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”
  - Fill 2 “after strain softening” (after filling and passive emptying)
  - Fill 3 “after active voiding”
- Quantifying dynamic elasticity
  - Average $P_{ves}$ throughout each fill was calculated
  - $\Delta$ dynamic elasticity = $\Delta$ average $P_{ves}$ between fills/$\Delta$ %capacity for that fill
  - Capacity was assumed to be 500 ml

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 immediately 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 cm3-H2O/%capacity) and regained following active voiding (0.12 cm3-H2O/%capacity)

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

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