DEVELOPMENT OF OUTSIDE-IN FILTRATION HOLLOW FIBERS FOR THE ARTPLAC DEVICE.

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Introduction

Despite medical progress, around 1 million premature babies worldwide still die yearly due to complications such as lung or kidney failure [1]. Current treatments (mechanical ventilation, extracorporeal membrane oxygenation, and dialysis) are invasive have side-effects leading to lifelong disabilities. We propose the development of an artificial placenta (ArtPlac), connected to the umbilical vessel like the natural placenta in utero [2,3]. This innovative device aims to integrate lung and kidney assistant into a single unit by combining blood oxygenator fibers with dialysis hollow fibers (HF) in a bundle both working in outside-in mode (OIF) [Fig. 1]. Unlike the traditional dialysis mode, the baby's blood will flow around the fibers and either oxygen or dialysate fluid will flow inside the fiber. This combination would offer a compact device with low blood priming volume and adding dialyzer function [4,5]. In this study, we investigate the development of the HF suitable for outside-in dialysis for this neonatal application.

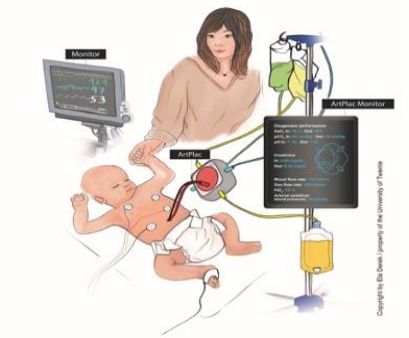

Figure 1: ArtPlac – one device attached to the umbilical cord combining lung and kidney support.

Methods

The hollow fibers (HF) were prepared using PES Ultrason (BASF, Ludwigshafen, Germany), a mixture of PVP K90, K30 (BASF, Ludwigshafen, Germany) and NMP (Acros Organics, Geel, Belgium) by dry-wet spinning**.** Scanning Electron Microscopy (SEM) was employed for fiber morphology characterization. The membrane ultrafiltration coefficient was determined via Clean-Water Flux (CWF) measurements.

Results

Figure 2 presents typical SEM images of new HF for OIF. They have sponge-like pore morphology with an outer selective layer, in contact with the blood, and porous inner layer, in contact with the dialysis fluid. These membranes have an ultrafiltration coefficient of 7 mL/(m^2·h·mmHg) and are considered as low-flux dialyzer membranes.

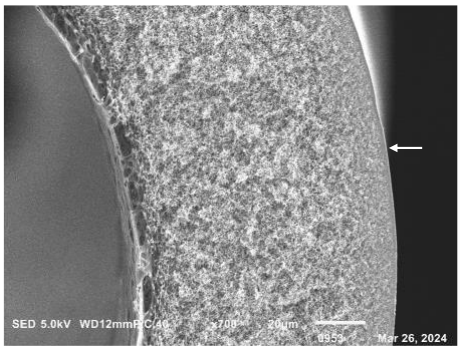

Figure 2: SEM image of the cross section of HF for OIF. The white arrow indicates the outer selective layer.

Discussion

The sponge-like pore morphology and the measured ultrafiltration coefficient of the HF present promising characteristics for their potential use within the ArtPlac device. To maximize membrane performance, we are working on the development of an optimal fiber design.

References

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