

A reliable method to assess the water permeability of a dialysis system: The global ultrafiltration coefficient

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Background

Recent RCTs on hemodiafiltration (HDF) suggest that **high convection** improves survival in dialysis patients (1).

When convection flow (Q_{UF}) is high (>30 mL/min) ultrafiltration coefficient required by FDA does not reflect system permeability. The **global ultrafiltration coefficient** of the dialysis system (gK_{D-UF} defined as Q_{UF}/TMP) is better adapted (2). The measure of gK_{D-UF} encompasses all the modifications occurring inside the dialyser (including viscosity induced resistance to filtration flow or oncotic pressure variation) which influence TMP.

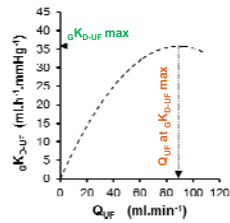


Fig 1. gK_{D-UF} and related Q_{UF}

gK_{D-UF} over Q_{UF} follows a **parabolic function** and its maximum (gK_{D-UF} max) is the highest water permeability which occurs at a specific Q_{UF} .

Objectives

The present study analyses **in vivo** the factors influencing gK_{D-UF} max and its Q_{UF} .

Methods

12 stable dialysis patients were closely monitored as for the gK_{D-UF} in HDF setting for 2 months. They were treated with HD or HDF. Blood and dialysate flow were respectively 368 ± 9 and 602 ± 1 mL/min. Weight loss was 2.9 ± 0.1 kg/session.

gK_{D-UF} was **weekly determined** at the start of session, and could be repeated during treatment, at 60 and 180 minutes.

For 3 patients, **3 successive measures** of gK_{D-UF} were repeated at session initiation and at the end of session

Results

Reproducibility

In all assessments, gK_{D-UF} always followed a **parabolic function** (least $R^2=0.96$ of 150 determinations). **For every patient**, initial gK_{D-UF} -max (VC, $4.7\% \pm 0.5\%$, max 11%) and related Q_{UF} ($3.9 \pm 0.3\%$, max 7.8%) were very reproducible from session to session, Fig 2.

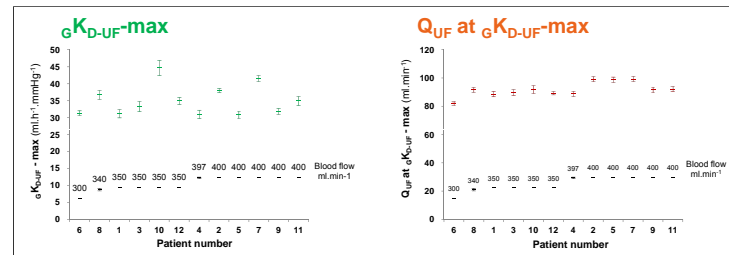


Fig 2. Reproducibility of initial gK_{D-UF} -max (left) and related Q_{UF} (right) measured at the start of different HDF sessions.

Successively **repeated measures** also showed acceptable reproducibility:

- gK_{D-UF} -max at initiation (VC, $3.6\% \pm 1.3\%$, max 5.1%) and end of treatment (VC, $1.9\% \pm 0.5\%$, max 2.9%)
- **Related Q_{UF}** at initiation (VC, $2.5\% \pm 1.4\%$, max 5.3%) and end of treatment (VC, $4.1\% \pm 0.5\%$, max 4.6%)

Inter-patient variability

gK_{D-UF} -max greatly **varied across patients** (from 31 to 45 mL.h⁻¹.mmHg⁻¹), and associated Q_{UF} changed from 82 to 99 mL/min (Fig 2). Multivariate analysis showed that gK_{D-UF} -max and Q_{UF} at gK_{D-UF} -max were influenced by **patient and blood flow** (all $p \leq 0.01$).

Conclusions

gK_{D-UF} -max **translates the convection ability** of the whole system including the patient and dialyzer. It decreases during dialysis, in association with weight loss, suggesting that hemoconcentration and refilling capacity could be involved.

gK_{D-UF} is a **reliable method** to assess the water permeability of a system, more adapted to modern dialysis with high convection than current methods requested by National Authorities. Monitoring gK_{D-UF} may help prescribe and deliver high convection volume therapies.

Behaviour during dialysis

The gK_{D-UF} -max and associated Q_{UF} **decreased during dialysis treatment** (Fig 3). The change was more pronounced for gK_{D-UF} -max.

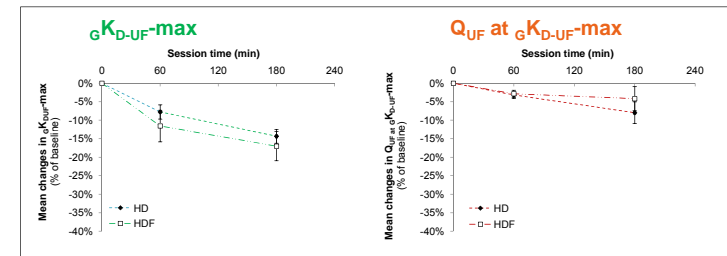
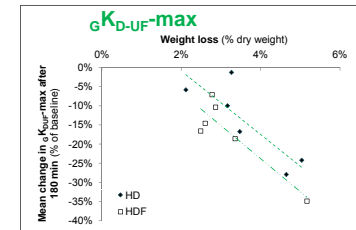


Fig 3. Changes in gK_{D-UF} -max (left) and related Q_{UF} (right) during HD or HDF sessions.



Decrease in gK_{D-UF} -max was not related to convection, but to patients and associated with **relative weight loss** ($R^2=0.66$; $p < 0.001$; Fig 4).

Fig 4. Changes in gK_{D-UF} -max after 180 min of HD or HDF dialysis and relative weight loss.

References

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