Mixed HDF
Optimising Efficiency and Safety
ONLINE HDF pump

Blood pump

ONLINE HDF pump

ONLINE substitute port
Mixed HDF — Achieving Higher Exchange Rates in Haemodiafiltration

High-efficiency ONLINE Haemodiafiltration (HDF) is recognised today as the most advanced haemodialysis treatment modality that improves patient outcomes thanks to its beneficial short-term and long-term effects.

The European DOPPS Study reported a significant 35% lower mortality risk in HDF patients with a volume exchange of more than 15 L per session compared to patients on low-flux haemodialysis (HD) (1). These results are supported by two other recent studies (3,4) also indicating a significant reduction in mortality for patients treated with high volume ONLINE HDF and are reflected in the EBPG recommendations (1).

One of the major goals of Fresenius Medical Care’s Cardioprotective Haemodialysis programme is the continuous development and implementation of innovative therapy systems and concepts, further improving the cardiovascular prognosis of dialysis patients.

With Mixed HDF, Fresenius Medical Care provides an innovative therapeutic option for the 5008 Therapy System that offers high fluid exchange rates mediating enhanced solute removal (3) and thereby resulting in optimized HDF treatment.

The superior performance of Mixed HDF is based on a refined regulating system that helps to preserve the permeability of high performance membranes (6).

*1: HDF with high fluid exchange rates between 15 and 25 L per treatment significantly reduces the mortality among dialysis patients in comparison to low-flux HD (Canaud et al, 2006)
Mixed HDF — Combining the Advantages of Pre-Dilution and Post-Dilution

Post-dilution haemodiafiltration offers the most effective removal of middle molecular solutes\(^7\). But highest efficiencies are often limited by increased blood viscosity and protein concentration which could result in a critically increased transmembrane pressure finally leading to an impaired removal of solutes.

The pre-dilution of blood partially overcomes this problem, but at the price of affecting the overall efficiency of this method as a consequence of diminished solute concentrations\(^7,8\).

By joining both modalities, it is possible to attain a higher therapeutic benefit for convective treatments without compromising the patient’s haemodynamic stability.

In the Mixed HDF option of the 5008 therapy system, a feedback system automatically maintains constant haemodynamic conditions adjusted to the characteristics of Fresenius Medical Care’s distinguished haemodiafilter membranes.

By better preserving the hydraulic characteristics of the dialyser, it is possible to achieve greater substitution volumes and thus higher ultrafiltration. This results in significantly higher convective removal of small and middle molecular uremic toxins \(\beta_2\) while minimising albumin loss (occurring primarily in the early phase of the treatment and with too high pressure gradients over the membrane) that may compromise the nutritional status of the patients\(^6\).

**Factors affecting the quality of treatment**

<table>
<thead>
<tr>
<th>HDF dilution modality</th>
<th>Pre</th>
<th>Post</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convective clearance (middle molecules)</td>
<td>✓</td>
<td>✓✓✓</td>
<td>✓✓✓</td>
</tr>
<tr>
<td>Diffusive clearance (small solutes)</td>
<td>✓</td>
<td>✓✓✓</td>
<td>✓✓✓</td>
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<tr>
<td>Restriction of albumin loss</td>
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<td>✓</td>
<td>✓</td>
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<tr>
<td>Maintenance of optimal pressure conditions within the dialysate</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Maintenance of membrane permeability (both hydraulic and solute)</td>
<td>✓</td>
<td>✓</td>
<td>✓✓✓</td>
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</table>
Mixed HDF Ensures Optimised Efficiency and Safety

In Mixed HDF, the substitution fluid is administered simultaneously in pre-dilution and post-dilution, regulated by a refined control system. This feedback system automatically adjusts and controls the infusion ratio between pre-dilution and post-dilution, as well as the total infusion volume as a sum of both. The system also takes into account flow conditions, internal pressures and the hydraulic permeability of the dialyser and their complex interactions and changes during the treatment. Mixed HDF is thus a significant advancement in the optimisation of convective treatment modalities in terms of offering the highest detoxification efficacy and patient safety.

Previous studies have shown that limits and risks implicit in the traditional infusion modes in HDF may be overcome with Mixed HDF, which ensures more favorable blood rheology and membrane permeability than in the postdilution mode, and allows the total infusion to be increased and convective removal to be forced beyond the operational limits placed in postdilution.

L. Pedrini et al., Kidney International 2003
Literature

2. Canaud B et al., Mortality risk for patients receiving hemodiafiltration versus hemodialysis: European results from the DOPPS, Kidney Int 2006; 70:2087-2093.