Intradialytic morbid events are not caused by reduced refilling

Susanne Kron[1], Daniel Schneditz[2], Til Leimbach[3], Sabine Aign[3], Joachim Kron[3]

[1]Department of Nephrology, Charite, Universitätsmedizin Berlin, Germany, [2]Institute of Physiology, Medical University Graz, Austria,
[3]KfH Kidney Centre Berlin-Köpenick, Berlin, Germany

It is commonly believed that insufficient vascular refilling leads to hypovolaemia during haemodialysis and contributes to **intradialytic morbid events** (**IME**). The nature of refilling is poorly understood, and refilling volume was not a measurable parameter, so far. Recently, we developed a simple and easy method to determine absolute blood volume during routine haemodialysis sessions (1). Knowledge of absolute blood volume allows now the calculation of vascular refilling volume (2). In the present study, we compared the vascular refilling in haemodialysis patients who experienced IME to the refilling in stable haemodialysis patients with normal blood volume.

Method:

Absolute blood volume (aBV) was measured by indicator dilution using a relative blood volume monitor (BVM) incorporated in the dialysis machine (1):

- An on-line infusate bolus was administered immediately after the beginning of the dialysis session before ultrafiltration was started.
- 240 mL of ultra-pure dialysate were infused as post-dilution by the bolus function of a commercial dialysis machine (5008, FMC).
- The resulting increase in relative blood volume (RBVpost-RBVpre) was measured by the BVM.
- Absolute blood volume was calculated as:

$$\text{absolute blood volume (in mL)} = \frac{\text{bolus volume (240 mL)} \times 100\ \%}{\text{increase in relative blood volume in \%}}$$

Blood volume at dialysis end or at occurrence of IME was given as:

$$aBV_{(t)} = aBV_{beginning} \times RBV_t \text{ in \%}/100$$

Assuming a steady-state hematocrit distribution model, refilling volume can be calculated as (2):

$$\text{Refilling volume} = \text{UF volume} - (aBV_{beginning} - aBV_t)$$

The refilling fraction **Fref** was calculated as the ratio of refilling volume to prescribed ultrafiltration volume:

$$\text{Refilling fraction} = \text{refilling volume} / \text{UF volume}$$

Patients:

Blood volume, refilling volume and UF volume of **10 patients** of a previous study (3) in whom IME (symptomatic hypotension, severe cramps, loss of voice) had occurred were analyzed at the onset of IME.

These patients had shown symptoms at a blood volume between 65 and 56 mL/kg (mean 62 mL/kg).

Data were compared to **14 patients** without IME and with a normal blood volume **(66 – 80 mL/kg)** at the end of dialysis session.

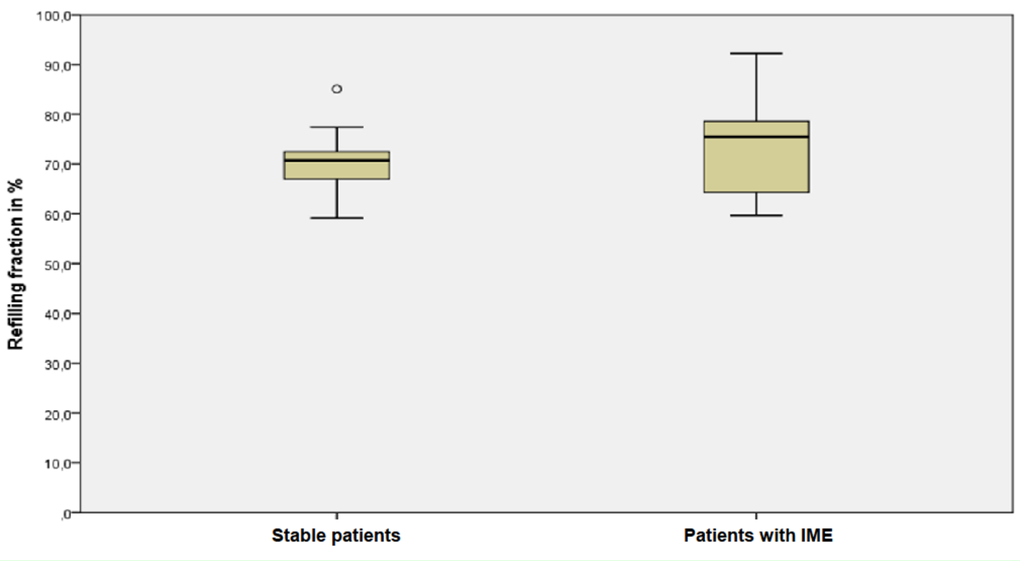
Absolute blood volume in hemodialysis patients with an occurrence of IME was **5.09 ± 1.26 L (69.6 ± 5.8 mL/kg)** at the beginning, and dropped to **4.64 ± 1.81 L (62.2 ± 2.8 mL/kg)** at the time of the IME.

In patients with normal blood volume, absolute blood volume at the beginning was **6.45 ± 1.67 L (80.0 ± 6.7 mL/kg)** and **5.78 ± 1.54 L (71.6 ± 5.3 mL/kg)** at the end of the dialysis session, respectively.

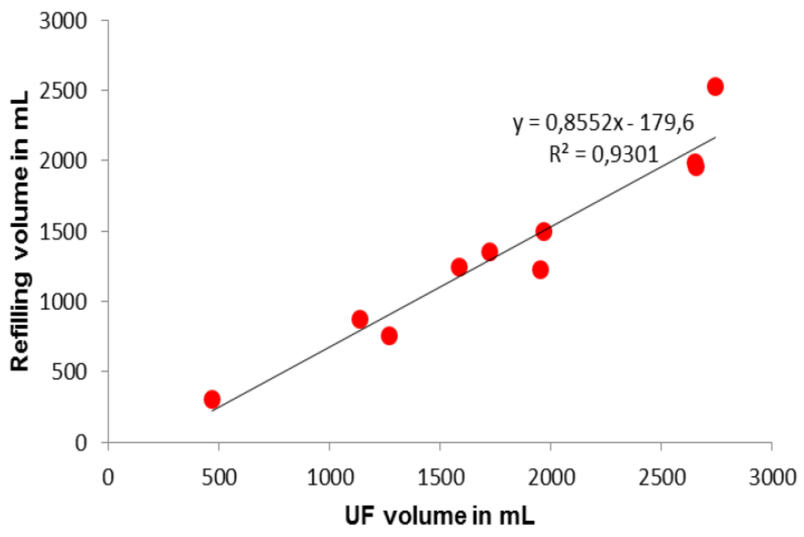
Results:

	stable patients	IME-patients
Refilling volume	**1.58 ± 0.37 L**	**1.37 ± 0.66 L**
Refilling fraction (refilling / UF ratio)	**70.2 ± 6.4 %**	**73.8 ± 9.4 %**

In patients with IME there was an even higher refilling in the central vasculature. This could be due to the mobilization of volume from the capillary system and the peripheral vasculature as a protection function against a volume deficit in the central circulation:



The refilling volume strongly correlated with the UF volume in IME-prone patients



(vs. R^2 = 0.82 in stable patients)

IN CONCLUSION, this is the first study to analyze vascular refilling during dialysis in chronic hemodialysis patients with regard to intradialytic morbid events (IME). A blood volume of 65 mL/kg, seems to represent the threshold for volume-dependent IME. A fall below a critical blood volume causes IME, but that is not linked to reduced refilling. The refilling process in IME-prone patients is basically the same as in stable hemodialysis patients, and depends primarily on the UF volume.

Current on-line haemodiafiltration machines equipped with a blood volume monitor and an online bolus function can be used to determine absolute blood volume in clinical practice. With a simple software modification this technique could be completely automated without altering the hardware of the dialysis device. Present integrated feedback-controlled systems for automated blood volume-controlled ultrafiltration should be adapted to this critical absolute blood volume. If such technology was available, volume-dependent IME could be almost completely avoided.

Therefore, we call upon manufacturers to implement this modification into their on-line haemodiafiltration machines.

1. Kron J, Schneditz D, Leimbach T, Aign S, Kron S: A simple and feasible method to determine absolute blood volume in hemodialysis patients in clinical practice. Blood Purif 2014; 38: 180-187.
2. Kron S, Schneditz D, Leimbach T, Aign S, Kron J: Vascular refilling is independent of volume overload in hemodialysis with moderate ultrafiltration requirements. Hemodial Int 2016; 20: early view.
3. Kron S, Schneditz D, Leimbach T, Czerny J, Aign S, Kron J: Determination of the critical absolute blood volume for intradialytic morbid events. Hemodial Int 2016; 20: 321-326.

53 ERA 423--SP

Dialysis. Extracorporeal dialysis: techniques and adequacy.

Susanne Kron

DOI: 10.3252/pso.eu.53era.2016

ePosters supported by F. Hoffmann- La Roche Ltd.