Hemodiafiltration (HDF) with Dialog+

Brief instructions

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SHARING EXPERTISE

Introduction

B. Braun's objective is to optimize the methods used in renal replacement therapies in order to offer the best treatment possible to patients and to improve their quality of life and well-being.

There are three main modes of HD currently employed in the treatment of end-stage kidney disease.

- **Hemodialysis (HD, the conventional therapy)**

  Principle: mainly diffusive metabolic transport through semi-permeable membrane with a concentration difference between blood and dialysis fluid

  → performed with either low or high flux membranes

  → effective removal of small-molecular substances like urea

  → removal of toxic middle-size molecules with high flux membranes

- **Hemofiltration (HF)**

  Principle: soluble substances are swept along in a fluid stream across high permeable membranes (convection) without dialysate flow

  → convection depends on the transmembrane pressure and on membrane features like size, density, and quality of the pores („cut-off-value")

  → optimized elimination of middle-molecular proteins, like Beta2M[1,2]

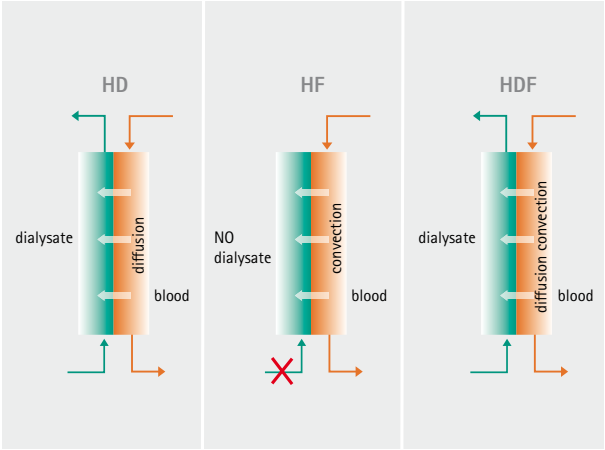
  → performed with high flux membranes

▪ Hemodiafiltration (HDF)

Principle: combination of both diffusion and convection, resulting in the removal of solutes with a broad spectrum of molecules.

→ effective clearance of both small and especially middle molecules through the combination of diffusion and convection.

→ supposed increase of hemodynamic stability, possibly reducing hypotensive symptoms.



Introduction

Dialyzers

It is essential that the choice of the dialyzer matches the high ultrafiltration volumes of an HDF treatment. Therefore a large surface area and a high UF coefficient are needed. The UF coefficient indicates the water permeability of a dialyzer: how many millilitres of water can be removed in one hour with a transmembrane pressure of 1 mmHg pressure difference.

Recommendations of dialyzers suitable for HDF

High flux dialyzers	Product name	Surface area (m^2)	UF-coefficient (ml/h/mmHg)
xevonta 	Hi 10	1.0	58
	Hi 12	1.2	69
	Hi 15	1.5	87
	Hi 18	1.8	99
	Hi 20	2.0	111
	Hi 23	2.3	124
Diacap α Polysulfone 	Hi PS 10	1.0	34
	Hi PS 12	1.2	42
	Hi PS 15	1.5	50
	Hi PS 18	1.8	55
	Hi PS 20	2.0	58
Diacap α Polysulfone HiFlo 	Hi Flo 18	1.8	78
	Hi Flo 23	2.3	92

Pre- and Postdilution

There are two ways of performing a HDF therapy: pre- and postdilution.

Postdilution (= substitution fluid after the dialyzer)

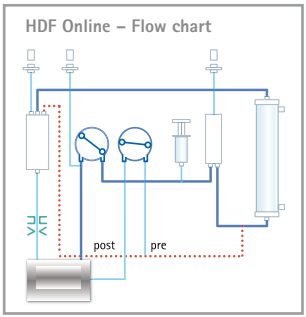
Advantage:
can be considered as the most efficient method of HDF, as the clearance of both small and medium molecules is significantly increased.

Disadvantage:
high hemoconcentration on the outlet side of the dialyzer increases the risks of coagulation and increases the TMP, the more so when the blood flow is low or the hematocrit (Hct) is high.

Predilution (= substitution fluid before the dialyzer)

Advantage:
diluted blood enters into the dialyzer, allows better rheological conditions, and higher convective of large molecules.

Disadvantage:
decreases the elimination of the small molecules because of hemodilution in the dialyzer.

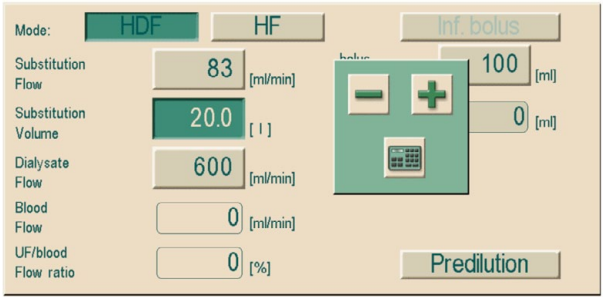


Ports /Patient

Machine preparation

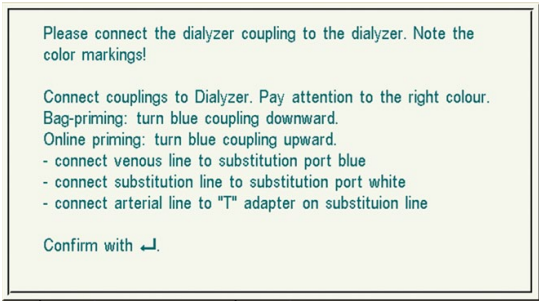
- Select

- Connect concentrates as usual.
- Open the HDF sub screen by touching the HDF icon.



- Select HDF.
- Set up extracorporeal circuit, attaching the Luer Lock ends of the blood lines to the tube clamps on the machine's left hand side.
- If a **pre-dilution** treatment is planned, position the adapter piece at the dialyzer inlet or use a bloodline type with an integrated pre-dilution adapter.

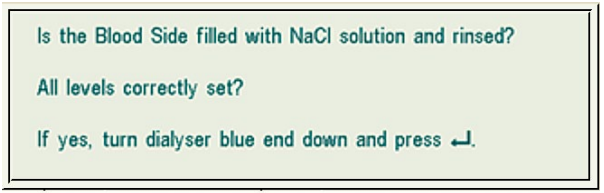
- Insert the substitution line in the substitution pump. Mind the flow direction: short end left, long end right.
- For **pre-dilution**, fix the long end of the substitution line to the pre-dialyzer connection.
- For **post-dilution**, connect long end of the substitution line to the venous blood line.
- In both cases, **do not** yet connect the short end to the port.
- After ca. 15 minutes, a confirmation window appears:



- Follow the instructions: for Online priming, leave blue dialyzer coupling **upwards.**

Machine preparation (cont.)

- Connect the venous line to the blue waste port.
- Connect substitution line to the white substitution port.
- Connect arterial line to T-piece of substitution line before blood pump.
- Confirm with Enter key ↵
- The blood tube system and the substitution line is filled with substitution solution (in the first moment, there can be a certain amount of fluid flow back from the waste port into the venous line).
- Shortly afterwards, a second confirmation window appears:



! Before confirming and turning dialyzer, make sure the lines and the dialyzer are sufficiently filled and rinsed with saline (priming volume reached) and the levels are set correctly.

- Turn dialyzer blue end down and confirm.
- The machine will perform the blood side tests.

Connecting the Patient

- When the patient is ready for connection, press the "Connect patient" icon, confirming treatment parameters.
- For a "bleed-out", take arterial line from T-piece and connect to patient. Close port. Put a cap back on this line for infection control purposes. Leave the venous line where it is.
- For a straight connection, connect the venous line at this point too, making sure the blue port door is closed.
- Confirm with Enter ↵
  The blood pump will start automatically.

! A manual stop of the blood pump, an alarm or deactivation of Bypass causes the cancellation of the **Connect** function via the waste port, recognizable by the rising venous pressure

- To be able to continue the connecting process, press

- In case of "bleed-out", remove the venous line from the waste port and connect to the patient, latest when blood reaches the red detector. Close port.
- Confirm with the Enter key ↵

During Therapy

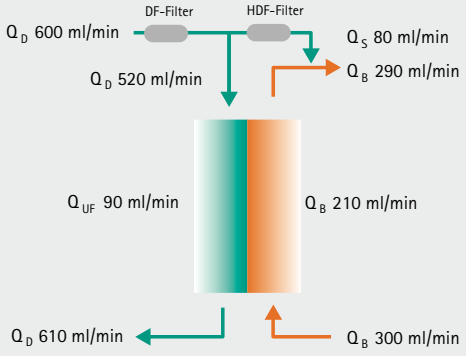
Make sure the clamp on the substitution line is opened. If closed, the system will perform an HD instead of an HDF treatment.
Make sure all ends are tightly connected and no leakage occurs in order to prevent balance deviations.

Flow Chart

- In HDF treatment mode, the set dialysate flow (Qd) is split into dialysate flow and substitution flow (Qs).
- For this reason, the DF flow is automatically increased by 100 ml/min in case HDF is activated.

Example:

HDF-Online Flow on the Dialyzer



Recommendation for Rates and Ratios

Rule of thumb for substitution volume in pre-dilution mode:

≥ 40 L per session.

(approx. **2x post-dilution volume**).

Rule of thumb for substitution volume in post-dilution mode:

≥ 20 L per session.

(approx. **1/3 of the patient body weight**, but max. 24 L)

Due to **high ultrafiltration** in HDF, the **hematocrit** (Hct) value strongly increases during therapy and is higher at the dialyzer blood outlet than inlet.

To minimize the risk of clotting, the ratio between **total UF** and **blood flow** should be ca. 1:3, e.g. 100 : 300 ml/min.

- The percentage is displayed on the Dialog+ screen, it should be between

25 to 30 %

Conversion from substitution volumes to rates

Substitution Volume [l]	Substitution Rate [ml/min]		
	in 4 h	in 4,5 h	in 5 h
18	75	67	60
19	79	70	63
20	83	74	67
21	88	78	70
22	92	81	73
23	96	85	77
24	100	89	80

Examples for HDF post-dilution substitution volumes

Explanation how to read the tables

- **1st step:** What is the patient net UF removed? → → select example 1, 2 or 3 (closest)
- **2nd step:** What is the patient treatment time?
- **3rd step:** What is the acceptable patient blood flow?
- **4th step:** Find the matching substitution volume.

Example 1

Blood Flow (Qb) [ml/min]	Total UF rate [ml/min] = 30% of Qb	Patient UF net removal 1,0 L		
		Sub vol. [L] in 4 h	Sub vol. [L] in 4,5 h	Sub vol. [L] in 5 h
200	60	13	15	16
250	75	16	19	21
300	90	20	23	24
350	105	24	24	24
400	120	24	24	24
450	135	24	24	24

The green fields are examples of an optimal setting. If it cannot be reached, **time and/or blood flow** could be increased. If both is not possible, a lower substitution volume must be accepted. It should be tried to come as close as possible to 20 L.

Alternatively to an HDF therapy with less than 20L, a **high-flux HD therapy** could be indicated.

Example 2

Blood Flow (Qb) [ml/min]	Total UF rate [ml/min] = 30% of Qb	Patient UF net removal 2,5 L		
		Sub vol. [L] in 4 h	Sub vol. [L] in 4,5 h	Sub vol. [L] in 5 h
200	60	11	13	15
250	75	15	17	19
300	90	19	21	23
350	105	22	24	24
400	120	24	24	24
450	135	24	24	24

Example 3

Blood Flow (Qb) [ml/min]	Total UF rate [ml/min] = 30% of Qb	Patient UF net removal 4,0 L		
		Sub vol. [L] in 4 h	Sub vol. [L] in 4,5 h	Sub vol. [L] in 5 h
200	60	10	11	13
250	75	13	15	17
300	90	17	19	22
350	105	20	23	24
400	120	24	24	24
450	135	24	24	24

Note: Total UF = Patient UF net removal + substitution volume

FAQs

The machine alarm shows the message "Ratio gross UF/blood flow too low". What shall I do?

If possible, increase the blood flow. Otherwise reduce substitution flow or increase time.

During HDF treatment, TMP (transmembrane pressure) and PBE (pressure blood entry) usually increase. What are the maximum tolerable values?

The dialyzer will start to clot, if

- TMP reaches 500 mmHg and/or
- PBE value is >650...700 mmHg.

In both cases, the substitution rate should be reduced.

There is a high venous pressure when connecting the patient and the machine will not start the blood pump. What shall I do?

Take the venous line from the blue port and connect to a saline or drain bag to release the pressure and continue the patient connection as usual.

Literature

[1] Online hemodiafiltration versus low-flux hemodialysis: effects on all-cause mortality and cardiovascular events in a randomized controlled trial. The convective transport study (CONTRAST) Grooteman, van den Dorpel, Bots, Penne, van der Weerd, Mazairac, den Hoedt, van der Tweel, Lévesque, Nubé, ter Wee, Blankestijn J Am Soc Nephrol 23: 1087–1096, 2012

[2] Recent Trials on hemodiafiltration Locatelli, Manzoni, Del Vecchio, Cavalli, Pontoriero Contrib. Nephrol. Basel, Karger, 2011, vol 171, pp 92-100

Notes

These brief instructions are not a substitute
for reading the detailed instructions

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