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Perspective

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Online HDF-How to reach the Sufficient Target Filtrate

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Abstract

Online-Therapy is an excellent quality of treatment, introduced in 1993. There is still a lack of proof concerning the better survival of these patients, as there will be up today a positive selection of the online-HDF-treated patients. There are several important points to make sure in order to reach the sufficient convective target volume in post-dilution (23 L), with has supposed at first in the ESHOL study. To reach this target (>proven longer survival), it will be reasonable to keep the conditions of this extraordinary treatment not at the absolute minimum. This will comprise the following points.

Keywords: Online-Therapy; High-flux-HD; High blood flow; Ultra-pure dialysis fluid

Treatment Time and Blood Flow

Treatment time remains the important principle of every RRT. This means for online-HDF 4:30 h or more. Post-dilution is the favourite model for the infusion line, so the high blood flow will be of prime importance [1-4]. This means, clearly spoken, 15 G cannulas and Q_b = 400 cc/min. If one single condition of these three will not completely realized, this may result in a potential critical reduction of the convective exchange. This can easily happen in a multi-centre study when these three points not have accepted with conviction.

Vascular Access

A regular forearm fistula with anastomosis of 3 mm in diameter will have a real blood flow between 700 and 1100 cc/min. This means, that you will get 300, 400 or 500 cc/min. Without any effect on the cardiovascular circulation, as this extracorporeal volume will give back in the same moment. Many staff will have difficulties with this context. Naturally, there will be important influences by the vascular surgeon and as well by the experience and the skill of the staff concerning the puncture of the shunt. In short: Online-HDF requires a safe double puncture, whereas dialysis can performed also with lower blood flow and even as SN.

Hygienic Quality of Dialysis Fluid

Referring to ISO standard 11663-2016. For high-flux-HD, one-step ultrafiltration will be sufficient in CFU<10^{-1}/ml, named ultra-pure dialysis fluid. For online-infusion fluid, two-step ultrafiltration will be required. CFU's must be smaller then 10^{-6}/ml (SAL>6, Sterility Assurance Level). This will reach a CFU reduction of 10^{-8}, starting from 10^{+2}/ml AMI standard. This will name sterile and pyrogen-free infusion fluid [3].

The Flow of Dialysis Fluid

With nearly the best blood flow (15 G cannulas. Qb=400 cc/min) You will need a flow of dialysis fluid for the best diffusion of 480 cc/min. (factor 1,2 of Q_b) . Nearly maximal infusate production means 6,6 L/h (=110 cc/min.). Both of these flows added, resulting in a total flow of needed dialysis fluid of 600 cc/min. This 600 cc/min. flow should put into the pre-set of the online monitors. Only in the 5008 monitors, this had realized automatically. The BiCart cartridge (720/750 g) for all other monitors will run with dialysis flow of 600 cc/min. for 5:00 hours.

The Design of the Dialyzer

25 years ago, the internal mechanical resistance of the high-flux dialyzers had risen. The idea of this concept back then was to raise the internal filtration at high-flux-HD. This concept failed [5,6], unfortunately. The higher pressures inside of the high-flux will reduce the convection by the pressure-driven Auto Processing [7]. Additional to this mechanical reason, there appears today the inclusion of the high Systemic Pressure (Blood Pressure Entry, BPE) into the TMP (3 point measurement), resulting in a second step reduction of convection with online-HDF post-dilution. Both detriments favours the online-HDF pre-dilution (exchange up to 9,0 L/h resp. 150 cc/min., flow of dialysis fluid 600 cc/min.) with moderate TMP and moderate blood flow. There are many high-flux dialyzers on the market. The best of them today (>with high internal resistance of today) are these with a shortened length (and 2 m² surfaces).

Bicarbonate Containing Dialysis Fluid

Generally, the A component of the common dialysis fluid will acidify with 3 mmol/l acetate. This prescription does calcify, that is why the monitors need a descaling procedure when disinfected. Using online-therapy, large amounts of this calcifying infusate fluid will run into the CKD-5 patients. These patients have their own problems with calcification, a well-known problem. In 2007/2008, a new prescription of a component for bicarbonate dialysis appeared on the market with acidification by citrate (0.85 or 1.0 mmol/l, authorized Medical Product). Additional to the classic effect of acidification, with the citrate acidification there will be a second principle of working inside, the Chelate binding between citrate and the problematic cations (Ca^{+} $^{+}$ and Mg^{++}). By this, there will be no calcification in this new prescription of bicarbonate dialysis fluid. In the US, one dialysis provider treats all his patients (40% of the US patients) with this prescription. The survival of the US patients had raised one-step without an improvement of the Kt/V. In case of any new study concerning online-HDF, this should be taking into consideration.

Conclusion

All these points will contribute to an elevated and secure filtrate volume in online-HDF post-dilution in order to reach the proven longer survival for so treated CKD-5 patients.

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