Abstract: TH-PO769

Platelet Accumulated Stress Modeling Predicts Platelet Activation and Thrombosis

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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), biochemichemical assays of platelet activation, and in vivo thrombosis between two different implanted hemofilter designs.

Methods

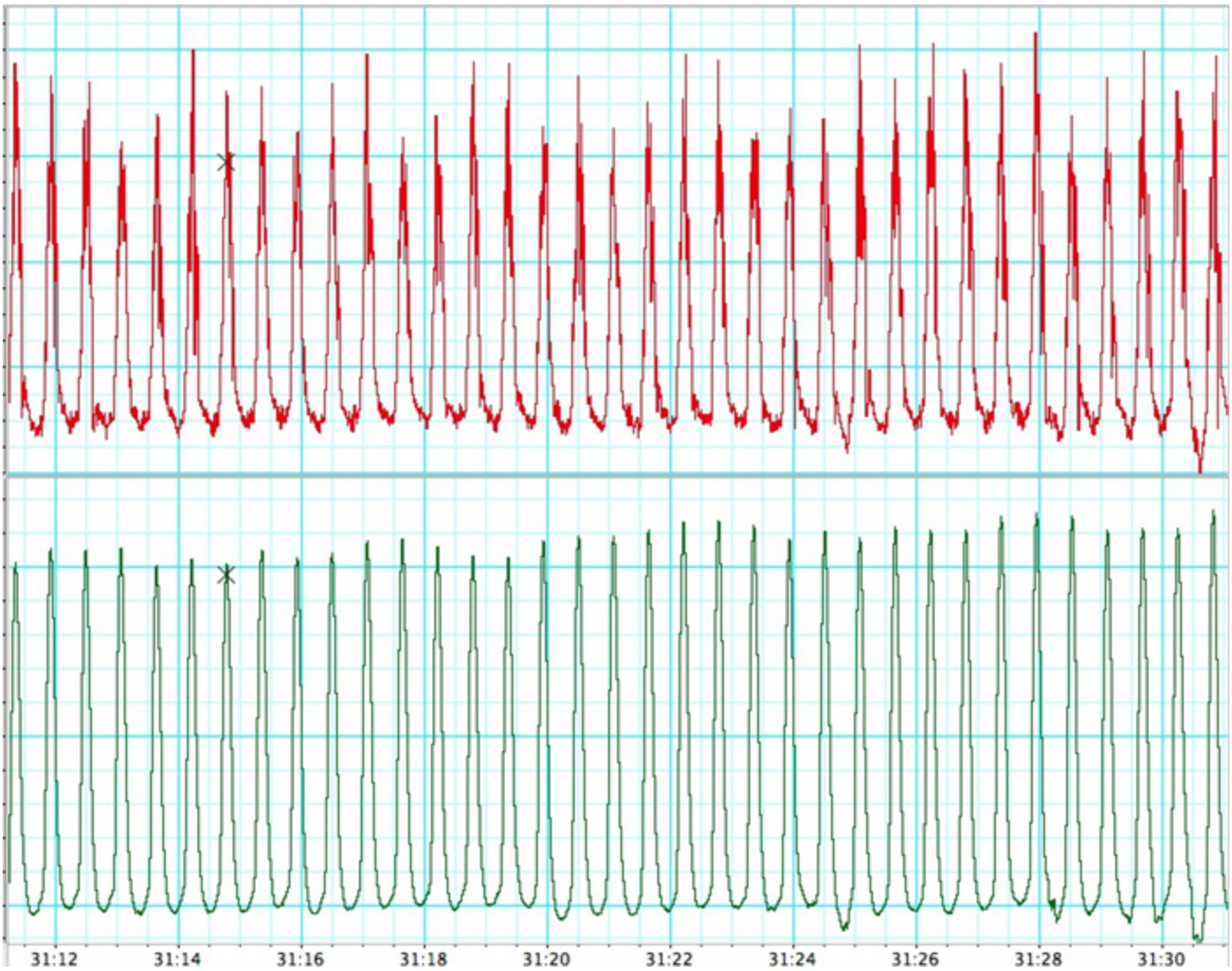
Platelet accumulated stress distributions under unsteady flow in two candidate blood conduit designs were predicted using computational fluid dynamics (CFD) tools. Hemofilter catrtridges were machined from polycarbonate and implanted in Class A dogs for 2-7 days without anticoagulation. Platelet activation 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) thombosed 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 comapred between a femoral artery with a standarized trauma (red) and a contralateral control artery (green). Cyclic variations in flow distinct from respiration arise from transient thrombosis at the arterial trauma.

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