Evaluation of the sterility and oxygenator performance of an ECMO circuit after 30 days of storage

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Abstract

The ELSO General Guidelines for ECLS Cases 2017 recommend an ECMO circuit storage period of up to 30 days after filling the circuit. However, no studies have been conducted on ECMO circuits containing artificial lungs with silicone membrane and porous polypropylene hollow fiber for support. Also, no Japanese standards have been formulated for the storage period of filled ECMO circuits. The main problems during the storage period after filling the ECMO circuits are maintaining sterility in the circuit and maintaining gas exchange performance in the artificial lungs. Therefore, we evaluated the sterility and maintenance of artificial lung performance in ECMO circuits containing artificial lungs with silicone membranes having porous polypropylene hollow fiber as support during 30 days of storage. The ECMO circuit used was the MERA Exceline circuitHP2 “#ST SOLAS23H-CSP3 Hepa”（SENKO MEDICAL INSTRU MENT Mfg. CO., LTD.）. The ECMO circuits were categorized into a dry group （n＝5）, which were kept in an unfilled condition, and a wet group （n＝5）, which were filled and primed. Bacteriological tests included bacterial culture evaluation using a BHI medium and endotoxin evaluation. Furthermore, oxygen transfer, carbon dioxide transfer, and pressure drop were assessed as part of the artificial lung performance evaluation. As a result, all samples showed no turbidity in the medium, indicating no bacterial growth, and endotoxin levels were below the detection limit. No degradation of artificial lung performance was observed, and their gas exchange capacity specifications were met. In this study, ECMO circuits having silicone membranes and porous polypropylene hollow fiber supports could maintain sterility even after 30 days of storage without affecting blood gas exchange performance specifications, which would become inapplicable otherwise. The results of this study demonstrated that an ECMO circuit containing artificial lungs constructed using silicone membrane and porous propylene hollow fiber can be stored for 30 days after filling.

Key words：ECMO, aseptic, BHI culture, endotoxin

Investigation of a method for the electrical measurement of venous reservoir blood volume

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Abstract

Blood volume in the venous reservoir（VR）is an important parameter that should be continuously monitored in patients with a cardiopulmonary bypass. In this study, we investigated the effects of measurement frequency, hematocrit（Ht）, and blood volume on the capacitance（Cs）of blood present in the venous reservoir by utilizing electrical properties of polycarbonate, a material used in VR. In Experiment 1, two electrodes were attached to the VR wall surface and the capacitance Cs［F］between the electrodes at each liquid level was measured at frequencies from 100kHz to 1MHz. VR was filled with physiological saline or bovine blood（Ht 20%, 25%, and 30%）. In Experiment 2, Cs values were measured at a frequency of 1MHz by attaching an electrode to a cylindrical container and filling it with physiological saline. The results of Experiment 1 showed that the Cs value increased with raising liquid level, with increases of 1.30pF/cm（saline）, 1.26pF/cm（Ht 20%）, 1.28pF/cm（Ht 25%）and 1.13pF/cm（Ht 30%）at a frequency of 1MHz. In Experiment 2, Cs increased by 1.41pF/cm. The frequency range of 800kHz to 1MHz was found to be stable with minimal effects on the blood, suggesting that the frequency can be used for continuous measurement of the blood volume in VRs of various shapes.

Key words：cardiopulmonary bypass, venous reservoir, level sensor, reservoir volume, automation