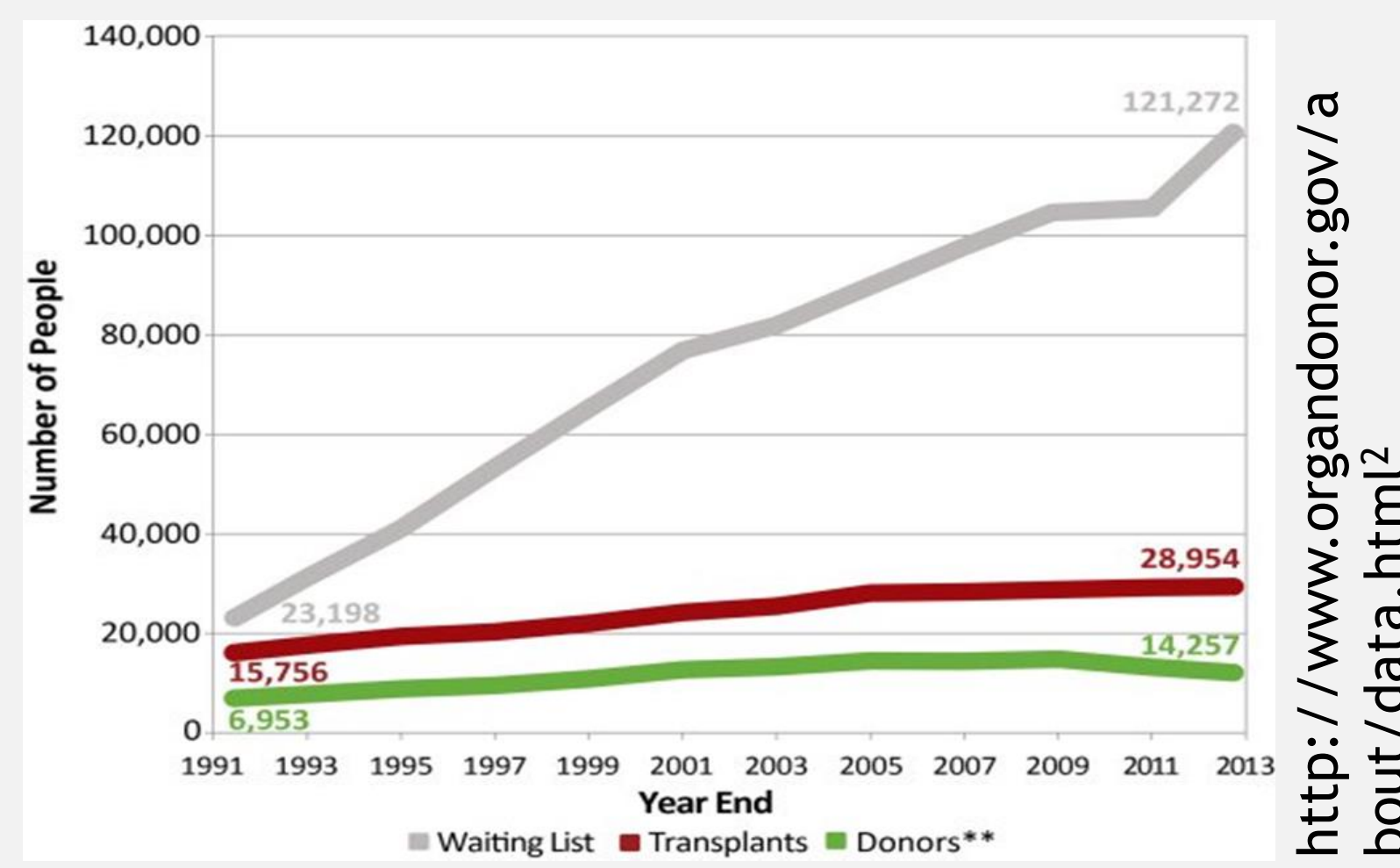


Opportunity

Currently, there are over 93,000 people on the kidney transplant waitlist with an average wait time of 5-10 years, depending on the state. Transplantable organs are only viable up to 48 hours so a method to improve organ shelf-life would be one way to address this severe shortage in donor organs.¹



Project Objectives

1. Evaluate the presence of fixed charges in kidneys
2. Perfuse kidneys with hypo- and isotonic solutions to detect blood vessel impingement

Background

VITRIFICATION

The process of turning an organ into a glass-like solid and essentially 'freezing it in time.' Successful vitrification requires loading of tissues with a cryoprotectant solution.

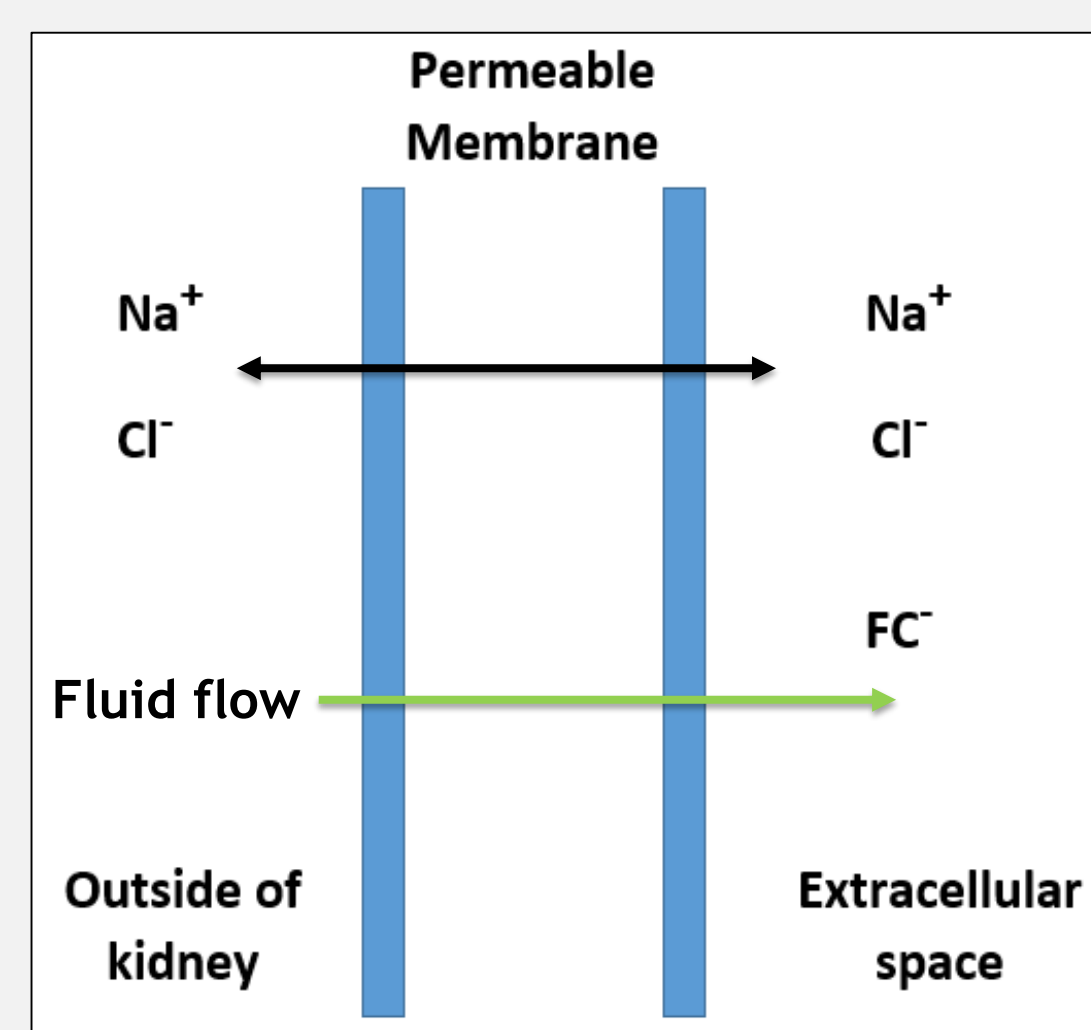


<http://www.alcor.org/Library/html/vitrification.html>

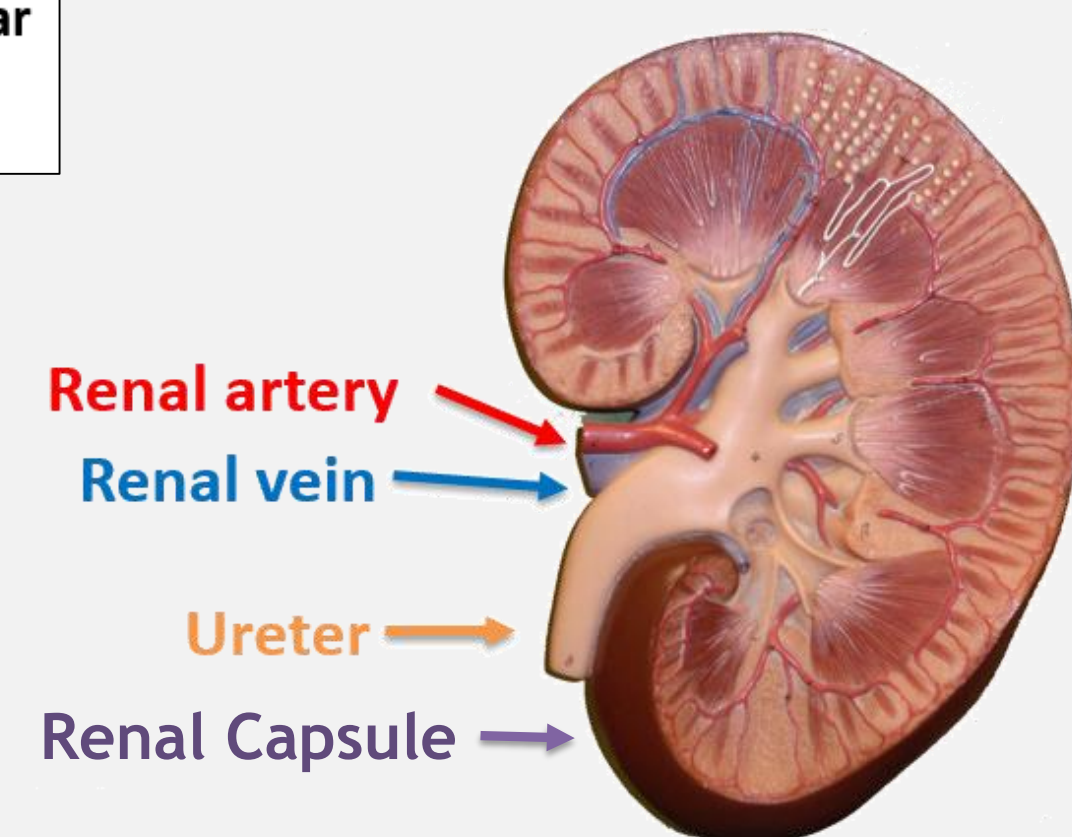
CRYOPROTECTANTS

Substances that protect tissues from freezing damage. Organ cryoprotectant saturation is key to organ viability after vitrification.

DONNAN EQUILIBRIUM & FIXED CHARGES



Fixed charges (FC), shown right, affect the movement of cryoprotectants through tissues. Donnan Equilibrium describes the behavior of ions in the presence of fixed charges.



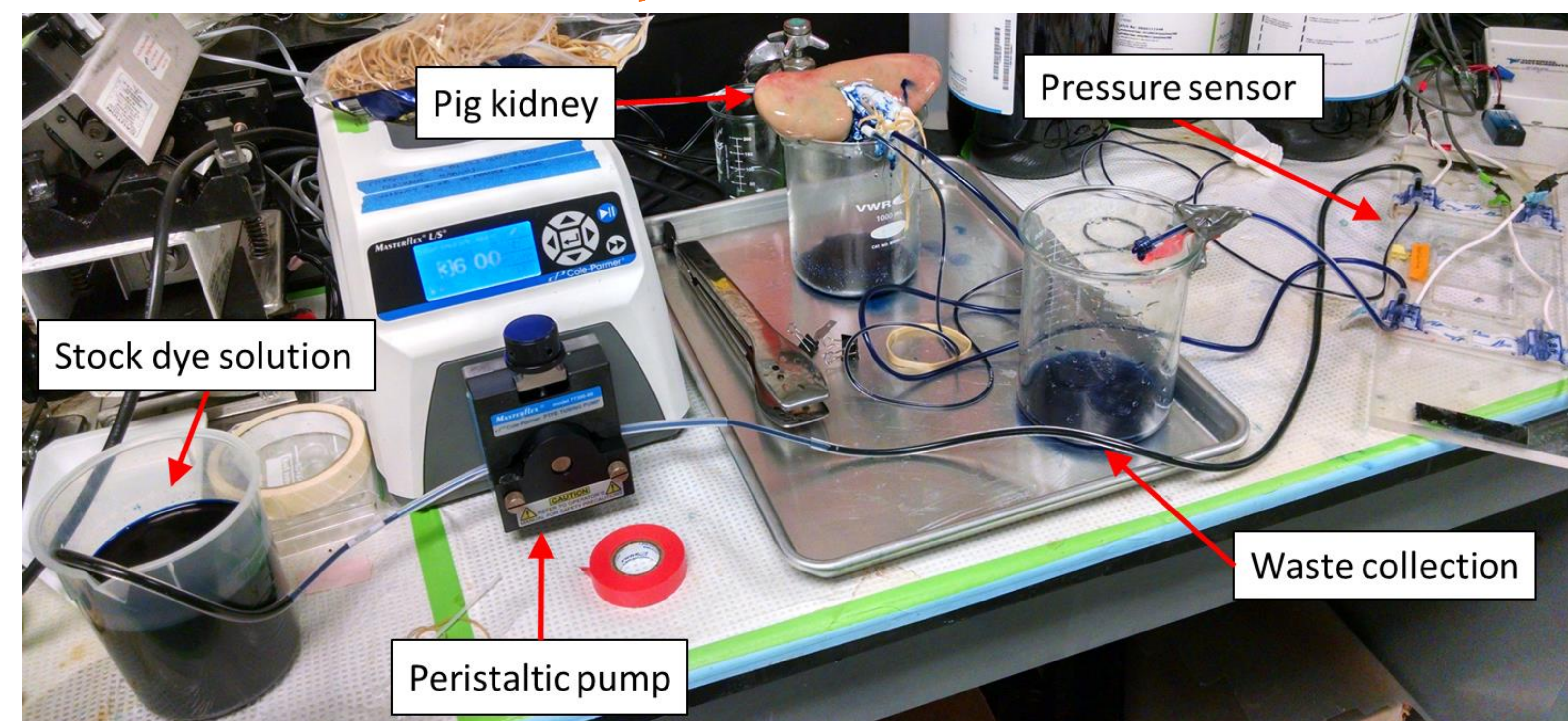
KIDNEY ANATOMY

We are focusing on the renal artery and vein as the kidney inlet and outlet, respectively.

INVESTIGATING MASS TRANSFER DURING LOADING OF CRYOPROTECTANTS INTO TISSUES

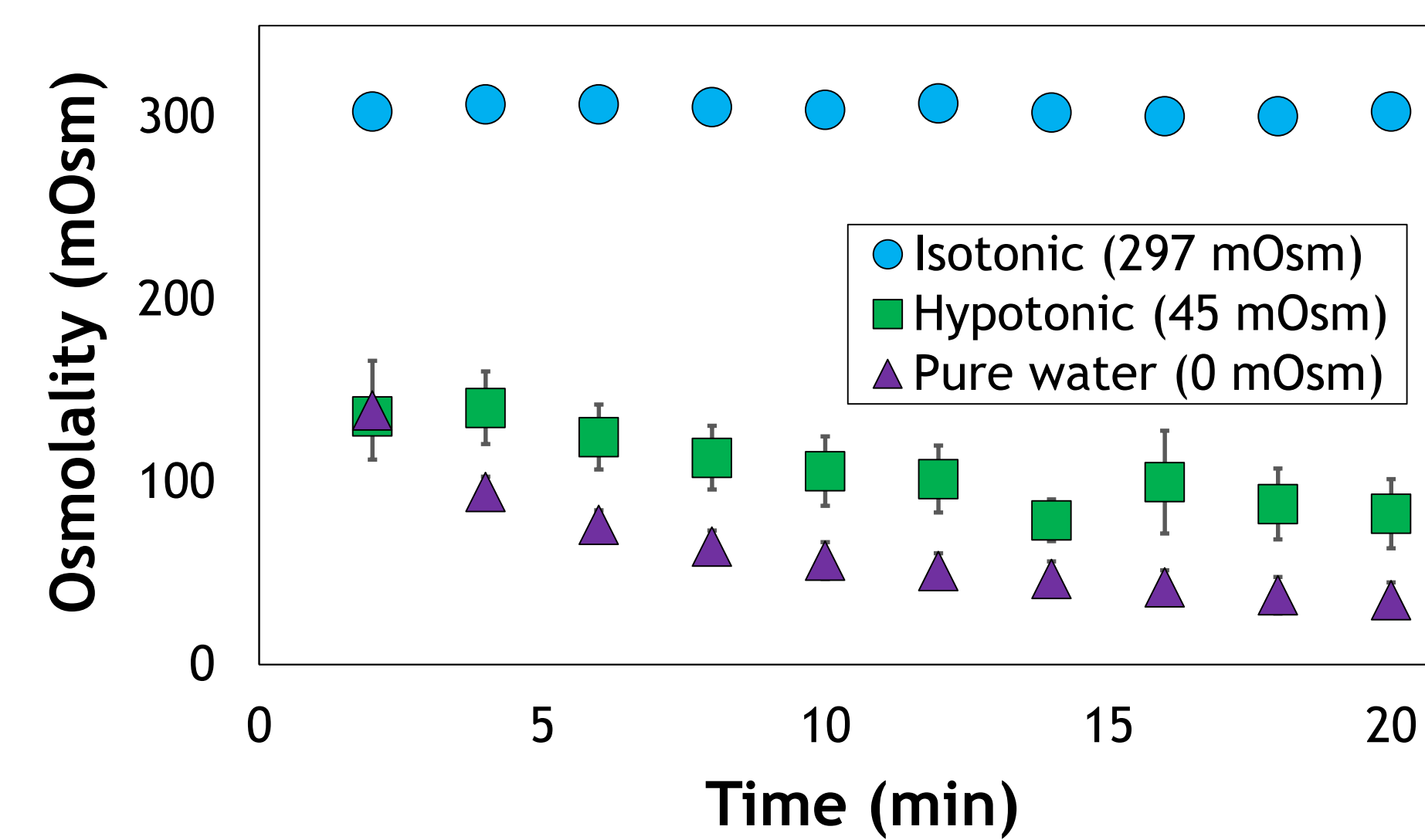
Bronson Ayala, Kristine Nguyen, Miranda Raper

Kidney Perfusion Platform

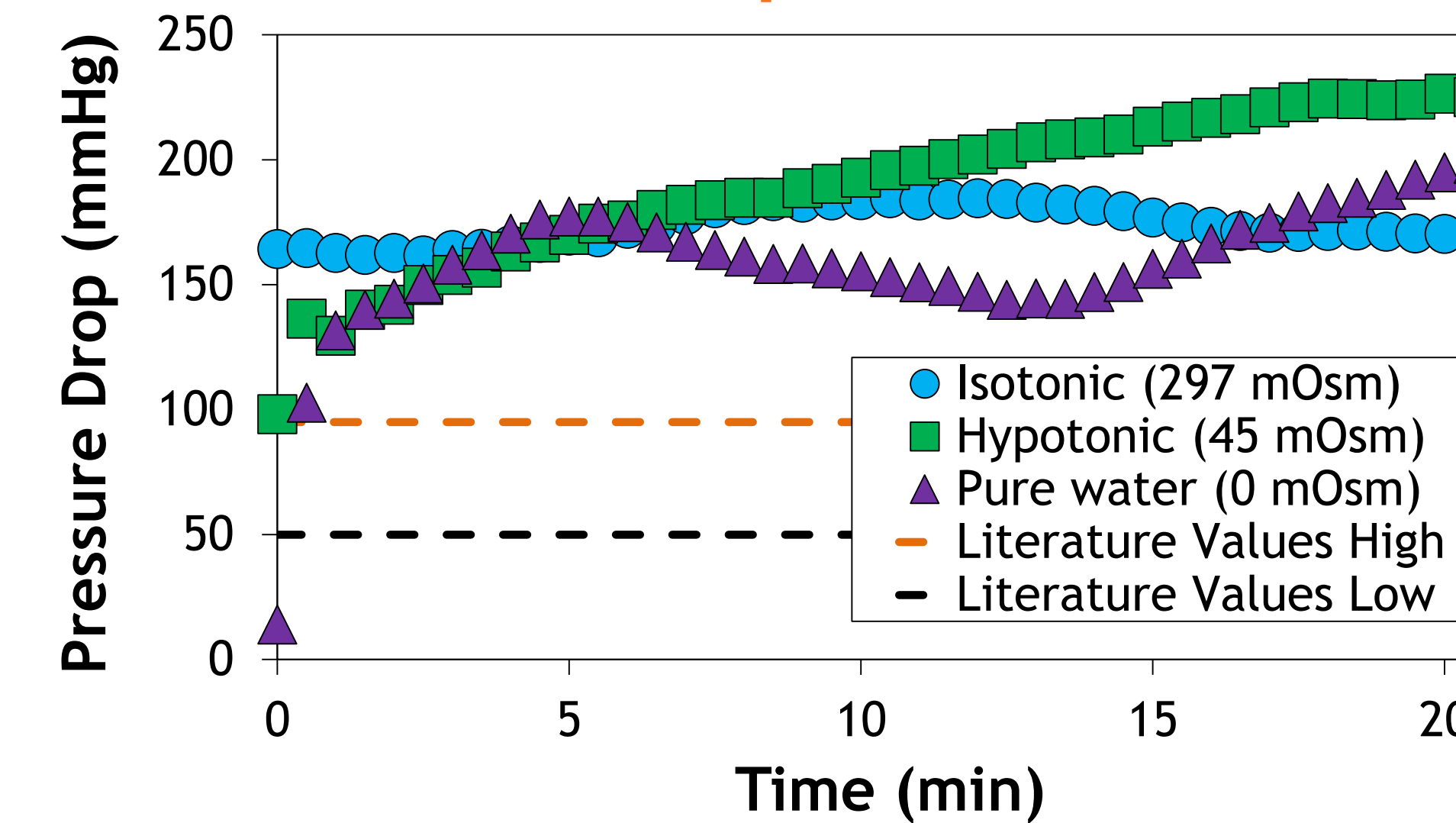


Kidney perfusion platform used to pump various solutions through the kidney via the renal artery (inlet) and renal vein (outlet)

Kidney Solution Perfusion

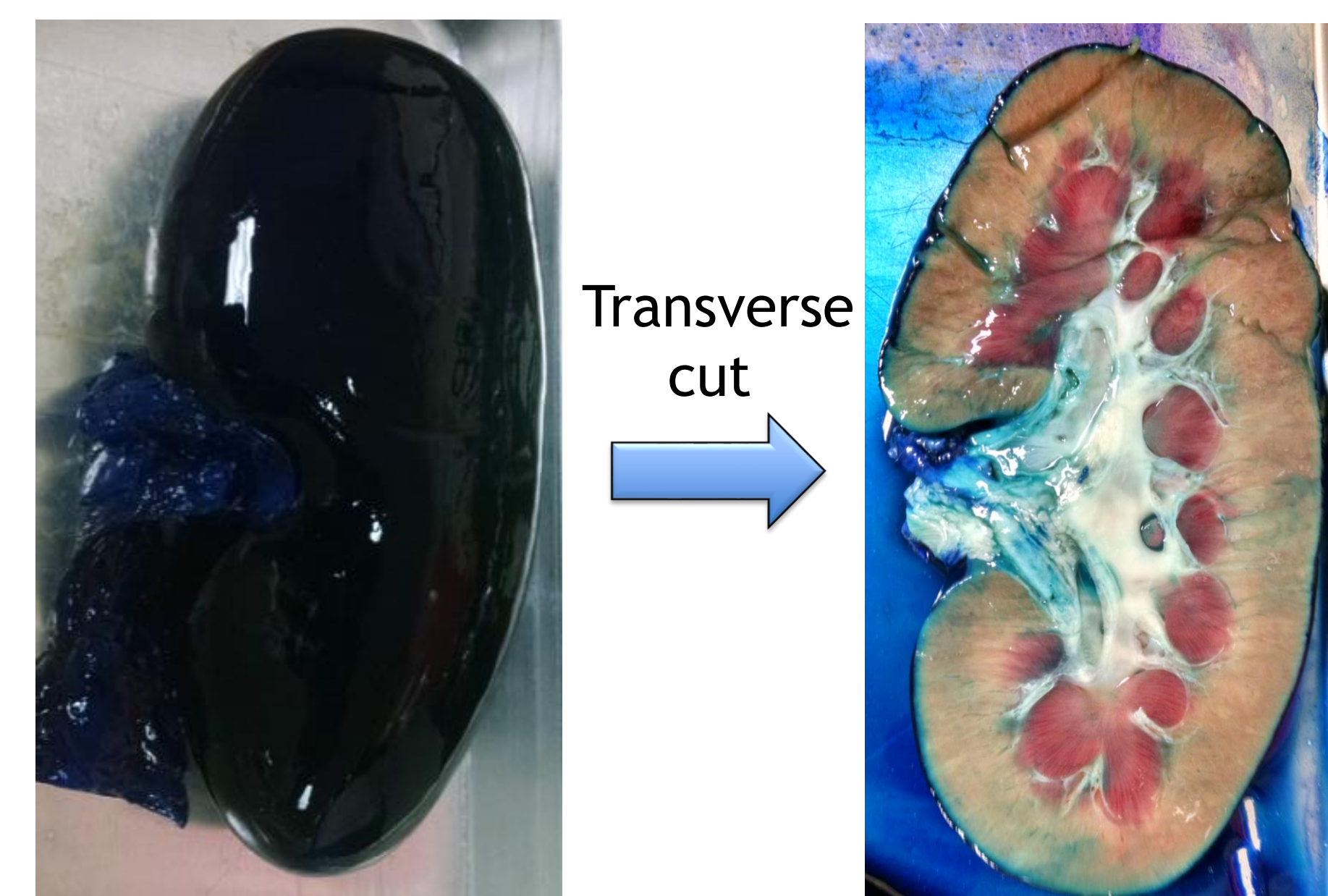


Pressure Drop Across Kidney



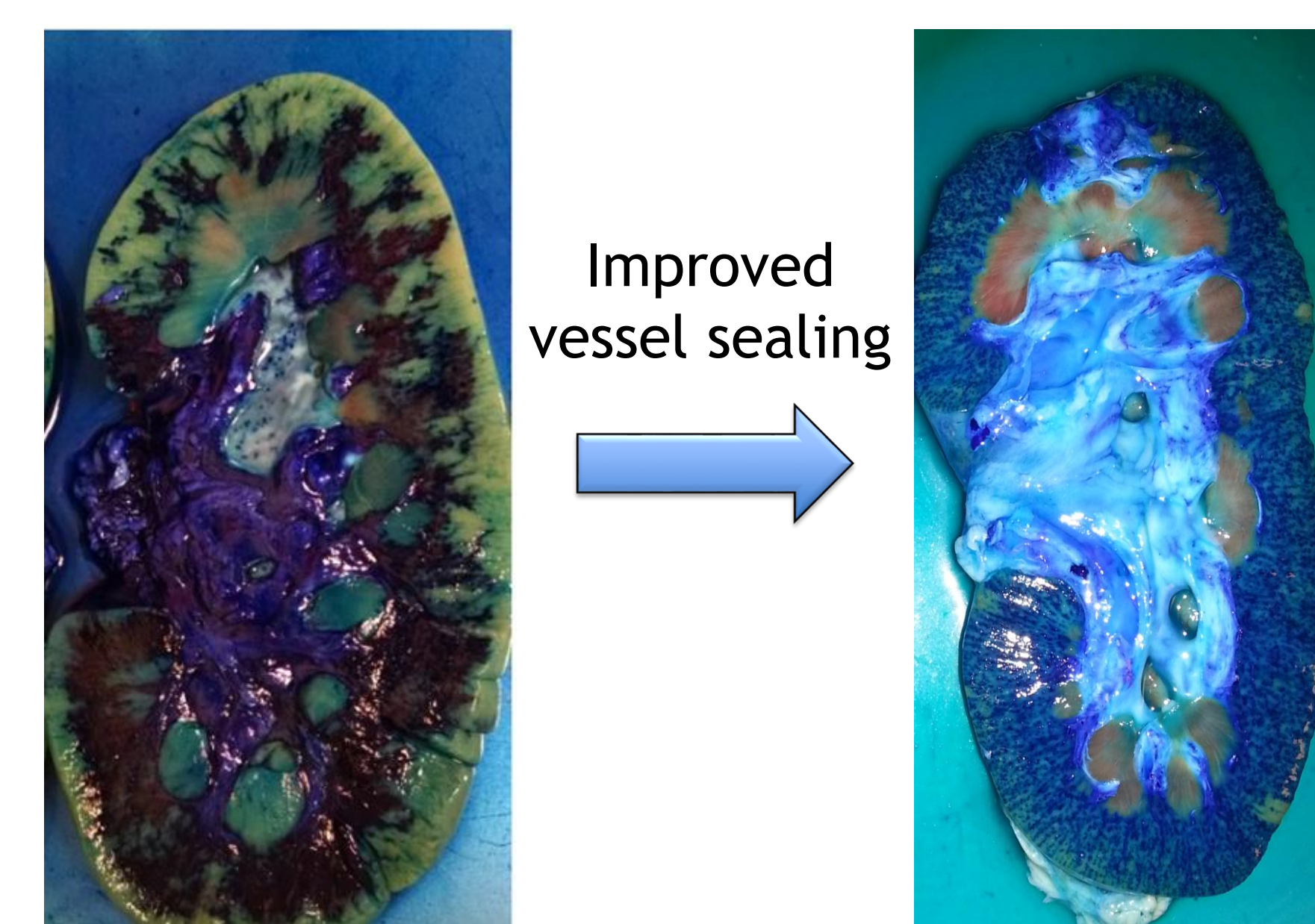
Pressure drop increases as solution moves into the kidney indicating that blood vessel impingement may be present

Kidney Dye Soak Experiment Results



Dye mostly diffused into renal capsule

Kidney Dye Perfusion Experiment Results



Perfusion delivers more dye to tissues than soaking

Conclusions

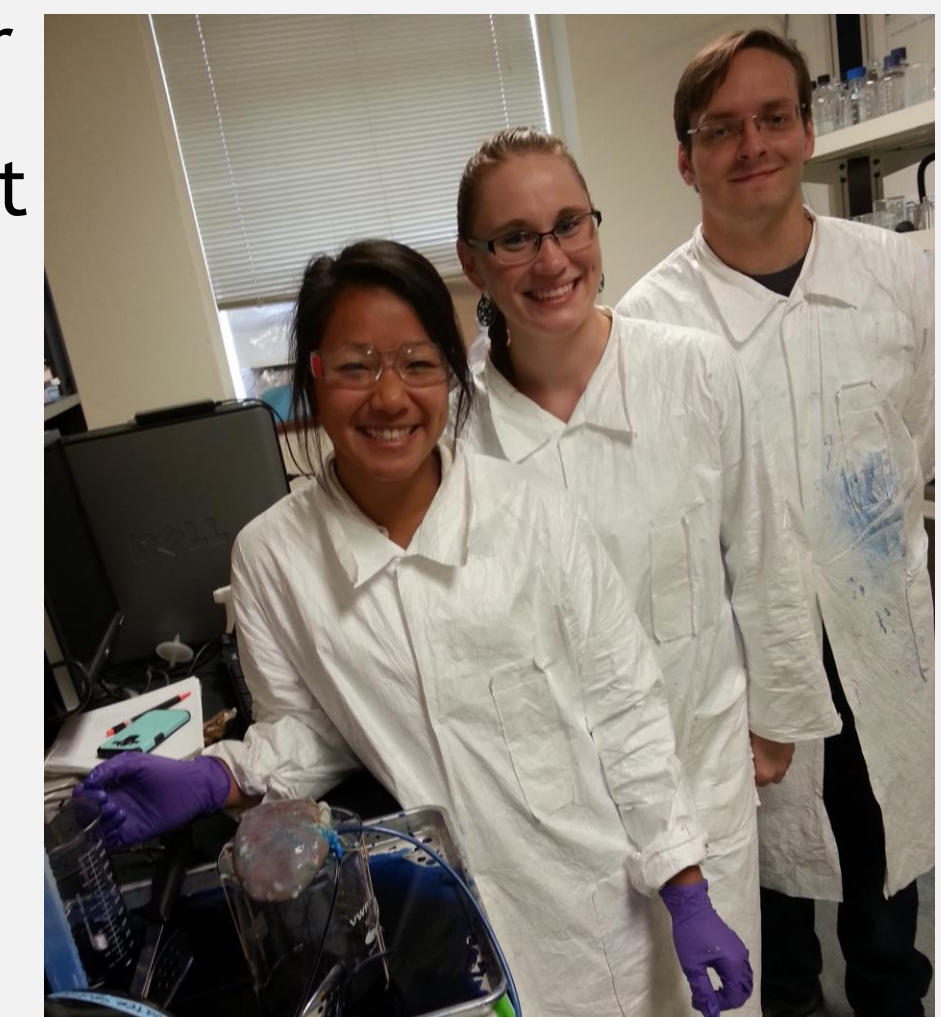
- More dye or solute diffuses into the kidney via perfusion rather than simply soaking
- Optimal perfusion platform parameters based on dye experiments:
 - Flowrate: 40 mL/min
 - Time: 30 minutes
 - Solute concentration: 780 μ M
- Based on literature values for similar perfusion systems (50-95 mmHg) the pressure differences across the kidney suggest blood vessel impingement is occurring
- Fixed charges appear to be insignificant but further testing is required to verify this
- Older kidneys are prone to blood clotting, leading to blood vessel impingement

Future Work

- Construct mathematical model to predict relative mass for a given solution
- Perfuse kidneys with cryoprotectants for future vitrification

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- -Donated organs and tissues
- Dr. Philip Harding, Senior Project Director



Team Frankenstein (from left): Kristine, Miranda, Bronson

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2. The Need Is Real: Data. (n.d.). Retrieved April 17, 2016.
3. "What Is Vitrification?" Alcor: Life Extension Foundation, 2014. Web. 16 May 2016.