Applicability of a sucrose solution as a model fluid for single needle dialysis
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Abstract—We aimed to develop an experimental model for single needle dialysis (SND), allowing real-time measurement of both flows and pressures to establish optimal operating conditions for SND. Here, a sucrose solution was applied as a model fluid and compared with bovine blood. The measured flow waveforms as well as pressures were similar for both the model fluid and bovine blood, including a functional recirculation in the venous phase. It is thus suggested that a sucrose solution can be used as a model fluid to establish optimal operating conditions for SND.

I. INTRODUCTION

In a conventional hemodialysis (HD), blood is removed from and returned to a patient through double puncture needles, respectively. In contrast, SND is a treatment that uses single puncture needle with a Y connector to take out blood from a patient (arterial phase) and return it to the patient (venous phase) after purification. Thus, these two flow phases alternate continually during treatment. However, there have been no detailed investigations on optimal operating conditions of SND. Here, we evaluated the applicability of a sucrose solution as a model fluid and compared it with bovine blood.

II. MATERIALS AND METHODS

Recently, we have developed a system capable of measurement of both flow rate and pressure during SND [1, 2]. Here, a sucrose solution was prepared by dissolving sucrose (Wako Pure Chemical Industries, Ltd., Osaka, Japan) in reverse osmosis water. The viscosity was 3.62 mPa·s at 36.7 °C. Bovine blood (Tokyo Shibaura Organ, Ltd., Tokyo, Japan) was adjusted its hematocrit (viscosity) with saline, (Hct: 38%; viscosity: 3.63 mPa·s at 37.3 °C). During the experiments, perfusate temperature was maintained at 37.0 ± 1.0 °C using a water bath.

The experimental procedures as well as the experimental model conformed to the 2012 performance evaluation method of blood purifiers by Japan Society for Dialysis Therapy [3].

III. RESULTS AND DISCUSSION

Figure 1 shows all the flow waveforms (inflow, outflow and Y-outflow) for both a 40% sucrose solution and bovine blood. It is clear that both fluids show nearly identical waveforms both qualitatively and quantitatively. Even similarities of acute and rapid changes in flows were observed.

Figure 1. Measured flow rates of a 40% sucrose solution (upper panel) and bovine blood (lower panel).

IV. CONCLUSION

During SND, the flow rate waveforms of both a sucrose solution and bovine blood were nearly identical. To prevent unnecessary infection during the experiments by contacting blood, a sucrose solution can be an ideal alternative model solution for SND studies.

REFERENCES