kidney and dialysis

Opinion

A Personal and Practical Answer from a Clinical Perspective

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Abstract: Restoring sodium and fluid homeostasis in hemodialysis (HD) patients is a crucial aim to reduce cardiovascular burden and improve global outcome. This crucial target is achieved at maximum in one quarter of HD patients according to a recent study. Sodium and fluid balance relies on a multitarget approach involving dietary salt restriction, dialysis salt mass removal and eventually residual kidney function. Salt mass removal in hemodialysis relies on ultrafiltration (convective sodium), the dialysate–plasma sodium gradient (diffusive sodium) and total treatment time. Manual dialysate sodium prescription has three major aims: dialysate–plasma sodium gradient; sodium mass removal target; hemodialysis tolerance and patient risks. In the future, automated dialysate sodium adjustment by HD machine will facilitate this aim.

Keywords: fluid overload; hypertension; cardiovascular mortality; sodium removal; fluid removal; dialysis adequacy

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Citation: Canaud, B. A Personal and Practical Answer from a Clinical Perspective. *Kidney Dial.* **2021**, *1*, 149–151. https://doi.org/10.3390/kidneydial1020019

Academic Editors: Manfred Hecking, Peter Kotanko and Jochen G. Raimann

Received: 15 November 2021
Accepted: 16 November 2021
Published: 1 December 2021

Dialysate Sodium Prescription from a Personal Clinician Perspective

Restoring sodium and fluid homeostasis in hemodialysis patients is a crucial aim to reduce cardiovascular burden and improve global outcome [1–3]. Unfortunately, this target is achieved in only one quarter to one third of patients according to recent studies using objective quantification tools (multifrequency bioimpedance) [4,5].

Sodium and fluid balance in dialysis patients relies on a multitarget approach involving dietary salt restriction, dialysis salt mass removal and eventually residual kidney function [4,6]. Salt mass removal in hemodialysis relies on three components: firstly, convective sodium flux dragged isotonically through ultrafiltration; secondly, diffusive sodium flux driven by the dialysate–plasma sodium gradient and flow conditions [7]; thirdly, treatment time, which integrates sodium fluxes and conditions, thus the total salt mass removed per session [8]. In this context, dialysate sodium concentration plays a particular role in sodium management since it acts both on sodium mass removal and on plasma tonicity changes [9]. This dual action should be kept in mind for choosing dialysate sodium prescription.

From my perspective, manual dialysate sodium prescription should be based on three major components: firstly, the dialysate–plasma sodium gradient; secondly, the sodium mass removal target; thirdly, hemodialysis tolerance and patient risks.

(1) Dialysate–plasma sodium gradient prescription rather than dialysate sodium concentration alone should be the rule for achieving a more personalized dialysis prescription approach [7]. There is no medical rationale to prescribe dialysate sodium on a fixed concentration reflecting dialysis facility practices, except when a central dialysate delivery system is used. In all cases, predialysis plasma sodium concentration or mean value over the last month should be used as a reference value. Manual dialysate sodium alignment to predialysis plasma sodium concentration should be reconsidered on a monthly basis. Considering this mode of prescription, one may easily delineate three prescription options: positive gradient (or hypertonic dialysis), neutral gradient (or isonatremic dialysis) or negative gradient (or hypotonic dialysis). For safety reasons, positive gradient will range between +1 and

+5 mmol/L, and negative gradient will range between −1 and −5 mmol/L. Isonatremic dialysis will range between −1 and +1 mmol/L. A recent Japanese study has shown the cardiovascular risk associated with a high dialysate–plasma gradient and large dialysis changes [10]. Clinical indications for such prescription are described in the next paragraph.

(2) The sodium mass removal target is the second main component for defining this prescription [11,12]. When hypertension, fluid overload or sodium and congestive heart failure are of concern, a negative gradient should be preferred. In this condition, sodium mass removal may be increased by 10% to 20% per session. This may also address the concern of tissue salt retention. When intradialytic hypotension or intradialytic morbidity due to hypovolemia is of concern, a positive gradient will be preferred. Hypertonic dialysis may facilitate vascular refilling and prevent the occurrence of critical hypovolemia and intradialytic morbidity. Dialysate sodium prescription may also be integrated in a more cardiovascular protective approach including feedback control of volemia [13] and/or negative thermal balance [14]. Fine tuning of the dialysate–plasma sodium gradient will be probed over time until outcome and reconsidered on a monthly or quarterly basis based on the hemodynamic profile and dialysis tolerance. In addition, a more objective way of assessing extracellular fluid overload (i.e., multifrequency bioimpedance spectroscopy, lung ultrasound, cardiac biomarkers) should be considered to prevent potentially long-term sodium accumulation due to a positive gradient [6].

(3) Hemodialysis tolerance, including patient risks and/or patient perception, is the third component for dialysate sodium prescription [15,16]. In fragile patients (i.e., cardiac patients, elderly, diabetic, liver disease, brain disease, malnutrition), hemodynamically unstable patients presenting with high intradialytic morbidity (hypotension, headache, cramps, paradoxical hypertension) or uncompliant patients (i.e., large interdialytic weight gain, hyponatremic patients), isonatremic dialysis conditions will be preferred [17,18]. In those cases, isonatremic conditions or dialysate sodium aligned to plasma sodium will improve hemodialysis tolerance by reducing osmotic shift and preventing end-organ damage, in particular related to brain swelling or shrinking [19].

Dialysate sodium concentration prescription may also be integrated in a more sophisticated approach including sodium and ultrafiltration profiling. However, a more interesting and innovative approach of dialysate sodium prescription has been developed and validated recently, relying on an automated sodium balancing module [20,21]. In the future, such a tool embedded in a dialysis machine will facilitate dialysate sodium management by providing a direct quantification of sodium mass removal and by aligning dialysate sodium concentration to plasma sodium according to an individualized prescription [22]. Further outcome-based studies are required to validate clinical values of such a new tool.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The author declares no conflict of interest.

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