

Assessment of Removal Efficiency of Protein-bound Uremic Toxins by Pre-dilution On-line Hemodiafiltration

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Introduction and aims

Indoxyl sulfate (IS) and *p*-Cresol (Cres) are classified into protein-bound uremic toxin and more than 90% of them in the blood are bound to albumin. Both substances are strongly involved in the onset and progress of dialysis complication. However, it is difficult for hemodialysis to efficiently remove the both substances from the blood.

In this study we assessed the removal efficiency of IS and Cres by pre-dilution on-line hemodiafiltration (HDF) by changing various dialysis conditions.

We also assessed the effectiveness of extending the dialysis circuit (with double chambers) before the filter on the removal of IS.

Methods (1)

7 stable patients on maintenance dialysis

Age: 54.1±8.8 yrs old, Duration of dialysis: 207.3±95.5mo
Cause of CRF: CGN 4, DMN 1, VUR 1, PCK 1

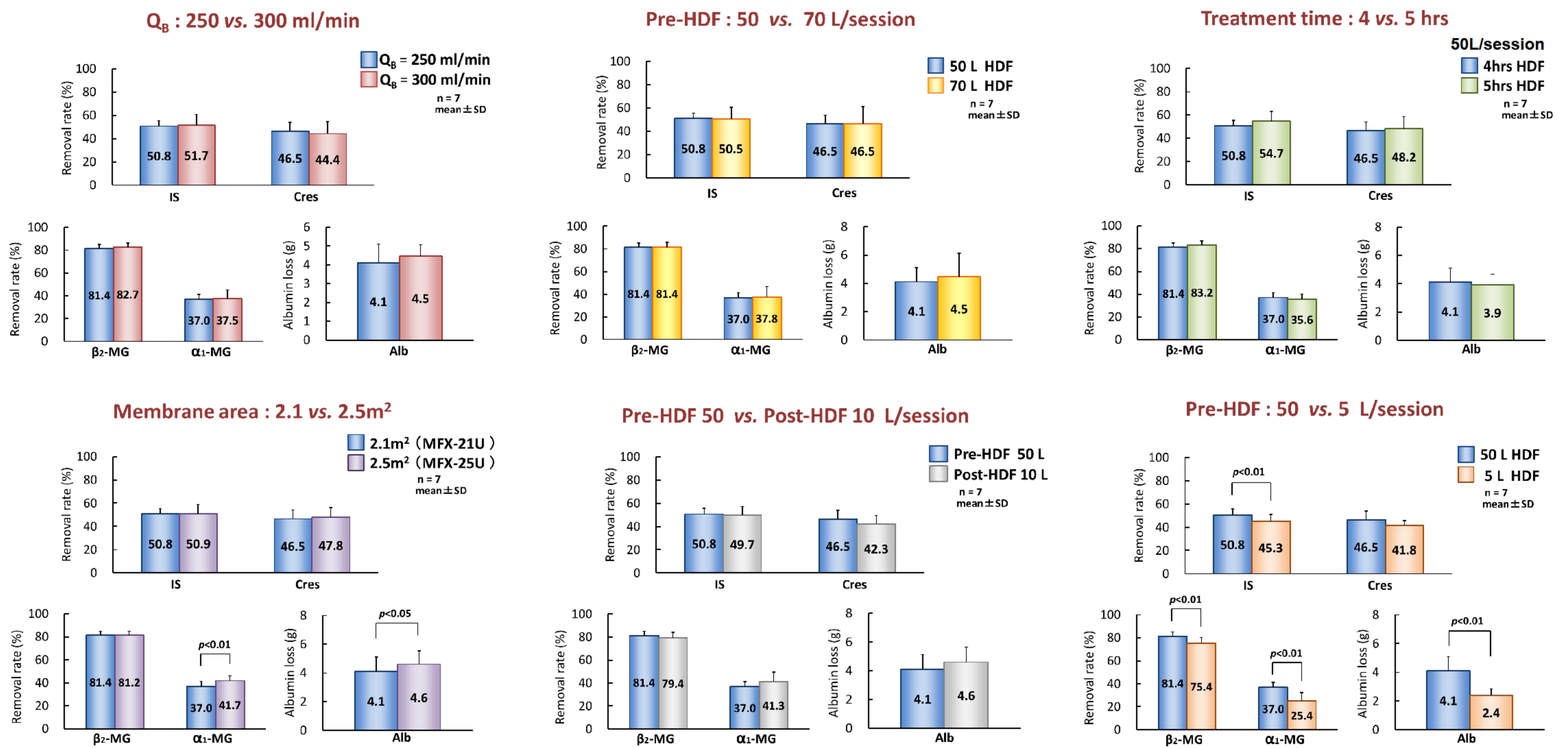
Basic treatment condition;
50 L/s Pre-dilution on-line HDF (4hrs HDF)
 $Q_B = 250$ ml/min, $Q_{Dtotal} = 600$ ml/min
Hemodiafilter: MFX-21U eco (2.1m², Nipro Co.)

VS.

★ $Q_B = 300$ ml/min ★ Area = 2.5m², MFX-25U eco
★ Pre-HDF = 70 L/session ★ Post-HDF = 10 L/session
★ Treatment time = 5hrs ★ Mild Pre-HDF = 5 L/session

Analysis; Removal Rate: indoxyl sulfate, *p*-Cresol, β_2 -MG, α_1 -MG
Amount of Alb loss

Results (1)

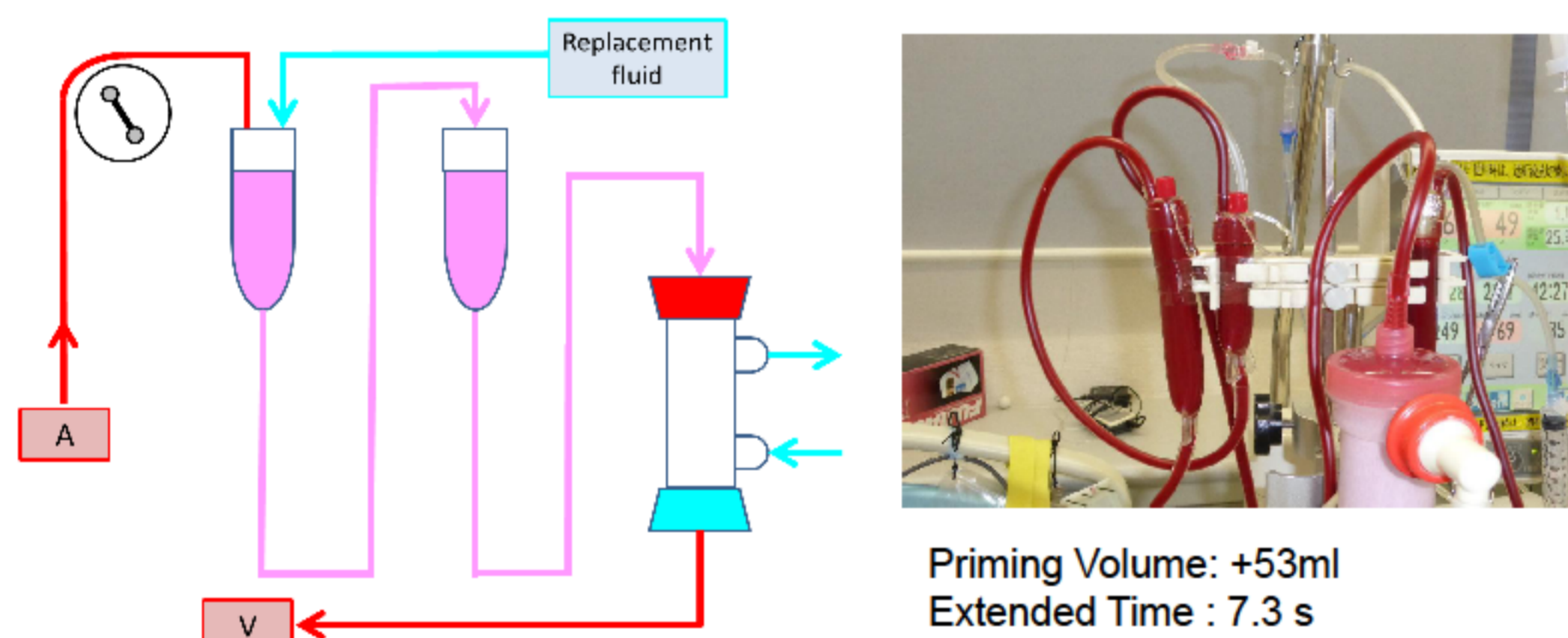


Methods (2)

8 stable patients on maintenance dialysis

We compared IS removal efficiency at Q_B of 250 ml/min when 50L Pre-HDF was performed using an ordinary circuit and an extended circuit with double chambers.

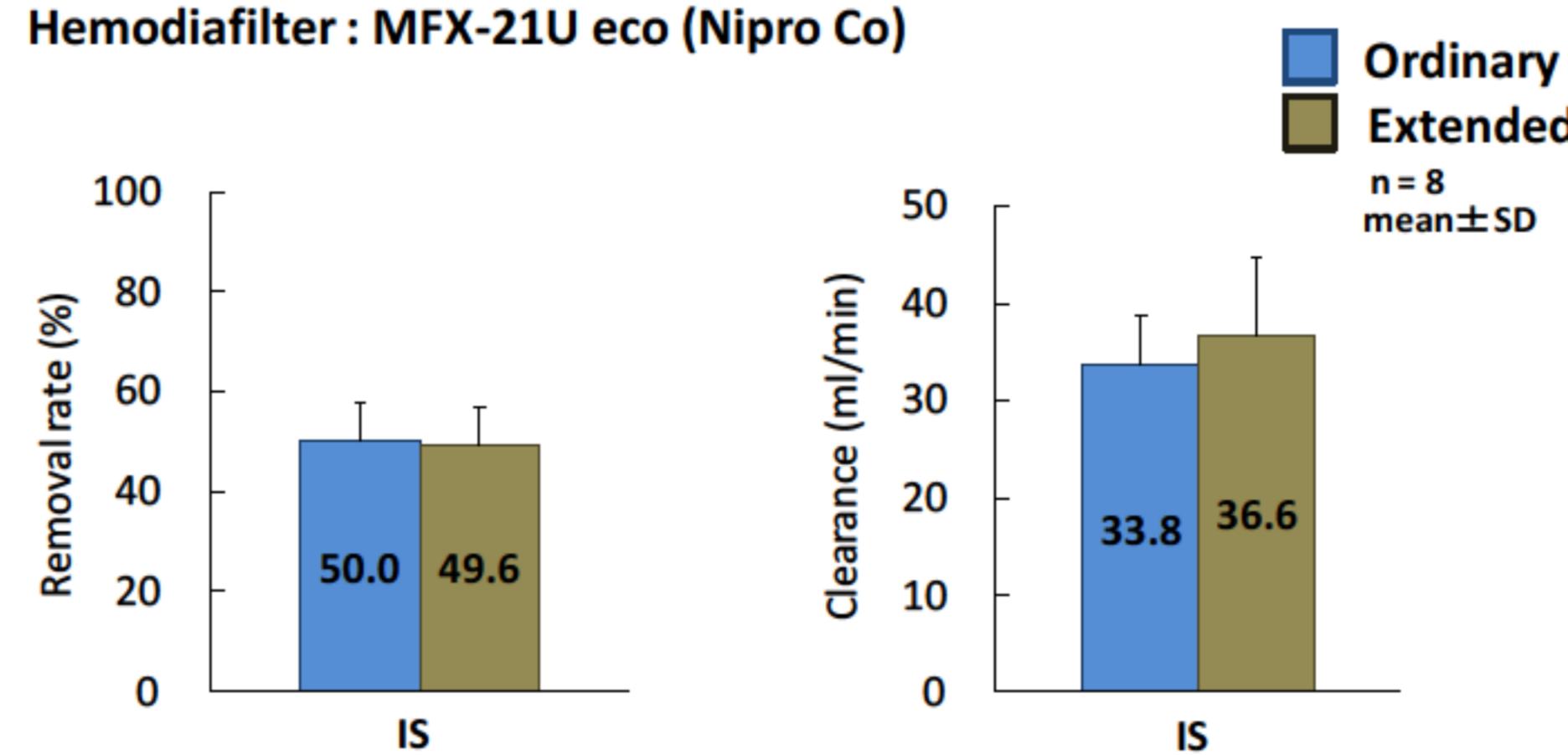
Analysis; indoxyl sulfate: removal rate, clearance (check point : one hour after the start)



Results (2)

Ordinary circuit vs. Extended circuit (double chambers)

- Condition; 50L/s Pre-dilution on-line HDF (4hrs)
 $Q_B = 250$ ml/min, $Q_{Dtotal} = 600$ ml/min
- Hemodiafilter: MFX-21U eco (Nipro Co)



Discussion

IS and Cres removal rates (RR) did not improve when the HDF condition settings were changed in this study. However, there is a statistically significant difference in the RR of IS when pre-dilution HDF was performed with replacement fluid volume of 5 L (equivalent to HD) and 50L.

With 4hrs HDF, IS and Cres removal rates were 50.8% and 46.5% , and with 5hrs HDF, 54.7% and 48.2% respectively. Though there was no statistically significant difference in the RR, treatment time was also important for improving the RR of IS and Cres.

The purpose of extending the circuit with double chambers before the filter is to give the blood more time to mix with the replacement fluid and to enhance the mixing effect.

We expected that IS bound to albumin may decrease and IS may be released into the blood. Since IS itself is a small molecule, it is efficiently removed by HDF. If so, pre-dilution HDF appears to be a superior method for removing IS.

However, our results showed no difference in the RR of IS between ordinary and extended circuit though there was a somewhat large difference in IS clearance.

This suggested that there were two types of adsorbed form of IS in the blood at that point (one hour after the start); adsorbed IS that readily desorbed from Alb and adsorbed IS that tightly bound to Alb. And the total amount of IS to be removed during 4hrs HDF did not change even though it increased during the early phase with the extended circuit.

Conclusions

Even with 4-hrs HDF with a high-efficiency hemodiafilter Indoxyl sulfate and *p*-Cresol removal rates were limited to 45–50%.

Higher removal efficiency of these substances requires longer treatment time or/and more albumin loss.

