EFFECT OF DIALYSATE FLOW RATE (QD) ON SMALL AND MIDDLE MOLECULAR SOLUTE REMOVAL IN HIGH-EFFICIENCY ON-LINE HAEMODIAFILTRATION (oI-HDF)

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INTRODUCTION

The mass transfer-area coefficient for a given dialyzer–solute combination (KoA) is assumed constant in hollow fiber dialyzers. However, controversial effects on KoA and solute clearance (K) were reported by increasing the dialysate flow rate (QD). Leypoldt [1,2] showed that urea KoA increases in vitro by an average of 14±7% (range 3% to 33%) with an increase in QD from 500 to 800 ml/min, with greater effect for high flux membranes. While other Authors confirmed these findings in vivo[3,4], Bihami[5] reported that increasing QD beyond 600 ml/min have only a modest impact on dialyzer performance, limited to the theoretical increase predicted by the Michaels model[6] for a constant KoA (Equation1).
More recently it was claimed that reduced QD rates in high-efficiency on-line HDF offer substantial savings in dialysate consumption without decreasing dialysis efficiency with respect to high-flux haemodialysis[7].

AIM OF THE STUDY

To verify the effect of different dialysate flow rates (QD) on small and middle molecular solute removal when applied to a modality of high-efficiency on-line HDF (Mixed HDF),

METHODS

In a cross-over study design, 50 stable chronic HD patients of 4 Dialysis Centres, mean age 63.5±13.1 years, were randomly submitted to two study periods of 2 weeks each during which Mixed HDF was performed with two different QD and matching the other operational parameters. The AutoFlow (AF) function implemented on the 5008 Therapy System (Fresenius Medical Care) allows to set different blood/dialysate flow rate ratios. AF Factors (= QB/QD ratio) of 1.2 and 1.5 were compared in this study. High-flux helixone dialyzers 1.8-2.1 m^2 were used. Efficiency of the technique was evaluated for small toxins (urea clearance and Kt/V from on-line ionic dialysance), phosphate (P), and for middle molecular compounds (β2-microglobulin reduction ratio, β2-M RR, and β2-M level of the observation periods).

Table 1

N. = 50	AF Factor 1.2 mean ± SD	AF Factor 1.5 mean ± SD	*P*
time, min	241 ± 7	240 ± 7	*ns*
QB effective, ml/min	388 ± 24	387 ± 23	*ns*
QD effective, ml/min	471 ± 28	588 ± 34	*<0.0001*
Total Infusion, L.	39,6 ± 4,3	40,7 ± 4,9	*ns*
Post Infusion, %	*62 % ± 6,0*	*58 % ± 9,5*	*<0.005*
Convective Volume, L.	42,1 ± 5,3	43,2 ± 5,1	*ns*
Hb, g/dl	11,4 ± 1,2	11,6 ± 1,3	*ns*
Tot. Proteins, g/dl	6,5 ± 0,5	6,5 ± 0,5	*ns*
Dry B W, Kg	74,1 ± 14,7	74,1 ± 14,6	*ns*
Δ B Wt, Kg	2,5 ± 0,7	2,5 ± 0,8	*ns*

$$KD = \frac{[1-EXP\ (KoA^*\ (QB-QD)/(QB^*QD))}{1/QB-1/QD\ ^*\ EXP\ (KoA^*(QB-QD)/(QB^*QD))} \quad \text{(Eq. 1)}$$

RESULTS

All patient and operational parameters but QD were matched in the two compared periods of the study (Table1). Statistically significant reduction of ionic clearance **K** and **Kt/V** (~ 4%) were shown in Mixed HDF by reducing AF Factor from 1.5 to 1.2 (QD= 588→471 ml/min) (Fig.1,2), in agreement with the theoretical equation by Michaels (Eq. 1), predicting a reduction by 4,8% in urea K at the conditions of this study. P level and β2-M level and RR were not affected by reducing QD (Fig.3,4). A mean of 27.8±3.6 liters of final dialysate per session (27.2 L. water and 0,6 L. concentrate) were saved by reducing QD (AF Factor from 1.5 to 1.2).

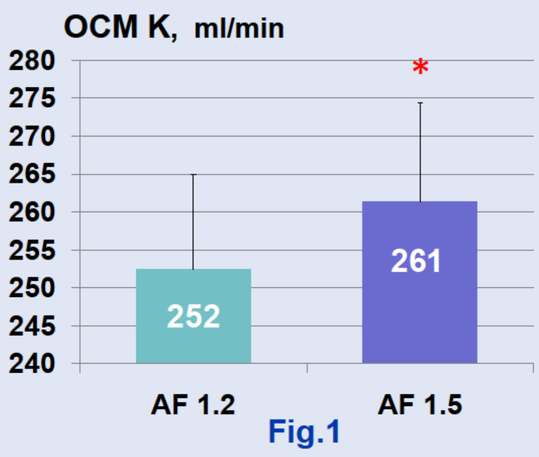

Fig.1

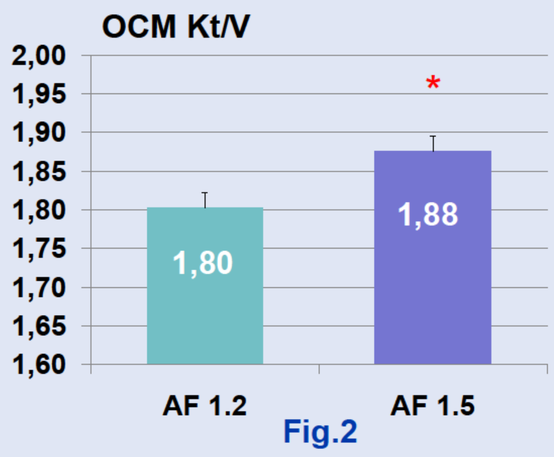

Fig.2

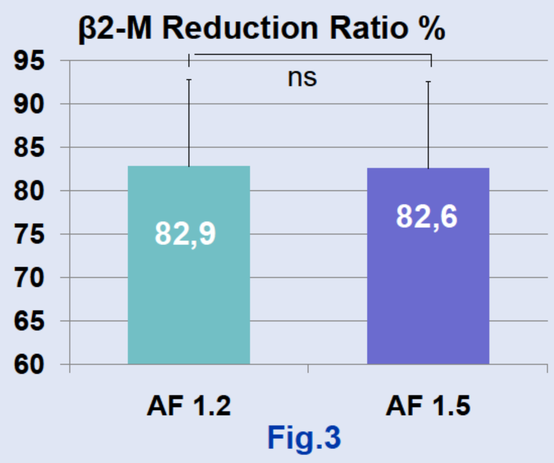

Fig.3

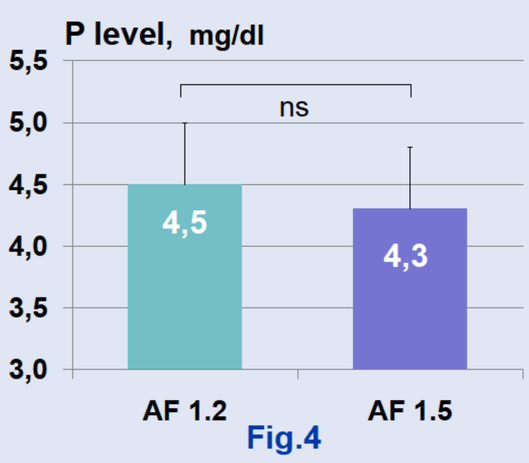

Fig.4

CONCLUSIONS

Reduction of the dialysate flow rate in Mixed HDF resulted in cost-saving in water and dialysate concentrate at the expenses of a reduction of small solute removal which was statistically significant but, probably, not clinically relevant in this study, due to the very high efficiency of the applied treatment.
However, if AF Factor lower than 1.5 is applied to sessions performed with lower QB than in this study, the negative effect of QD reduction might be enhanced and prevent to achieve the adequate efficiency parameter (Kt/V) of the sessions. These issues should be clarified with further studies, keeping into account that low QD could also affect significantly the removal of small protein-bound solutes, as suggested by the results of a recent study [8].

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