657: Vascular Mapping in the Porcine Bladder Using Chromometric Analysis

Zachary E Cullingsworth¹, Naveen Nandanand MD², Natalie Swavely MD², Konstantin Frolov¹, Randy Vince MD², Adam P Klausner MD², and John E Speich PhD¹

¹Department of Mechanical & Nuclear Engineering, Virginia Commonwealth University College of Engineering, ²Department of Surgery/Division of Urology, Virginia Commonwealth University School of Medicine, Richmond, VA, Richmond, VA

Hypothesis/Aims of Study

- Acute bladder ischemia has not been studied to the same extent as chronic ischemia, resulting in a knowledge gap
- With little evidence on the effects of acute ischemia, it may affect bladder function more than anticipated

Hypothesis:

- Pig bladders are composed of two hemispheres that are primarily fed by separate vesical arteries

Study Design & Methods

- Pig bladders with their associated vasculature were harvested immediately after slaughter
- Bladders were placed in a warm, humidified chamber and filled through the catheter to a volume 250 mL
- One vesical artery was perfused with 50 mL of green dye (food coloring in water) at 10 mL/min
- The other vesical artery was perfused with 50 mL of red dye
- Photographic images were collected during the dyeing process (Fig 1A)
- All images were cropped to remove the background and then divided into equal halves along the midline
- Chromometric analysis was performed on all images using a custom algorithm to quantify the average hue of each half
- In addition to chromometric analysis of the original images, color saturation was maximized to enhance visualization of the red and green regions (Fig 1B)

Results

- Bladders from five pigs were studied
- Hue values were normalized to yellow, because yellow is midway between green and red on the hue, saturation, brightness color wheel (Fig 2A)
- Average normalized hues of the green and red halves were 28° ± 5° and -58° ± 19°, respectively (Fig 2)
- Perfusion of different dyes into each artery produced bladders that demonstrated statistically different color patterns (Fig 2, n = 5, p < 0.05)

Figures

Figure 1: A. Photo of a bladder after perfusion. B. Image from panel A with enhanced saturation

Figure 2: A. HSB (hue, saturation, brightness) wheel with yellow set as a vertical reference (black line), with the average hues of the green side (magenta lines ± dashed lines) and red side (cyan lines ± dashed lines) compared for reference. B. The average hues for the green and red halves of the bladder were significantly different (n=5, *p<0.05).

Interpretation of Results and Concluding Message

- The results of this study support the hypothesis that pig bladders are composed of two hemispheres that are primarily fed by separate vesical arteries
- Chromometric analysis of porcine bladder vasculature demonstrated a lack of collateral vesical blood flow
- This provides evidence that the bladder might be more affected by a vascular compromise of one the vesical arteries than previously expected
- Further studies are needed studying effects of unilateral and bilateral acute ischemia on bladder biomechanics