tolerate a lower RBV-crit than patients with less interdialytic weight gains’. It is not clear from their data whether the same applies to the intra-individual RBV-crit variation.

With regard to the study of Barth et al., there are two additional factors that may explain some of the variability in RBV-crit. The authors used a rather liberal definition of dialysis-hypotension that also included patients who developed headache or cramps in combination with a medical intervention (ultrafiltration stop or change in body position) but without a documented decrease of blood pressure. The pathophysiology of headache and cramps, however, is multi-factorial and may not be related to hypovolaemia. Some patients with headache or cramps may not have had hypovolaemia and excluding these patients may result in a decrease of the RBV-crit variability in some patients. Finally, Barth et al., used both first and following episodes of dialysis-hypotension to calculate the mean and SD of RBV-crit. In our experience, the first episode of dialysis-hypotension usually occurs at a lower relative blood volume than the following episodes during that same dialysis session. Since it was the authors’ ultimate goal to define an individual RBV-crit in order to avoid dialysis-hypotension we think it would have been more appropriate if they had included only the first episodes of dialysis-hypotension in their analysis. In conclusion, we still believe that because of the intra-individual variability, which was even shown in many of the patients in the study of Barth et al., the concept of the RBV-crit to prevent dialysis-hypotension will only have limited applicability.

Conflict of interest statement. None declared.

1Dialysis Centre Groningen Casper Franssen1,2  
2Department of Internal Medicine Judith Dasselaar1  
Division of Nephrology Roel Huisman1,2  
University Hospital Groningen  
The Netherlands  
Email: c.f.m.franssen@int.azg.nl


DOI: 10.1093/ndt/gfg610

Reply

Sir,

It is with great interest that we read the letter from Franssen et al. Their major concern is the variability of RBV-crit. They mention that other groups references 2 and 3 also stated a large variability. This conclusion of reference 2 was immediately commented [1], suggesting outliers and mentioning the number of only seven out of 100 dialysis treatments with hypotensive episodes as too small. Moreover, the data of reference 2 show a highly significant decrease of coefficient of the RBV variation throughout the treatment ($P < 0.01$), thus a trend towards a limit. Unfortunately, the other reference was a study with exponential RBV decrease and sodium variation at the same time, and it was therefore not clear whether the observed effects were due to sodium profiles or to ultrafiltration profiles or to the mixture of both.

Franssen et al., claim that variations in the hydration status at the start of the dialysis session contribute to the variability of the RBV-crit. Although this might be true in general, this influence seems to be overestimated in our population of hypotension-prone patients. In figure 2 of our publication the mean values and the standard deviations of all patients were shown (sorted by the value of RBV-crit). Obviously, patients with a strong RBV decrease do not have a larger standard deviation than patients with a modest RBV decrease. Said differences in the hydration status at the start of the dialysis session should also be detectable in the standard deviation of the described ultrafiltration volume to obtain dry weight. However, no correlation was found between the ultrafiltration volume (in per cent of body weight) and the standard deviation of this volume ($r = 0.03$) for our patients. While in our patient population the ultrafiltration volume decreases with increasing RBV-crit in three quartiles (RBV-crit 80.4%: UFV 5.1%, RBV-crit 87.2%: UFV 3.5%, RBV-crit 91.6%: UFV 2.8%, all values in mean), in the quartile with the highest RBV-crit the ultrafiltration volume is again higher (RBV-crit 96.3%: UFV 3.4%). Especially near over-hydration we observe the well-known non-linear relationship between extracellular and vascular volume, leading to the effect that patients with a higher ultrafiltration volume may only have a modest RBV decrease (so-called ‘flatliners’), while in patients with a lower ultrafiltration volume a higher RBV decrease is measured.

In our population of hypotension-prone patients, we can confirm in only 11% of patients the experience of Franssen et al., that the first episodes of dialysis-hypotension usually occur at a lower relative blood volume than the following episodes during that same dialysis session. Thirty-eight percent of these patients had equal RBV-crit (±1%), and the majority had a higher RBV-crit at the first episode than at the following episodes during the same dialysis session. Therefore, our concern about the variability of RBV-crit is moderate. With several other causes leading to interdialytic morbid events a certain variability of a single factor, even if it is predominant, seems to be inevitable. Nevertheless, a control algorithm, which decreases the ultrafiltration rate when the actual relative blood volume approaches the RBV-crit of the patient should be more appropriate than neglecting an individual limit and should avoid many of the hypotensive episodes.

Whether an individual RBV-crit is a useful concept or not, can only be confirmed by comparison of a blood volume controlled ultrafiltration rate with individual RBV-crit vs a fixed ultrafiltration rate in the same patient. The benefit for the patients becomes visible with the highly significant reduction of symptomatic hypotension, e.g. in the preliminary results of the international multicentre study IVORIC [2–4].

Conflict of interest statement. None declared.

Fresenius Medical Care  
Jutta Passlick-Deetjen  
Bad Homburg  
Germany  
Email: jutta.passlick-deetjen@fmc-ag.com
Bone mineral density in the distal radius and increased risk of fractures in haemodialysis

Sir,

We read with great interest the recent article by Urena et al. [1], which correlated the markedly decreased Z-score in the mid-radius with subsequent development of fractures. As opposed to the prevalent use of BMD, T-scores of $<-2.5$ to define osteoporosis [2], the Z-score is commonly used to identify the number of standard deviations for the mean of a healthy, age and gender-matched normal population and may be a better indicator for identification of osteoporosis in patients receiving steroids, post-transplant and those with chronic diseases.

Quite controversial is the preferred site for measurement of bone density. It is commonly felt that the risk of fracture at a particular site is dependent on the BMD at that site [3]. Most authorities recommend the measurement of BMD at the spine and hip as fractures in these areas have the most adverse effects on the individual’s health. However, recent studies have revealed that forearm fractures are more important indicators of subsequent osteoporotic fractures at the hip (×2.7-fold in men, ×1.6-fold in woman) [4]. Following a forearm fracture, the cumulative incidence of any fracture was 55% at 10 years and 80% by 20 years [4]. However, strangely enough, this fact is under-recognized and only 17% receive any form of pharmacological osteoporosis intervention within a year of sustaining a distal forearm fracture and visiting their physicians for a non-orthopaedic reason [5]. The current study illustrates that the forearm Z-score is markedly decreased in haemodialysis patients. Though not clearly demonstrated in this study, extrapolation of information from population studies of osteoporotic fractures, BMD density in the distal radius in the first quartile could increase their risks for future hip fractures to ~8/1000 patient years [6].

The role of biochemical markers of bone turnover is often indicated when the BMD is in the middle tertile, and any value above the upper limits of normal in pre-menopausal women is often an indicator to consider pharmacological treatment [7].

The current study highlights an often ignored site of bone mineral loss, i.e. the distal radius, and the increased propensity for fracture despite a normal BMD score at the hip and spine.

Conflict of interest statement. None declared.

Reply

Sir,

We would like to thank Ghosh for his interesting comment to our article [1]. Indeed, 80% of our patients had osteoporosis when taking into account the T-score at the mid-radius. Moreover, as previously reported, the 30% prevalence, since the onset of haemodialysis (HD) treatment, of symptomatic skeletal fractures in this population of HD patients is extremely high. Unfortunately, we cannot completely agree with his first comment as we could not see any difference in the Z-score at the mid-radius between patients with or without fracture, most certainly because the majority of these patients already had a reduced Z-score at this particular site. Only the Z-score at the total body, which also mostly represents cortical bone, was significantly lower in patients with fractures.

However, after reviewing the data again, we have found that the number of patients sustaining fractures was significantly greater when the Z-score at the mid-radius was lower than $-2.5$ (11/21) than when the total body Z-score was lower than $-2.5$ (2/21) (Figure 1). In conclusion, as in patients with normal renal function, low bone density at the mid-radius appears to be associated with peripheral fractures. However, for unexplained reasons, the Z-score at the total body better discriminates patients with fractures in the present small cohort of HD patients.

Conflict of interest statement. None declared.