Development of a new hollow fiber silicone membrane oxygenator: in vitro study


Abstract An experimental silicone hollow fiber membrane oxygenator for long-term extracorporeal membrane oxygenation (ECMO) was developed in our laboratory using an ultrathin silicone hollow fiber. However, the marginal gas transfer performances and a high-pressure drop in some cases were demonstrated in the initial models. In order to improve performance the following features were incorporated in the most recent oxygenator model: increasing the fiber length and total surface area, decreasing the packing density, and modifying the flow distributor. The aim of this study was to evaluate the gas transfer performances and biocompatibility of this newly improved model with in vitro experiments. According to the established method in our laboratory, in vitro studies were performed using fresh bovine blood. Gas transfer performance tests were performed at a blood flow rate of 0.5 to 6 L/min and a V/Q ratio (V = gas flow rate, Q = blood flow rate) of 2 and 3. Hemolysis tests were performed at a blood flow rate of 1 and 5 L/min. Blood pressure drop was also measured. At a blood flow rate of 1 L/min and V/Q = 3, the O₂ and CO₂ gas transfer rates were 72.45 ± 1.24 and 39.87 ± 2.92 ml/min, respectively. At a blood flow rate of 2 L/min and V/Q = 3, the O₂ and CO₂ gas transfer rates were 128.83 ± 1.09 and 47.49 ± 5.11 ml/min. Clearly, these data were superior to those obtained with previous models. As for the pressure drop and hemolytic performance, remarkable improvements were also demonstrated. These data indicate that this newly improved oxygenator is superior to the previous model and may be clinically acceptable for long-term ECMO application.

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