

9 Day Filtration by an Implantable Hemofilter

Clark Kensinger MD¹, Seth Karp MD¹, Joseph Groszek², David Laneve³, Phil Williams³, Mark Goodin⁴, Rishi Kant⁵, Torin Yeager⁵, Shuvo Roy PhD⁵, William Fissell MD²

¹ Department of General Surgery, Vanderbilt University

² Department of Medicine, Vanderbilt University

³ Division of Surgical Research, Vanderbilt University

⁴ SimuTech Group

⁵ Department of Bioengineering and Therapeutic Sciences, UCSF

Background:

Patients with end-stage renal disease (ESRD) have high mortality and morbidity rates on dialysis. ESRD patients could experience better quality of life if implanted with an artificial kidney. A new ultrathin membrane with highly controlled pores made by sacrificial silicon oxide techniques allows size selective sieving *in vivo*. In a canine model, we have demonstrated albumin sieving through an implantable, high-efficiency hemofiltration membrane over 9 days.

Methods:

The device comprised of a single channel blood conduit with parallel-plate hemofiltration membranes. The membranes were bench tested for Ficoll sieving before implantation. *In vivo*, the device was attached to PTFE grafts and anastomosed to the common iliac artery and vein. Filtrate was collected in two implanted reservoirs. The animal was housed without restriction and received thromboembolic prophylactic doses of Lovenox (0.5mg/kg) once a day. After 9 days, filtrate was sampled from subcutaneous ports connected to the reservoirs. Albumin concentration in filtrate was measured by colorimetric assay. Filtration rates were estimated by indicator dilution.

Results:

Effluent sampled on day 9 had albumin sieving coefficients (bag 1: 0.13, and bag 2: 0.24). Ficoll sieving coefficients at equivalent Stokes radius were 0.14 and 0.19 respectively. *In vivo* filtration rates were consistent with *in vitro* measurements after correction for plasma oncotic pressure.

Conclusion:

A high efficiency hemofiltration device is capable of filtration over 9 days in a canine surgical model. Albumin sieving *in vivo* correlate well to Ficoll sieving collected at the bench indicating unchanged filtration characteristics, while filtration rates are commensurate with the expected pressure gradient across the hemofiltration membrane.