MCO Membranes: Enhanced Selectivity in High-Flux Class

Abstract # FP478

A. Boschetti de Fierro, M. Voigt, M. Storr, B. Krause

Gambro Dialysatoren GmbH, Research & Development, Hechingen, Germany

Background and Introduction

Medium Cut-off (MCO) high-flux dialysis membranes with increased permeability compared to conventional high-flux membranes were designed for use in conventional hemodialysis treatment schedules, targeting small, middle and large molecules normally addressed by healthy kidneys.

In this contribution, dextran filtration has been used to characterize these membranes according to previously published classification of blood purification membranes.[1]

Methods

Four experimental MCO membranes were analyzed. Membranes were characterized in minimodules (360 cm^2 surface area, 170 mm nominal length, 120-150 mm effective length, 10 mm inner diameter, 180 µm internal diameter of fibers).

Dextran sieving coefficient tests before and after blood exposure were conducted as described elsewhere.[1] The obtained sieving curves were characterized by two points: molecular weight retention onset (MWRO), defined as the molecular weight at which the sieving coefficient is 0.9, and molecular weight cut-off (MWCO), defined as the molecular weight at which the sieving coefficient is 0.1.

Table 1: Characteristics of the devices the membranes of which were used for characterization with dextran filtration.

Devices	Surface area [m^2]	Fiber dimensions [µm]	
		Inner diameter	Wall thickness
Revaclear	1.8	190	35
MCO 1	1.7	180	35
MCO 2	1.7	180	35
MCO 3	1.7	180	35
MCO 4	1.7	180	35
Theralite	2.1	215	50

Results

Dextran Sieving Curves

Figure 1 compares the dextran sieving curves for different membranes and depicts also ficoll filtration data from the glomerular membrane for comparison.[2]

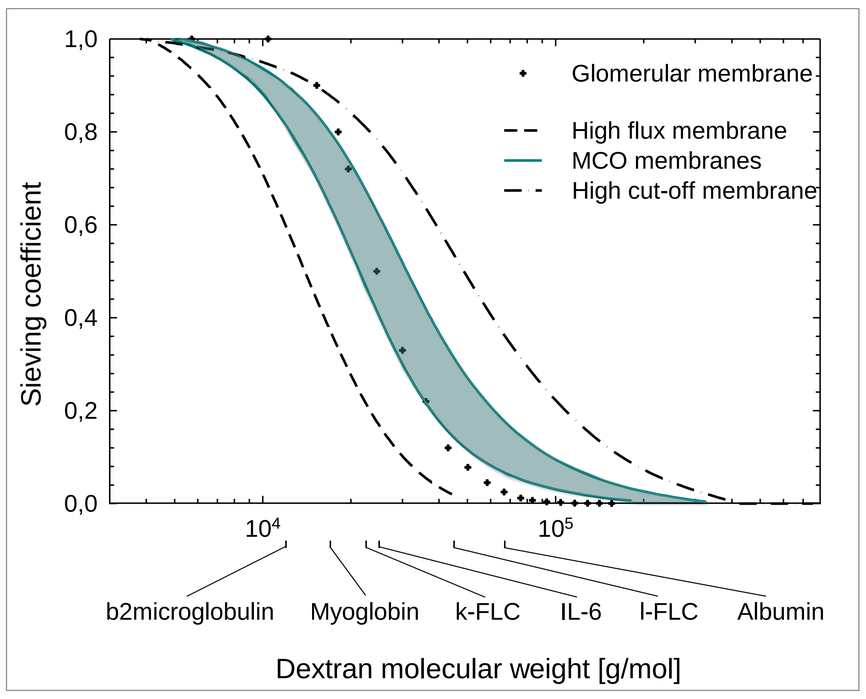

Figure 1: Dextran Sieving Curves for Blood Purification Membranes

Compared to the natural kidney, conventional high flux membranes remove less toxins, while high cut-off membranes are more open than the natural kidney – what makes their removal effective in acute applications. The sieving curves of the MCO membranes show the highest similarity to that of the natural kidney.

Effective Pore Sizes

The effective Stokes-Einstein pore radius has been calculated for membranes before and after blood contact, as shown in Figure 2. As a reference, the values for **Revaclear** and **Theralite** dialyzers before blood exposure and the size of albumin has been included.[3] After blood exposure the secondary membrane is formed, and the effective pore radius decreases to the target range between 3 and 3.5 nm.

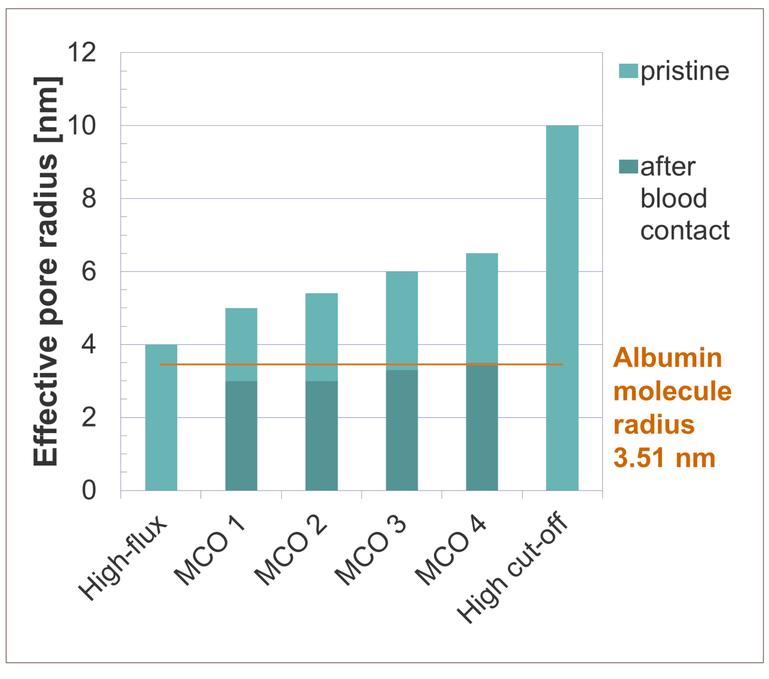

Figure 2: Stokes-Einstein pore radius of MCO membranes based on dextran sieving experiments before and after blood exposure

Membrane Classification

The landscape of blood purification membranes previously published[1] is presented in Figure 3, now including also the MCO high-flux membranes.[4] The square previously used to denote the high-flux dialyzers (continuous line) has now being expanded to include the MWRO vs. MWCO values obtained for the MCO membranes (broken line).

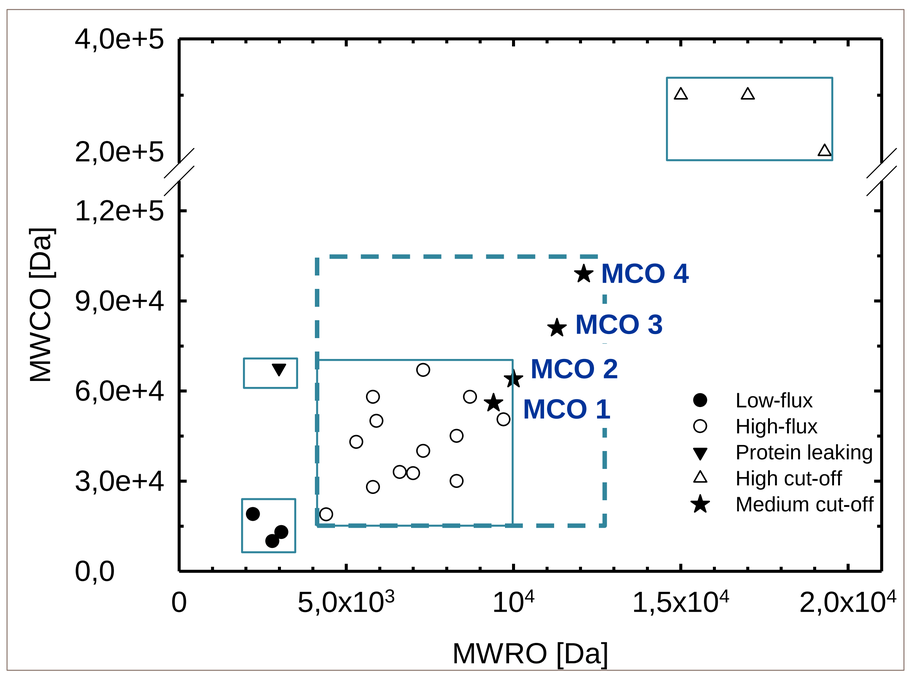

Figure 3: Mapping of the different blood purification membranes types

Conclusions

The novel MCO membranes show **permeability close** to that of the natural kidney.

Their MWCO values indicate that, when used in hemodialysis treatments, they allow for **removal of an expanded range of uremic toxins** compared to conventional high-flux membranes.

Formation of a protein layer on top of the synthetic membrane during hemodialysis **restricts the removal of molecules above 3.5 nm in radius**, ensuring retention of albumin during treatment

References

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2 Axelsson J, Mahmutovic I, Rippe A, Rippe B. Loss of size selectivity of the glomerular filtration barrier in rats following laparotomy and muscle trauma. Am. J. Physiol.-Renal. 2009;297(3):F577-F582.

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4 International Patent Application No. PCT/EP2015/052364 filed on February 05, 2015 (Title: “Membrane For Blood Purification”)

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