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High-Performance Membrane Dialyzers in Hemodialysis Patients

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Introduction

In recent decades, a lot of types of dialysis filters with various solute removal properties and of various membrane materials have been used for high-flux hemodialysis (HD) or online hemodiafiltration (HDF). Generally, the effectiveness of a new therapy has been evaluated by evaluated by the survival rate parameters, the onset of a cardiovascular event, and other adverse events, which became the basis of Evidence-Based Medicine. However, the main concept of medicine in the 21th century is the patient-centeredness, then we should evaluate the quality of the dialysis modality from the patient's view point and establish the daily practice pattern based on the patient-reported outcomes (PRO).

High-flux vs. High-performance

"High-flux membrane" has been usually used to express the dialysis modality which intensively remove middle molecules (MMs) rather than water soluble small solutes. "High-performance membrane" has been used mainly inside of Japan to express the dialysis modality which aggressively remove MMs with better biocompatibility. We could say, although "High-flux" focuses only on the solute removal property, "High-performance" also focuses on the biocompatibility of the membrane and the clinical outcomes as well as solute removal.

Evaluation of the membrane performance and the dialysis quality

The performance of dialysis membrane has been evaluated by two essential points; the solute removal property and the biocompatibility of the membrane. On the other hand, the quality of dialysis therapy should be evaluated by clinical outcomes such as survival rate and quality of life, as well as by and some surrogate parameters related to clinical outcomes. There is a bit of gap between evaluating membrane performance and clinical performance since high efficiency membrane does not always lead to a better clinical outcome. There have been a few studies that evaluated the relationship between membrane performance; solute removal property or biocompatibility and clinical outcomes. I will introduce some of these reports in the lecture.

Solute remove property in each dialysis membrane and hemodiafiltration

High-flux hemodialysis/hemodiafiltration (HDF) were developed to intensively remove MMs such as beta-2 microglobulin which is the precursor of dialysis related amyloid fibril. Recently dialysis modalities that can aggressively remove larger MMs than beta-2 microglobulin were introduced, and these modalities were so-called "protein permeable dialysis". Predilution online hemodiafiltration, protein adsorption hemodialysis and expanded hemodialysis are included in this category. Sakurai et al. reported that aggressive removal of alpha-1 microglobulin (MW 33KDa) by predilution online HDF significantly improved restless leg syndrome of the dialysis patients.

Biocompatibility of dialysis membrane

In high-flux, high-convective therapies, membrane materials must be strong enough to maintain membrane pore integrity and resist high trans-membrane pressures due to high convection volumes. Membrane materials that meet these requirements are synthetic membranes such as polysulfone, polyether sulfone. In recent years, it has been reported that some of the chemical components of these membranes such as polyvinyl pyrrolidone and bisphenol A can adversely affect the quality of dialysis therapy. Polymethylmethacrylate and cellulose triacetate doesn't contain both chemicals.

These membranes can be classified by the presence of these chemicals. We should evaluate the clinical outcomes by the view point of biocompatibility of the membrane.

Daily practice pattern based on PRO

In the Standardized Outcome in Nephrology (SONG) initiative, "fatigue" is addressed as one of the core outcomes in hemodialysis patients as well as mortality, cardio-vascular event and vascular access patency. Fatigue is a common symptom in dialysis patients and it causes inactivity, appetite loss, depressive sense and frailty. In 2005 we started the daily practice pattern based on PRO called "Patient-oriented dialysis (Pod) system. Monitoring the patient's symptom and nutritional status, we change the dialysis prescription by changing the dialysis modality from hemodialysis to hemodiafiltration, and by changing membrane material.
Through almost twenty years of our practice pattern, we found that several dialysis related symptoms were an independent prognostic factor and also a proper parameter to validate the intervention.

Summary

To improve the quality of life and survival of dialysis patients, it is necessary to establish a daily practice pattern based on PRO. In addition, it is necessary to tailor dialysis prescriptions to each individual patient, taking into account the performance of the dialyzer as solute removal performance and biocompatibility.