JOURNAL OF NEPHROLOGY & KIDNEY DISEASES Open Access

SCIENTIFIC LITERATURE

REVIEW ARTICLE

What does an Adequate Dialysis dose in the Elderly Mean? Usefulness of Kt/V, Functional Status and Incremental Dialysis in Elderly Patients

Juan F. Macías-Núñez[1*], Javier Deira[2], Miguel A. Suarez[3], Laura Piquero[2], and Carlos G. Musso[4]

[1]Emeritus Professor of Nephrology and Director FIIPERVA Chair Faculty of Medicine. University of Salamanca. Spain
[2]Department of Internal Medicine, Division of Nephrology, San Pedro de Alcántara Hospital, Spain
[3]Department of Internal Medicine, Division of Nephrology, Virgen Del Puerto Hospital, Spain
[4]Nephrology Division. Ageing Biology Unit. Hospital Italiano de Buenos Aires. Argentina

ARTICLE INFO

Article history:
Received: 13 July 2017
Accepted: 28 August 2017
Published: 06 September 2017

Keywords:
Kt/V;
Dialysis;
Elderly patients

Citation this article: Macías-Núñez JF, Deira J, Suarez MA, Piquero L, Musso CG. What does an Adequate Dialysis dose in the Elderly Mean? Usefulness of Kt/V, Functional Status and Incremental Dialysis in Elderly Patients. J Nephrol Kidney Dis. 2017; 1(1):112.

Correspondence:
Juan F. Macías-Núñez,
Emeritus Professor of Nephrology and Director FIIPERVA Chair Faculty of Medicine. University of Salamanca. Spain;
Email: jfmacias@usal.es

ABSTRACT

What is currently considered an adequate hemodialysis dose for young patients has been calculated by Gotch equation which is mainly based on urea generation rate, volume of urea distribution, total body water, and water compartmental distribution. However, all these parameters are usually modified by ageing and senescence (abnormal ageing). Because of that in the present article, it is hypothesized that hemodialysis prescription in elderly patients, particularly in those affected by geriatric syndromes, should require not only an individualized Kt/V value, where incremental dialysis could be the way to achieve it, but also the periodic evaluation of the functional status (frailty assessment) which could be even a better marker than Kt/V for adjusting dialysis dose in this group.

Introduction

In order to assess the Kt/V utility in elderly dialysis patients, it should take into account the procedure usually used to prescribe and monitor the hemodialysis dose in young patients but paying attention particularly to those aspects which can lead to inexact prescriptions in aged patients. Firstly, which of the parameters usually take into account for calculating the dialysis dose differs between young (18-64 years old), elderly (65-79 years old), and ≥80 years old) very old patients?

Secondly, which dialytic parameters are usually changed if elderly patients suffer from the geriatric syndromes (dementia, falls, immobility, incontinence)? These conditions are also known as "geriatric giants" since they have high prevalence and significant health impact in the elderly [1]. Thirdly, does the current dialytic prescription usually take into account the structural and physiological changes that ageing induces to those organs involve in homeostasis, such as the heart, lungs and liver? Fourthly, is there a specific dialysis dose for old and very old patients?

Finally, have all these questions a precise answer? Clearly, they have not. The most common method worldwide currently used for calculating the haemodialysis (HD) dose is the formal variable-volume single-pool urea kinetic

model of Gotch (standard Kt/V), although this method has been questioned [2,3].

In this sense, what is currently considered an adequate hemodialysis dose for young patients has been calculated by Gotch equation which is mainly based on: urea generation rate, volume of urea distribution, total body water, water compartmental distribution [4-6]. However, all these parameters suffer changes induced by normal ageing, and abnormal ageing (senescence) too [7-9]:

• Urea generation rate: it depends on protein diet and basal metabolism, both usually reduced in old individuals, and much more in malnourished elderly and in the oldest old.

• Total body water (TBW): it is progressively reduced along ageing, changing from around 65% in young people to around 50% in male, and 40% in female elderly people. Thus, old people have 10-20% lower TBW content compared to young people. Conversely, TBW is relative high (60%) in elderly patients suffering from immobility syndrome.

• Volume of urea distribution: it is related to TBW, so it is reduced in the elderly

• Water compartmental distribution: it has been reported that the lower TBW content in the elderly is at the expense of the intracellular compartment. However, in untreated intellectual impairment syndrome, an alteration in intracellular, extracellular and TBW has been found. Deterioration of verbal learning has been associated with an increase in TBW, while the decline in verbal ability has been associated with a shift of water from the extracellular to the intercellular compartment.

Based on the above analyzed ageing related changes, it could reasonably question why there is currently no different dialysis dose for dialyzing young and old patients?

It seems that stable elderly patients could be treated using at least a 10% lower dialysis dose (for instance eKt/V of 1.1), while water balance requires more precise care in those elderly suffering from geriatric syndromes.

Additionally, there are other important variables which should also be taken into account, such as body surface area (BSA), and residual diuresis (RD).

Regarding BSA, it usually suffers a progressive reduction and modification of its composition along ageing. Thus, BSA and lean body mass (LBM) estimation should be interpreted cautiously in old people since they have a greater proportion of fat in their body weight compared to young people [10-12]. BSA and LBM are particularly reduced in very old individuals, sarcopenic, and frail elderly patients [13,14].

In regards with RD, it is known that its preservation is crucial even in dialysis patients since it is significantly associated to longer survival. This phenomenon has been attributed not only to a better handling of water balance but also to a better uremic toxins excretion by tubular secretion [15]. In these sense, creatinine and urea renal handling, for calculating the residual renal function, differs between young and elderly people, since urine excretion of urea and creatinine in elderly people is higher and lower respectively, compared to young people [7,16,17].

Because of the criticisms to Kt/V, alternative methods for scaling dialysis such as body weight, body surface area, resting energy expenditure, high metabolic rate organ mass, liver size and bioelectrical resistance have been proposed [11-20]. Regarding the alternative methods proposed, extensive validation of them is lacking and/or their validity has not been proved in large studies yet, and they are based on indirect measurements of the amount of urea removed from patients during their dialysis session [20].

We have been looking for any evidence in the literature which could answer at least one of the previously exposed questions regarding which is the appropriate dialysis dose in elderly patients, and we have found that there was no study which had specifically determined which were the optimum and the minimum dialysis dose in old people, and which were these doses in elderly dialysis patients who suffer from any of the geriatric syndromes. In Europe, it is consider a standard dialysis dose an eKt/V of 1.2 three times per week [21]. The European Renal Best Practice Group (EBPG) based on

the available evidence, it has determined that a hemodialysis dose of an eKt/V < 1 three times per week is associated to bad prognosis. Consequently, the EBPG recommends a hemodialysis dose of an eKt/V ≥1.2 (standard Kt/V ≥1.4) per session in a thrice-weekly program [21,22]. However, the HEMO study failed to document any beneficial outcome between an eKTV of 1.05 and 1.45. Moreover, this study suggests that to achieve adequate targets is more important than the target level itself [20]. Another clinical problem which requires to be solved is the difficulty usually found in achieving the prescribed hemodialysis dose in elderly patients since advanced age is an unchangeable limiting factor, that together with other well-known impediments, such as catheter use, female sex, high body weight, short dialysis times and low Qb, avoid all to achieve the prescribed dialysis dose [23]. Moreover, hypotension arrhythmias, cramps, vomiting also avoid achieving the prescribed hemodialysis dose in elderly dialysis patients [24]. Because of the above exposed facts, it seem reasonable to admit that an eKt/V of 1.2 as the only reference value, is not the best way to dose and control dialysis quality in the elderly with CKD undergoing renal replacement therapy.

Due to the lack of information on this topic we have started two research lines in order to learn more about it.

On one hand, Doctors Deira and Suarez are performing a prospective multi-center study to evaluate the possible advantages and disadvantages of individualized dialysis dose in elderly patients, using the concept of incremental hemodialysis. They have followed incident elderly patients who started hemodialysis at the Nephrology Division of San Pedro de Alcántara and Virgen del Puerto Hospital. In this study, serum urea, creatinine, and electrolytes were assessed twice a month, while urine volume and renal urea clearance (KRU) were assessed monthly. Since 2012, Deira et al. prescribed to elderly patients suffering from end-stage renal disease a progressive regimen of once-weekly hemodialysis to incident patients with KRU > 4 ml/min/1,73 m² in 40 patients (14 male), and 20 of them ≥ 75 years old (mean age: 81 year, range: 75-81). Hemodialysis dose was increased in those patients who required an ultrafiltration rate >13 ml/kg/hour for achieving volume control, or whose KRU fell below < 4 ml/minute/ 1.73m² [25]. In a preliminary analysis, they documented that this dialytic procedure allow very elderly patients to avoid serum electrolytes alterations, abrupt overhydration, as well as to maintain good functional status and wellbeing (personal communication).

On the other hand, Drs Musso, Macías-Núñez, Jauregui et al. (Frailty in Dialysis Study Group) have recently started a prospective multi-center study in order to evaluate the impact of dialytic treatment on functional status in the elderly, as well as to explore if the functional evaluation could be useful for guiding dialysis dose prescription in this population. This study is based on two geriatric principles:

First: Since the goal of any treatment in geriatrics is to maintain the patient in the best functional status (physical, psychical, and social); consequently any dialytic treatment given to elderly patients should evaluate periodically its effect on patients´ functional status [13].

Second: Since complexity is an essential condition for making the organism capable of keeping homeostasis, and ageing is characterized by a progressive loss of complexity, then this loss of complexity makes old individuals frail. Additionally, current epidemiology has documented that detrimental social-behavioral factors such as isolation, influence overall mortality, particularly in the elderly. The idea is that global functional-social variables could be better prognosis markers than the organ specific variables in frail population. Thus, it has been proposed that these variables should be considered at time of prescribing drugs or medical procedures in the elderly, and they should also be considered for following patient´s response to prescribed organ replacement therapies in the aged group [14].

Conclusion

In the present article, it is hypothesized that hemodialysis prescription in elderly patients, particularly in those

affected by geriatric syndromes, should require not only an individualized Kt/V value, where incremental dialysis could be the way to achieve it, but also the periodic evaluation of the functional status (frailty assessment) which could be even a better marker than Kt/V for adjusting dialysis dose in this group. Prospective studies are currently performed in order to evaluate the validity of this proposal.

Declaration of Interest

Authors declare no competing commercial/financial interests in the present publication

Acknowledgnment

We would like to acknowledge to Drs Gustavo Aroca (Colombia), Vincenzo Bellizzi (Italy), Adrian Covic (Romania), Periklis Dousdampanis (Greece), Vassilis Liakopoulos (Greece), Maria E. Portilla-Franco (Spain), Fernando Tornero-Molina (Spain), Konstantina Trigka (Greece) for their participation in the Frailty in Dialysis Study Group (FDSG).

References

1. Musso CG. (2002). Geriatric nephrology and the 'nephrogeriatric giants'. Int Urol Nephrol. 34: 255-256.

2. Sargent JA, Gotch FA. (1980). Mathematic modeling of dialysis therapy. Kidney Int. Suppl. 10: S2-S10.

3. Michaels AS. (1996). Operating parameters and performance criteria for hemodialyzers and other membrane-separation devices. Trans Am Soc Artif Int Organs. 12: 387–392.

4. Spalding EM, Chandna SM, Davenport A, Farrington K. (2008). Kt/V underestimates the hemodialysis dose in women and small men. Kidney Int. 74: 348–355.

5. Lowrie EG. (2008). Prescribing and monitoring hemodialysis dose. Aug. 74: 262-264.

6. Jenkin, PG. (2009). The illogic of Kt/V. Kidney International. 75: 337.

7. Musso CG, Alvarez Gregori J, Jauregui JR, Macías Núñez JF. (2012). Creatinine, urea, uric acid, water and electrolytes renal handling in the healthy oldest old.World J Nephrol. Oct 6. 1: 123-126.

8. Edelman IS, Leibman J. (1959). Anatomy of body water and electrolytes. Am.J.Med. 27: 256-260.

9. Musso CG, Liakopoulos V, Pangre N, DiTrolio J, Jauregui R, et al. (2009). Int Urol Nephrol. Renal physiology in elderly persons with severe immobility syndrome. 41: 437-441.

10. Edmon C.S. Jasani, BM. Simth T. (1975). Total body potassium and body fat estimation in relation to height, sex, age, malnutrition and obesity. Clin.Sci.Molec. Med. 48: 431-440.

11. Basile C, Vernaglione L, Lomonte C, Bellizzi V, Libutti P, et al. (2010). Comparison of alternative methods for scaling dialysis dose. Nephrol Dial Transplant. 25: 1232–1239.

12. Daugirdas JT, Depner TA, Greene T, Kuhlmann MK, Levin NW, et al. (2008). Surface-area normalized Kt/V: a method of rescaling dialysis dose to body surface area - implications for different-size patients by gender. Sem Dial. 21: 415–421.

13. Musso CG, Jauregui JR, Macías Núñez JF. (2015). Frailty phenotype and chronic kidney disease: a review of the literature. Int Urol Nephrol. 2015 Nov. 47: 1801-1807.

14. Musso CG, Vilas M, de Quirós FG, Núñez JF. (2016). The Importance of Evaluating Frailty and Social-behavioral Factors for Managing Drugs and Dialysis Prescription in Elderly Patients. Drug Res (Stuttg). Apr. 66: 223-224.

15. Masereeuw R, Mutsaers HA, Toyohara T, Abe T, Jhawar S, et al. (2014). The kidney and uremic toxin removal: glomerulus or tubule? Semin Nephrol. 2014 Mar. 34: 191-208.

16. Hecking E, Bragg-Gresham JL, Rayner HC, Pisoni RL, Andreucci VE, et al. (2014). Haemodialysis prescription, adherence and nutritional indicators in five European countries: results from the Dialysis Outcome and Practice pattern study (DOPPS). Nephrol Dial Transplant 2004. 19: 100-107.

17. Daugirdas JT, Depner TA, Greene T, Kuhlmann MK, Levin NW, et al. (2008). Surface-area normalized Kt/V: a method of rescaling dialysis dose to body surface area—implications for different-size patients by gender. Sem Dial 2008. 21: 415–421.

18. Daugirdas JT, Levin NW, Kotanko P, Depner TA, Kuhlmann MK, et al. (2008). Comparison of proposed alternative methods for rescaling dialysis dose: resting energy expenditure, high metabolic rate organ mass, liver size, and body surface area. Sem Dial 2008. 21: 377–384

19. Macías Núñez JF, Ribera Casado JM, Fuente del Rey M. (2008). Biology of the aging process and its clinical consequences. In Macías Núñez J, Cameron S, Oreopoulos D (editors.) New York. Springer. 2008: 55-92.

20. Tattersall J, Martin-Malo A, Pedrini L, Basci A, Canaud B, et al. (2007). EBPG guideline on dialysis strategies. Nephrol Dial Transplant 2007. 22: ii5–ii21

21. Farrington K, Covic A, Nistor I, Aucella F, Clyne N, et al. (2017). Clinical Practice Guideline on management of older patients with chronic kidney disease stage 3b or higher (eGFR<45 mL/min/1.73 m2): a summary document from the European Renal Best Practice Group. Nephrol Dial Transplant. 2017 Jan 1. 32: 9-16.

22. Greene T, Daugirdas J, Depner T, Allon M, Beck G, et al. (2005). Association of achieved dialysis dose with mortality in the haemodialysis study: an example of dose targeting bias. J. Am. Soc. Nephrol. 16: 3371-3380.

23. Maduell F, Ramos R, Palomares I, Martín-Malo A, Molina M, et al. (2013). ORD Group. Impact of targeting Kt instead of Kt/V. Nephrol Dial Transplant. 28: 2595-2603.

24. Brown EA, Finkelstein FO, Iyasere OU, Kliger AS. (2017). Peritoneal or hemodialysis for the frail elderly patient, the choice of 2 evils? Kidney Int. 91: 294-303.

25. González-Sanchidrián S, Deira J, Suárez MÁ. (2017). Progressive Hemodialysis: Is it the Future, or the Present? Semin Dial. 2017 Jan. 30: 80.