Abstract

Hemolysis remains one of the most serious problems during cardiopulmonary bypass (CPB), extracorporeal membrane oxygenation (ECMO), and percutaneous cardiopulmonary support (PCPS). However, the hemolytic characteristics associated with oxygenators are not well defined. A specialized hemolysis test protocol for oxygenators was developed. A comparative study was performed following this protocol to determine the hemolytic characteristics of the clinically available oxygenators during CPB; pressure drop measurements in the blood chamber were also performed. Four oxygenators (Medtronic Affinity, Cobe Optima, Terumo Capiox SX25, and Bard Quantum) were evaluated. Fresh blood from healthy Dexter calves anticoagulated with citrate phosphate dextrose adenine solution was used. The blood flow was fixed at 5 L/min, similar to that used in CPB. The Normalized Index of Hemolysis for Oxygenators (NIHO) has been modified according to the American Society of Testing and Materials (ASTM) standards. The NIH value, which was obtained from the circuit without an oxygenator, was subtracted from the primary NIH value, obtained from the circuit with an oxygenator to eliminate the effects of a centrifugal pump or other artifacts. The NIHO value was the lowest in the Affinity (0.0116 ± 0.0017) and increased from Affinity < Optima (0.0270 ± 0.0038) < Capiox (0.0335 ± 0.0028) < Quantum (0.0416 ± 0.0015 g/100 L). The Optima and Capiox did not demonstrate a significant difference. In addition, this NIHO value has a close relationship to the pressure drop. In conclusion, this new evaluation method is suitable to compare the biocompatibility performance of different types of clinically available oxygenators for CPB usage.

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