: Quantification of Acute Dynamic Elasticity in Isolated Porcine Bladders

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Hypothesis/Aims of the Study

Dynamic Elasticity:

- Like a latex balloon, bladder wall compliance can be acutely increased through repeat fill-empty cycles (strain softening)
- Unlike a latex balloon (irreversible), strain softening can be reversed by active contractions of the bladder
- Reversible strain softening in bladder is termed "dynamic elasticity"
- Dynamic elasticity has been identified in humans using comparative-fill urodynamics (Colhoun, et al., 2016)

Hypothesis:

- Dynamic Elasticity is present in an isolated perfused pig bladder model

Study Design, Materials & Methods

- Pig bladders with the vascular tree and a portion of the aorta were harvested immediately after slaughter
- Superior vesical arteries were cannulated and perfused with oxygenated Krebs-Henseleit buffer at 4 mL/min
- Vesical pressure (P_{ves}) data were collected during repeat fill-and-empty urodynamics
- Dynamic elasticity was quantified by comparing three fills to 250 ml (Fig 1):
  - Fill 1 - "before strain softening"
    - baseline after an active void
  - Fill 2 "after strain softening" (after filling and passive emptying)
    - quantify degree of dynamic elasticity lost
  - Fill 3 "after active voiding"
    - quantify dynamic elasticity recovered after active voiding
- Quantifying dynamic elasticity
  - Average P_{ves} throughout each fill was calculated
  - Δ dynamic elasticity = Δ average P_{ves} between fills/Δ %capacity for that fill
  - Capacity was assumed to be 500 ml

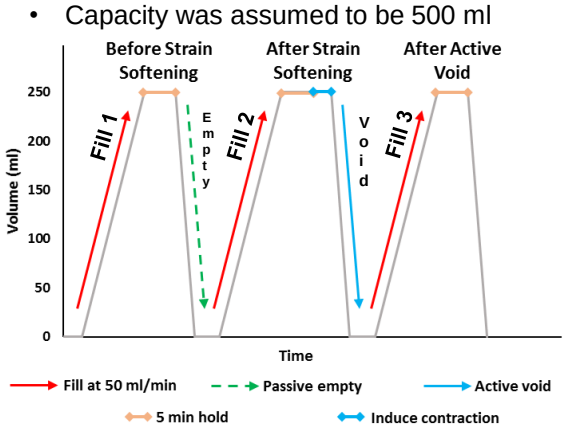

Fig 1. Comparative-Fill Urodynamics Protocol

Results

- The comparative-fill protocol was completed on bladders from five male pigs
- These bladders exhibited dynamic elasticity
  - A decrease in average P_{ves} throughout the fill immdiately after filling and passive emptying showed strain softening (Fig 2, red bar, * = $p<0.05$)
  - An increase in average P_{ves} towards baseline during filling after active voiding showed strain softening reversal (Fig 2, purple bar, $p>0.05$)
- Dynamic elasticity was lost to strain softening (-0.11 cm-H2O/%capacity) and regained following active voiding (0.12 cm-H2O/%capacity)

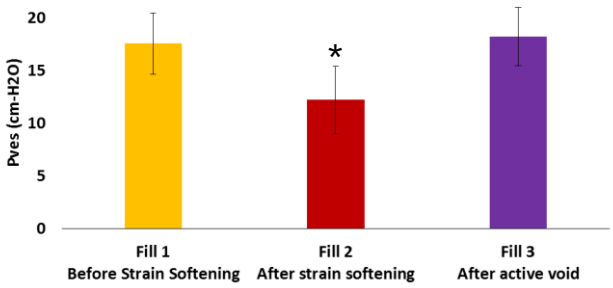

Fig 2. Average P_{ves} during filling from 0 to 50% CCap

Interpretation of Results

- The results of this study support the hypothesis that dynamic elasticity is present in an isolated perfused pig bladder model
- The results demonstrate the quantification dynamic elasticity in the pig bladders using the same methodology used in individuals with overactive bladder

Concluding Message

- Regulation of dynamic elasticity would affect bladder wall tension during filling by changing the load on tension-sensitive nerves responsible for the sensation
- A defect in the regulation of dynamic elasticity could alter sensation contributing to overactive bladder.
- The presence of acute dynamic elasticity in the isolated pig bladder model will allow for more detailed investigations of this bladder material property
- Factors that could affect dynamic elasticity, such as incomplete voiding, non-voiding contractions and ischemia, could be analyzed individually in the pig bladder model
- Improved knowledge of the role of dynamic elasticity in bladder function and the mechanisms responsible for this property could have diagnostic and therapeutic implications in the management of bladder pathology

Support provided by NIH R01DK101719