Probing ‘dry weight’ in haemodialysis patients: ‘back to the future’

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In the early 1960s, correcting fluid overload and hypertension were already a priority target assigned to haemodialysis treatment adequacy by the Scribner’s group [1, 2]. In the early days of renal replacement therapy, anti-hypertensive drugs were scarce and the control of extracellular fluid volume by sodium depletion was the only efficient tool for controlling severe and/or accelerated hypertension in end-stage renal disease patients [3]. The concept of volume-dependent hypertension elaborated by the Seattle’s group led to a very practical issue summarized in the ‘dry weight’ achievement [4]. In its basic definition, the dry weight is clinically established and usually reflects the lowest post-dialytic weight that a patient can tolerate without intra-dialytic symptoms and hypotension in the absence of fluid overload while achieving a near normal arterial pressure. Over time, the beneficial effects of adhering to a tight and regular control of the dry weight have been largely proved and considered as a crucial adequacy target for haemodialysis patients [5]. The leading nephrologists of Tassin trained at the Seattle school have kept this important message in mind and transformed this simple concept into a ‘doctrine’ group for their daily clinical practice [6]. In keeping with this concept, dialysis treatment schedules were customized to specific patient needs and to haemodynamic tolerance and then justifying the regular use of long slow dialysis treatment programmes (6–8 h thrice weekly). This old-fashioned haemodialysis modality was also accompanied by a strict salt-restricted diet and the use of a low dialysate sodium concentration. Based on this simple and pragmatic policy, the Tassin group has clearly proved that the regular correction and strict control of fluid volume by dialysis were able to control adequately the arterial pressure in the vast majority of dialysis patients (>80%) without requiring the use of anti-hypertensive drugs. In addition, the same group showed that a tight control of dry weight over a long period of time was associated with a significant reduction in the risk of cardiovascular mortality [5].

Several other studies found the association between chronic fluid overload and higher risks of all-cause and cardiovascular mortalities in haemodialysis patients [7, 8]. It is now well recognized that fluid and sodium homeostasis might be restored in dialysis patients, by lengthening the dialysis treatment time and/or by customizing dialysis treatment programmes (more frequent dialysis sessions, longer treatment time, isolated and/or adjunctive ultrafiltration, blood volume control, etc.) [9, 10]. Furthermore, the correction of the fluid overload has several beneficial effects on the long-term outcomes: it facilitates arterial pressure control; it minimizes the use of anti-hypertensive drugs; it reduces the left ventricular volume and left ventricular mass; it reduces the microinflammation [11] and it improves patient survival [12, 13]. This is why assessing and probing the dry weight should remain a priority objective in the quest for treatment adequacy.

In contrast to this physiological approach and customized renal replacement therapy, in the 1970s and 1980s, a different model of haemodialysis has been developed based on short and highly efficient dialysis, easily integrated into the patient’s daily life, more productive and profitable but no longer meeting the individual needs [14, 15]. Interestingly, ultrashort treatment schedules (<3 h thrice weekly) assessed in the 1980s in order to push back the barriers of treatment time have failed to achieve fluid volume control [16]. All these facts tend to prove that sodium and fluid volume removal are related to patient haemodynamic tolerance and compliance to a low-salt diet and are more easily achieved with a weekly longer treatment time [17].

Today, for economical and practical reasons, short haemodialysis treatment schedules based on 4-h thrice-weekly sessions still represent the most common form of haemodialysis worldwide. In addition, to comply with societal changes and patient requests, the medical prescription to dialysed patients has become more liberal, the dietary salt restriction has been neglected, anti-hypertensive drugs have been used more frequently than the older and the strict compliance to dry weight has been forgotten. Such differences in dialysis practices are clearly shown in large observational studies [18]. For example, comparison of a large amount of registry data shows that the use of anti-hypertensive drugs varies from 20 to 90% of patients according to the countries or dialysis facilities [19]. In addition, the extensive use of anti-hypertensive drugs is frequently supported by fallacious arguments claiming that these drugs have some specific cardioprotective effects. In this perspective, it is interesting to note that some cohort studies have reported some beneficial effects of agents acting on the renin–angiotensin axis (beta-blockers or angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers) but...
no prospective randomized controlled study has been able to confirm these facts [19, 20]. In contrast, most of the studies investigating the control of extracellular fluid overload by increasing the ultrafiltration and/or reducing dietary salt intake have confirmed the beneficial effects on both arterial pressure control and cardiac features [21–23]. The recent randomized controlled study (DRIP study) conducted in hypertensive haemodialysis patients has clearly shown the superiority of ultrafiltration in reducing arterial pressure. Several long-term observational or interventional studies conducted in Turkey by Ozkahya’s group have also shown that strict adherence to dry weight policy and reduced dietary salt intake permitted the reduction of arterial pressure and improvement of cardiac features (both morphological and functional parameters). However, the benefits of strict volume control for improving the survival of haemodialysis patients need to be further investigated in prospective randomized controlled studies.

According to our present knowledge, it is now clear that chronic sodium excess and fluid overload are among the most potent factors of the pathogenesis of cardiovascular diseases in haemodialysis patients. By designing an adequate treatment programme and refining ultrafiltration, fluid overload is a preventable and correctable risk factor in dialysed patients [24]. A recent study by Agarwal et al. reported the improvement in left ventricular mass index with probing dry weight in haemodialysis patients. In this perspective, assessing and probing the ideal dry weight should be considered as an efficient and cost-effective opportunity for improving outcomes of dialysis patients [25].

In a recent study, Chazot et al. [26] have analysed the impact of fluid overload on the survival of haemodialysis patients. For this purpose, they conducted a comparative 6.5-year follow-up study in two dialysis facilities (Tassin, F; Giessen, G) with different clinical practices and dialysis treatment schedules. A selected haemodialysis population from Tassin (F) was used as normohydrated (n = 50) control, while the comparative population from Giessen (G) was divided into two groups on the basis of pre-dialysis hydration status: normohydrated (n = 123) and hyperhydrated (n = 35) groups. All patients had an objective fluid assessment performed by whole-body bioimpedance spectroscopy at the beginning of the study. Patients received treatments without modifications according to local practices, 3 × 5–8 h, Qb = 220–250 mL/min with low-salt diet in Tassin and 3 × 4–5 h, Qb = 420 mL/min without salt restriction in Giessen. Based on bioimpedance assessment, most of the control patients from Tassin were found normohydrated (delta hydration status, AHS; ΔH = 0.25 ± 1.15 L). They were comparable to the normohydrated group of Giessen (ΔH = 0.8 ± 1.1 L) but significantly different from the hyperhydrated group (ΔH = 3.5 ± 2.1 L). Multivariate adjusted all-cause mortality, using Tassin as reference, was significantly higher in the hyperhydrated group of Giessen (hazard ratio = 3.41), while no differences were noted in the normohydrated groups of Tassin and Giessen. In this study, some interesting findings need to be underlined: firstly, the pre-dialysis arterial pressure of the Tassin group was significantly lower than in the paired normohydrated group of Giessen (127/68 versus 139/76 mmHg); secondly, ~50% of hyperhydrated patients detected by bioimpedance had a normal or low arterial pressure. The authors conclude that chronic fluid overload is an independent and prominent risk factor of mortality in haemodialysis patients. Probing the dry weight by bioimpedance is a quite appealing strategy and therapeutic approaches to preventing or correcting fluid overload are desirable in this high-risk population. In addition, pre-dialysis arterial pressure tends to be a poor indicator of fluid overload in ~50% of the haemodialysis population, confirming previous observations [27]. Nevertheless, there were some caveats in this study. Firstly, the study was a retrospective analysis. The hydration statuses of haemodialysis patients were only evaluated at the beginning of the study without longitudinal assessment follow-up of hydration status during baseline and follow-up after 6.5 years. However, the individual patient’s dry weight could fluctuate over the time with hyperhydration or normohydratation that might be different from the hydration status evaluated at the beginning of the study. Secondly, in the Tassin group, patients were recruited with specific criteria including haemodynamically stable patients with dry weight adjustment and without the recent histories of hospitalization and the use of anti-hypertensive agents. However, similar exclusion criteria were not applied to the study population in the Giessen group. Patients with low comorbidities (Tassin group) might be used as reference population leading to a selection bias in the study. Thirdly, only the presence of diabetes mellitus was mentioned, whereas other comorbidities, especially cardiovascular morbidities, were not. Cardiac parameters were also not assessed in the study. Other than the presence of diabetes mellitus, the overall mortality rates were not adjusted for major comorbidities, particularly cardiovascular ones. Indeed, the interest of regular assessment of hydration status by bioimpedance spectroscopy for improving the survival of haemodialysis patients needs to be addressed in future prospective randomized controlled studies.

The study by Chazot et al. raises another concern and needs further investigation to confirm the safety of the policy of ‘drying’ excessively haemodialysis patients. Based on their findings, it can be concluded that normovolaemic patients during the pre-dialysis periods should be hypovolaemic at the end of the dialysis session. Symptoms and signs of hypotension caused by increasing the ultrafiltration, such as seizure, dizziness and chest pain, have been observed in hypertensive haemodialysis patients adhering to strict dry weight control [21, 28]. As recently nicely illustrated by McIntyre’s group, severe hypovolaemia and/or intra-dialytic hypotensive episodes expose haemodialysis patients to ischaemic tissue injury [29, 30]. Cardiac stunning resulting from these repetitive myocardial ischaemic injuries may lead to progressive fibrosis causing left ventricular dysfunction [31, 32]. Gut ischaemia, another side effect of intra-dialytic hypotension, could be associated with endotoxin translocation, cytokine release and induction of microinflammation [33]. Particular caution should be exerted in high-risk haemodialysis patients with high ultrafiltration rates (UFRs) to prevent occurrence of severe hypovolaemic and/or hypotensive episodes. The association between UFRs (>10–12 mL/kg/h) and higher risks of mortality in haemodialysis patients has been well established...
in several studies [34, 35]. Therefore, UFR should be reduced and individualized to the patient’s haemodynamic tolerance, vascular refilling capacity and dialysis treatment prescription (dialysis time and frequency, isolated ultrafiltration and haemodiafiltration) [36] or technical dialysis options (blood volume monitoring, dialysate sodium concentration and temperature monitoring) should be adopted to improve the situations [37–39].

In conclusion, correction of fluid volume excess is crucial for controlling hypertension (volume-dependent hypertension in ~80% of dialysis patients) and reducing cardiovascular mortality of haemodialysis patients. Achieving the optimal dry weight is a key tool in the quest of restoring extracellular fluid balance in haemodialysis patients. Probing the dry weight was largely dependent on clinical subjective estimate until recently. New bedside non-invasive tools such as the bioimpedance spectroscopy monitor used in this study will provide more objective information on volume status and will guide physicians in the quest for dry weight [40–42]. However, one should remember that the more sophisticated tool will not replace the clinical assessment and judgement made by an expert physician.

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(See related article by Chazot et al. Importance of normohydration for the long-term survival of haemodialysis patients. Nephrol Dial Transplant 2012; 27: 2404–2410.)

References

17. Shaldon S. Is salt restriction more important than the length of dialysis in the miracle of Tassin? Int J Artif Organs 2004; 27: 813–814

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