

Abstract: TH-PO769

## **Platelet Accumulated Stress Modeling Predicts Platelet Activation and Thrombosis**

### **Session Information**

- [Bioengineering](#)  
October 25, 2018 | Location: Exhibit Hall, San Diego Convention Center  
Abstract Time: 10:00 AM - 12:00 PM

### **Category: Bioengineering**

- 300 Bioengineering

### **Authors**

- Marsh, Emily, Vanderbilt University Medical Center, Nashville, Tennessee, United States
- Forbes, Rachel C., Vanderbilt University Medical Center, Nashville, Tennessee, United States
- Roy, Shuvo, UCSF, San Francisco, California, United States
- Fissell, William Henry, Vanderbilt University, Nashville, Tennessee, United States
- Groszek, Joseph J., STERIS, Lakewood, Ohio, United States
- Williams, Phillip E., Vanderbilt University Medical Center, Nashville, Tennessee, United States
- Laneve, David C., Vanderbilt Medical Center, Brentwood, Tennessee, United States
- Goodin, Mark S., SimuTech Group, Hudson, Ohio, United States
- Goebel, Steven G., SimuTech Group, Hudson, Ohio, United States
- Buck, Amanda, Vanderbilt University, Nashville, Tennessee, United States
- Wright, Nathan, UCSF, San Francisco, California, United States
- Bluestein, Danny, Stony Brook University, Stony Brook, New York, United States

### **Background**

Thrombosis is a dreaded complication in blood-contacting medical devices including implantable artificial kidneys (IAK). Fluid shear stress primes platelets to initiate thrombosis. We compared computational predictions of platelet accumulated stress (PAS), biochemical assays of platelet activation, and in vivo thrombosis between two different implanted hemofilter designs.

### **Methods**

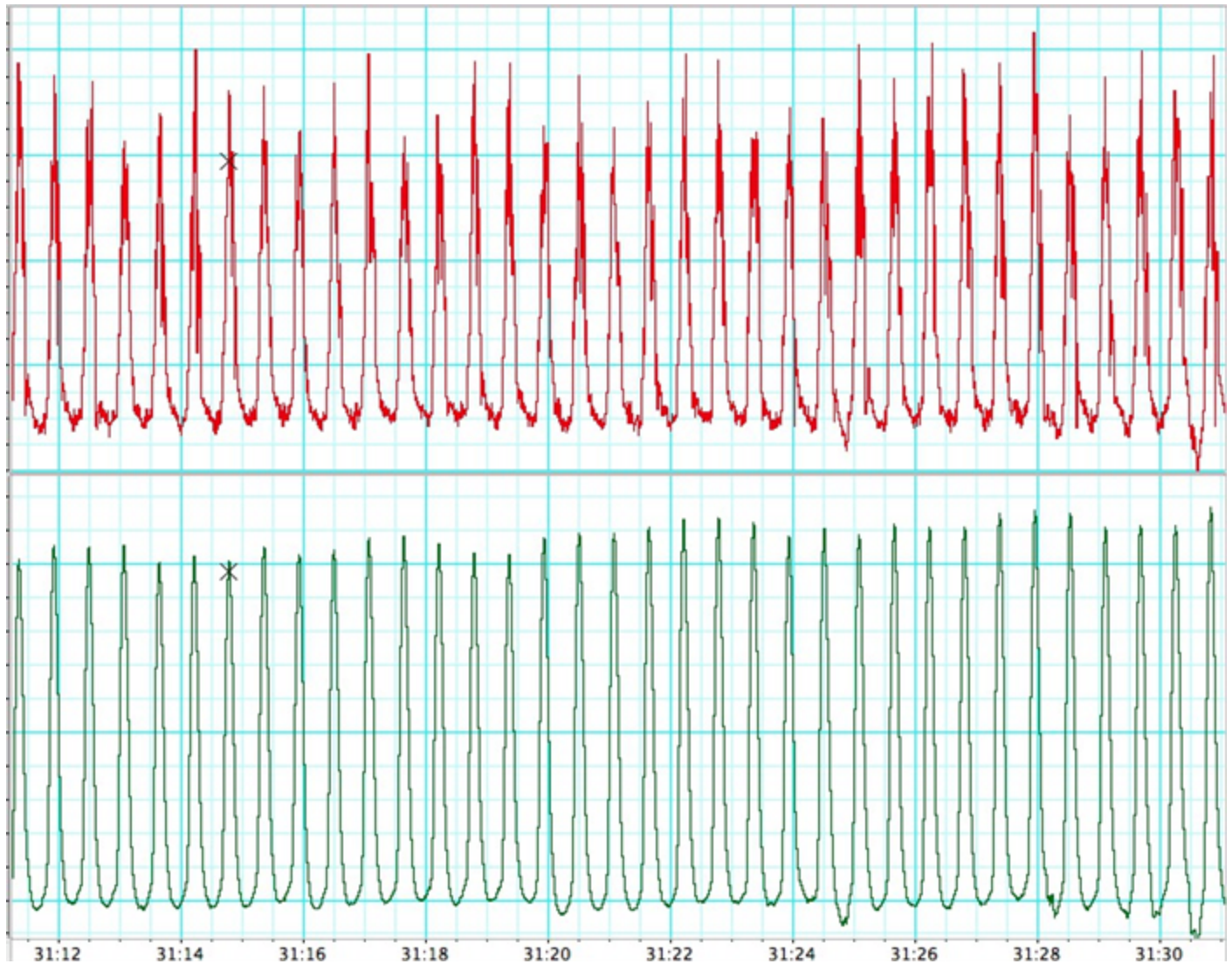
Platelet accumulated stress distributions under unsteady flow in two candidate blood conduit designs were predicted using computational fluid dynamics (CFD) tools. Hemofilter cartridges were machined from polycarbonate and implanted in Class A dogs for 2-7 days without anticoagulation. Platelet activation was measured using a modified prothrombinase assay. Thrombosis was assessed by measuring cyclic variation in blood velocity downstream of a controlled femoral artery lesion.

## **Results**

The two different hemofilter designs gave rise to two distinct histograms of PAS. In some animals, the hemofilter with the larger PAS (A) thrombosed almost immediately while the other hemofilter (B) did not. In animals where both cartridges remained patent, platelet stress as measured by prothrombinase activity agreed with CFD predictions. Femoral artery flow was disrupted to a greater extent in animals implanted with hemofilter A than Hemofilter B.

## **Conclusion**

We showed that CFD predicted biochemical measures of platelet activation and propensity to thrombosis in an animal model of an implanted hemofilter. Platelet stress is a useful tool to predict thromboembolic complications in blood contacting medical devices.



*Pulsatile flow was compared between a femoral artery with a standardized trauma (red) and a contralateral control artery (green). Cyclic variations in flow distinct from respiration arise from transient thrombosis at the arterial trauma.*

### **Funding**

- Other NIH Support