

In Vitro Clearance Performance of the Manual Single Lumen Alternating Micro-Batch (mSLAMB) - Potential Use in Austere Medical Environments

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Introduction: Most blood based renal replacement therapies (RRT) use a double lumen access to create a circuit to dialyze blood efficiently. A single lumen alternating micro-batch (SLAMB) has been developed that uses a single lumen to perform RRT. A variation of this single-lumen system is the manual SLAMB-HF (mSLAMB) kit. The mSLAMB works without need for electricity, a battery, or a pump thus making it potentially useful for medical situations in austere environments. The mSLAMB uses syringes, gravity, and standard intravenous fluids to effect RRT.

Methods: *In vitro* clearance experiments were conducted with the mSLAMB. The mSLAMB was connected to a 2-liter bag of a mixture of expired blood and 0.9% NaCl, which was spiked with urea to achieve a hematocrit of approximately 35%, a blood urea nitrogen concentration of 50 - 120 mg/dL and potassium levels of 9.9-16.6 meq/L. Three sets of experiments were conducted, each with a different ratio of hemofiltration fluid to blood volume. Three different dialyzers were also tested: Polyflux 6H, Rexreed 25S, and Nipro Cellentia 17H. The first set was hemofiltration series in a one-to-one ratio, with 100 cc of blood and 100 cc of hemofiltration fluid pulled. This was repeated, and the second and third experiments had a one-to-two ratio and a one-to-three ratio respectively. Eight cycles were performed in each set, and reduction of urea and potassium concentrations were recorded. The data were normalized by percent removed.

Results: The aggregate results present a urea reduction ratio (URR) of $27.4 \pm 7.1\%$ after 8 cycles. The predicted URR was $20.9 \pm 3.2\%$ (Figure 1). Mean percentage reduction of potassium was $23.4 \pm 9.3\%$. The mean URR for at the end of each cycle are shown in Figure 1. The mean potassium reduction for cycles 1-8 were: (1) $11.4 \pm 4.9\%$, (2) $12.8 \pm 9.5\%$, (3) $16.5 \pm 5.4\%$, (4) $17.2 \pm 6.7\%$, (5) $20.0 \pm 6.0\%$, (6) $22.5 \pm 8.8\%$, (7) $23.0 \pm 7.5\%$, (8) $23.4 \pm 9.3\%$. The largest reduction percentage for both urea and potassium occurred after the first cycle. An increase of hemofiltration fluid to blood volume ratios did not increase clearance.

Discussion: The mSLAMB disposable system removes urea and potassium effectively. The efficiency of the mSLAMB was similar across three different sizes of dialysis filter and membrane type which highlights the versatility of the system. Since the mSLAMB only requires manual syringe labor and gravity, this device allows healthcare workers to offer dialysis in austere medical conditions or environments with limited resources. This creates a potential availability of dialysis services worldwide allowing medical professionals to treat people where they could not before.

Character Count (2,421)

Actual versus Predicted URR Across all Experiments

