DEVELOPMENT OF AN IMPROVED EXTRACORPOREAL GAS EXCHANGE DEVICE FOR FUTURE PEDIATRIC APPLICATION

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INTRODUCTION.

At present, severe respiratory failure is a leading cause of neonatal and pediatric mortality in Kazakhstan. Ventilator therapy is not always applicable and do not allow to manage effectively the formidable complications of the diseases. The main focus of the project is the development of one of the methods that provides direct oxygen supply to the blood and CO_2 removal, bypassing the hemato-alveolar barrier and avoiding the risks of currently used extracorporeal life support devices. The overall goal was to modify an existing CO_2 removal device (Hemolung) to meet the required parameters for pediatric application.

MATERIALS AND METHODS.

We used two single lumen 8 Fr veno-venous catheters in our study.

In vivo testing. The duration of the experiment was at least for seven days (168 hours), involved three nonsedated lambs (22-28 kg), and consisted of cannulation (8 Fr Hemolung catheters were inserted in right jugular vein), connection with the extracorporeal respiratory system, clinical and laboratory evaluation of the device operation. The parameters of the data collected included: pump speed, blood flow, carbon dioxide elimination levels, oxygen and carbon dioxide partial pressure in pump outflow segment of tubing system, arterial and venous blood of the animal, oxygen saturation, the number of leucocytes, thrombocytes, hemoglobin, hematocrit, serum free hemoglobin, fibrinogen and other. In this experiment we did not use an animal disease model since such models had not yet been established.

RESULTS.

In vivo testing lasted 7 days and involved 3 nonsedated lambs (22-28 kg) for clinical and laboratory evaluation of the device operation. Results of the three animal studies were promising. The average CO_2 removal rates over the 7 day duration were 59.5 ± 6.5 ml/min in animal S020-11, 64.3 ± 6.6 ml/min in animal S024-11, and 51.8 ± 4.6 ml/min in animal S025-11. These levels of CO_2 removal would be clinically significant in the neonatal and pediatric populations. In all three animals, the Pediatric Hemolung fully oxygenated the blood returning to the animal at the flows in which it was operating. Parameters of hemocompatibility in all three animal studies were within the normal rates for lambs. In this experiment we did not use an animal disease model since such models had not yet been established.

CONCLUSIONS.

Use of the Hemolung system led to no hemodynamic sequelae, adequate hemcompatibility of the device in vivo, adequate gas exchange and pumping ability characteristics in vivo using the smaller catheter of 8 Fr. Necropsy and histopathology findings were unremarkable. The Hemolung Respiratory Support System could provide clinically significant levels of CO_2 exchange with future potential for pediatric use. More animal studies should be conducted to obtain more detailed data. The Hemolung did not cause any unexpected changes in hemodynamics.

ACKNOWLEDGMENTS.

The research was carried out in collaboration with McGowan Institute for Regenerative Medicine, University of Pittsburgh Medical Center, USA.