Saudi J Kidney Dis Transpl 2008;19(5):842-846

Saudi Journal of Kidney Diseases and Transplantation

Renal Data from Asia-Africa

Laboratory Variables and Treatment Adequacy in Hemodialysis Patients in Iran

Vahid Pourfarziani, Fahimeh Ghanbarpour, Eghlim Nemati, Saeed Taheri, Behzad Einollahi

Nephrology Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran

ABSTRACT. This study aims to evaluate the laboratory variables in Iranian hemodialysis patients. We studied 338 patients in 6 dialysis centers around the country. Sixty four percent of the patients were anemic, and the mean of hemoglobin levels in the patients was 9.6 ± 1.9 g/dL. Women had a significantly higher prevalence of anemia (p= 0.004); however, considering the absolute hemoglobin values, there was no significant difference between genders (p> 0.05). The mean urea reduction ratio (URR) and Kt/V in the patients were 62.6 ± 12.8 and 1.17 ± 0.31, respectively. Hyperphosphatemia and hyperkalemia were observed in 50% and 58%, respectively. We conclude that our study demonstrated a relatively high prevalence of anemia and hyperphosphatemia, however, a surprisingly good dialysis urea clearance in the Iranian hemodialysis patients. We should exploit more effort to maintain hemoglobin and serum phosphate levels within the target ranges.

Keywords: Adequacy, Hemodialysis, Kidney, Renal, Failure, Chronic, Nutritional, Mineral

Introduction

The prime aim of chronic dialysis is to remove the nitrogenous metabolic end-products and excess fluid.[1] However, several abnormal laboratory variables such as blood levels of hemoglobin, urea clearance, albumin, creatinine, and electrolytes have been identified as predictors of survival in patients undergoing maintenance hemodialysis (HD),[2-4] and high prevalence of such variables exists among patients undergoing maintenance hemodialysis.

Anemia is a frequent complication observed in HD patients, and it can result in adverse clinical outcomes, such as a reduction in tissue oxygenation, an increase in cardiac output, a reduction in the capacity for exercise, left ventricular hypertrophy, angina pectoris, congestive heart disease, fatigue, and attenuation of immunity. Moreover, anemia reduces patients' quality of life, prevents rehabilitation, and con-

Reprint request and correspondence to:

Prof. Behzad Einollahi
Nephrology Research Center
Dialysis Department
Baqiyatallah Hospital, Mullasadra St.,
P.O. Box 14155-6437,
1435915371, Tehran, Iran
E-mail: Behzad.einollahi@gmail.com

Table 1. Variables measured in the study population

Variables	Minimum	Maximum	Mean	Std. Deviation
Creatinine (mg/dL)	2	19	9.00	3.12
Albumin (g/dL)	2	11	4.3	0.79
Potassium (mmol/L)	2	11.5	5.42	1.08
Phosphorus (mg/dL)	2	14	5.94	1.77
Calcium (mg/dL)	5	13	8.68	1.24
Pre dialysis urea (mg/dL)	2	227	66.61	41.4
Post dialysis urea (mg/dL)	3	96	31.53	21.8
Weight (Kg)	11	96	62.81	14.5

tributes to a shortened life span.[3-5] Studies have demonstrated increased risk of mortality in chronic kidney disease patients who continued to maintain severe anemia.[5-6]

Urea-reduction ratio, which is an indicator for dialysis dose and a predictor of HD patients' survival, is recommended by Dialysis Outcomes Quality Initiative (DOQI) guidelines to be > 65%.[7] Receiving URR < 65% was significantly associated with a higher mortality risk.[8]

Recent investigations have implicated poor control of mineral metabolism and blood electrolytes balance as independent risk factors for cardiovascular disease (CVD) and mortality in HD patients, such as hyperphosphatemia, hypophosphatemia, hypercalcemia, hypocalcemia, and hyperkalemia. Moreover, the adequacy of nutrition as assessed by serum albumin and creatinine is a critical determinant for the morbidity and mortality among HD patients.[2]

We aim in this multicenter countrywide study to evaluate the prevalence of disturbances among Iranian HD patients.

Materials and methods

We enrolled in this cross sectional study 6 dialysis centers around the country; two centers from the capital city and the remaining centers were from Shiraz (Southern Iran), Ahvaz (South Western Iran), Mashhad (North Eastern Iran), and Kermanshah (Western Iran). Overall, 338 patients were entered into analysis. The following most recent variables were extracted for each patient's file: serum hemoglobin, serum albumin, serum potassium, serum calcium, serum phosphate, serum creatinine, and serum urea level before and after HD sessions. Urea reduction ratio was calculated using the formula: 100 x (1 - (urea before HD/urea after HD). Single pool Kt/V (spKt/V) was also calculated using the formula:[9,10]
Kt/V = (0.026 x PRU) - 0.460.

Statistical analysis

We analyzed the data using SPSS v.13.0 (SPSS Inc., Chicago, IL, USA). We compared the means and 95% confidence intervals (CI) of the different groups of patients. Independent sample *t*-tests and analysis of variance (ANOVA) were used for comparison of continuous variables. Pearson's exact test and Chi-square analysis were used to compare categorical variables. Two sided P values < 0.05 was considered significant.

Results

Of the 338 study HD patients, 192 (57%) were males, 171 (50.5%) were 50 years of age and older, 56(16.5%) had previously failed renal transplantations, and 175 (52%) were dialyzed against bicarbonate dialysate.

Ninety six percent of the patients with anemia received erythropoietin therapy. The mean hemoglobin (Hgb) levels for the all the study patients was 9.6 ± 1.9 g/dL (range: 5-15 g/dL), and 64% of patients revealed Hgb levels < 11 mg/dL. Women had a significantly higher prevalence of anemia than men (75% of women versus 56% of men; p= 0.004), however, there were no significant difference between genders in the mean levels of hemoglobin (p> 0.05).

The mean urea reduction ratio (URR) and Kt/V for the study patients were 62.6 ± 12.8 (range: 14.0-87.5) and 1.17 ± 0.31 (range: 0.31-1.82), respectively.

Hyperphosphatemia and hyperkalemia were observed in 50% and 58%, respectively. Measured variables are shown in table 1.

Discussion

Anemia, mainly caused by a reduction in blood erythropoietin concentration, contributes to most of the disabling symptoms in patients on maintenance hemodialysis.[11] However; there is no consensus on the target hemoglobin levels in hemodialysis patients. Although Hgb levels of 11 g/dL is generally considered as minimum target, there is evidence that hemoglobin target values should be individualized according to levels of kidney function, dialysis duration, and cardiovascular disease.[12-14] In our study, 64% of HD patients revealed Hgb < 11 g/dL and a mean of 9.8 g/dL, which is relatively low for this patient population considering the recommended target ranges and surveys from other parts of the world.[15-17] In contrast to studies from Spain,[15] USA[16] and Europe[17] in which female patients demonstrated a significantly lower mean hemoglobin level compared to males, our study revealed that women and men had approximately equivalent mean hemoglobin levels (9.5 ± 2.1 vs. 10.0 ± 2.2 g/dL, respectively; $p > 0.05$); however, similar to reports from other parts of the world, women had a significantly higher prevalence of anemia than men.

Surrogates of nutrition such as the serum albumin and creatinine concentrations can predict of survival for HD patients.[2-4] Moreover, half of the HD patients have some degree of malnutrition.[17-20] However, once adequate dialysis has been attained, patients usually regain a healthy appetite, and well-nourished patients are likely to have high predialysis concentrations of blood urea nitrogen ≥ 80 mg/dL and serum creatinine ≥ 8 mg/dL.[21] In our study, we found that the patients enjoyed a good nutritional status with acceptable serum albumin and creatinine levels in 97.5% and 65% of patients, respectively. Some studies suggested that serum albumin and creatinine concentration are directly and inversely correlated with Hgb levels, respectively.[22] In our study, we found no correlation of hemoglobin with serum albumin and creatinine levels.

Inadequate urea clearance by HD can result in malnutrition, anemia, and functional impairment with increased risk of hospitalizations, morbidity, and mortality.[23,24] In our study population, the URR and Kt/V levels were close to the recommended ranges (> 65% and 1.3 for URR and Kt/V, respectively),[23] and we found no correlation of the URR with Hgb levels ($p > 0.05$).

Hyperphosphatemia is highly prevalent among HD patients, as almost 40% of the U.S. HD population has a serum PO4 greater than 6.5 mg/dL,[25] and hyperphosphatemia and hypercalcemia have been associated with increased cardiovascular events.[26] Our patients manifested similarly high prevalence of hyperphosphatemia. This may alert us to pay more attention to lowering serum phosphate levels in our HD patients. In addition, there also was a relatively low prevalence of hypercalcemia in our studied population (about 6%). Moreover, contrary to previous studies, which correlated higher serum phosphate levels with lower hemoglobin levels,[27] we found no relationship between these two variables ($p > 0.05$).

Hyperkalemia is also a frequent electrolyte disturbance in HD patients. In our study, about 58% of patients had serum potassium levels over 5.2 mg/dL, which is comparable to other studies.[28] Although it is speculated that HD patients tolerate high serum potassium levels,[29] for the extreme importance of hyperkalemia, we should not underestimate the vital importance of maintaining serum potassium concentration within the normal range.

We conclude that our hemodialysis population has a relatively high percentage of inadequately controlled anemia and hyperphosphatemia but good urea clearance parameters. We should exploit more effort to maintain hemoglobin and serum phosphate levels within the target ranges.

References

1. Foley RN, Parfrey PS, Sarnak MJ. Epidemiology of CV disease in CRD. J Am Soc Nephrol 1998;

9(Suppl 12):S16-23.
2. Owen W, Lew N, Liu Y, Lowrie E, Lazarus J. The urea reduction ratio and serum albumin concentration as predictors of mortality in patients undergoing hemodialysis. N EngI J Med 1993;329(14):1001-6.
3. Lowrie E, Lew N. Death risk in hemodialysis patients. The predictive value of commonly measured variables and an evaluation of death rate differences between facilities. Am J Kidney Dis 1990;15(5):458-82.
4. Lowrie E, Lew N. Commonly measured laboratory variables in hemodialysis patients: Relationships among them and to death risk. Semin Nephrol 1992;12(3):276-83.
5. Ma JZ, Ebben J, Xia H, Collins AJ. Hematocrit level and associated mortality in HD patients. J Am Soc Nephrol 1999;10(3):610-9.
6. Ofsthun N, Labrecque J, Lacson E, Keen M, Lazarus JM. The effects of higher hemoglobin levels on mortality and hospitalization in HD patients. Kidney Int 2003;63(5):1908-14.
7. Hemodialysis Adequacy Work Group. NKF-DOQI practice guidelines for hemodialysis adequacy. Am J Kidney Dis 1997;30(suppl 2):S15-66,.
8. Wolfe RA, Dhingra RK, Hulbert-Shearon TE, Port FK. Association between urea reduction ratios and standardized mortality (SMR) and hospitalization (SHR) ratios in dialysis units.. J Am Soc Nephrol 2000;11:A1723.
9. Daugirdas JT. Second generation logarithmic estimates of single-pool variable volume Kt/V: An analysis of error. J Am Soc Nephrol 1993; 4(5):1205-13.
10. Daugirdas JT, Depner TA. A nomogram approach to hemodialysis urea modeling. Am J Kidney Dis 1994;23(1):33-40.
11. Eschbach JW, Abdulhadi MH, Browne JK, et al. Recombinant human erythropoietin in anemic patients with end-stage renal disease: Results of a phase III multicenter clinical trial. Ann Intern Med 1989;111(12):992-1000.
12. Stevens L, Stigant C, Levin A. Should hemoglobin be normalized in patients with chronic kidney disease? Semin Dial 2002;15(1):8-13.
13. Portolés J, López-Gómez JM, Aljama P. Anemia management and treatment response in patients on hemodialysis: The MAR study. J Nephrol 2006;19(3):352-60.
14. Coladonato JA, Frankenfield DL, Reddan DN, et al. Trends in anemia management among US Hemodialysis Patients. J Am Soc Nephrol 2002;13(5):1288-95.
15. Locatelli F, Pisoni RL, Combe C, et al. Anemia in haemodialysis patients of five European countries: Association with morbidity and mortality in the Dialysis Outcomes and Practice Patterns Study (DOPPS). Nephrol Dial Transplant 2004;19(1):121-32.
16. Drueke TB, Locatelli F, Clyne N, et al. Normalization of hemoglobin level in patients with chronic kidney disease and anemia. N Engl J Med 2006;355(20):2071-84.
17. Marcén R, Teruel JL, de la Cal MA, Gámez C. The impact of malnutrition in morbidity and mortality in stable haemodialysis patients: Spanish Cooperative Study of Nutrition in Hemodialysis. Nephrol Dial Transplant 1997; 12(11):2324-31.
18. Madore F, Wuest M, Ethier JH. Nutritional evaluation of hemodialysis patients using an impedance index. Clin Nephrol 1994;41(6): 377-82.
19. Thunberg BJ, Swamy AP, Cestero RV. Cross-sectional and longitudinal nutritional measurements in maintenance hemodialysis patients. Am J Clin Nutr 1981;34(10):2005-12.
20. Schoenfeld PY, Henry RR, Laird NM, Roxe DM. Assessment of nutritional status of the National Cooperative Dialysis Study population. Kidney Int 1983;23(suppl 13):80-8.
21. Pastan S, Bailey J. Dialysis therapy. N Engl J Med 1998;338(20):1428-37.
22. Madore F, Lowrie EG, Brugnara C, et al. Anemia in hemodialysis patients: Variables affecting this outcome predictor. J Am Soc Nephrol 1997;8(12):1921-9.
23. The USRDS Dialysis Morbidity and Mortality Study (Wave 1). In: Renal Data System. USRDS 1996 annual data report. Bethesda, Md.: National Institute of Diabetes and Digestive and Kidney Diseases, April 1996,45-67.
24. Hakim RM, Breyer J, Ismail N, Schulman G. Effects of dose of dialysis on morbidity and mortality. Am J Kidney Dis 1994;23(5):661-9.
25. Block GA, Hulbert-Shearon TE, Levin NW, Port FK. Association of serum phosphorous and calcium x phosphate product with mortality risk in chronic hemodialysis patients: A national study. Am J Kidney Dis 1998;31(4): 607-17.
26. Block GA, Klassen PS, Lazarus JM, Ofsthun N, Lowrie EG, Chertow GM. Mineral metabolism,

mortality and morbidity in maintenance hemo-dialysis. J Am Soc Nephrol 2004;15(8):2208-18.
27. Kestenbaum B, Sampson JN, Rudser KD, et al. Serum phosphate levels and mortality risk among people with chronic kidney disease. J Am Soc Nephrol 2005;16(2):520-8.
28. Aslam S, Friedman EA, Ifudu O. Electro-cardiography is unreliable in detecting poten-tially lethal hyperkalaemia in hemo-dialysis patients. Nephrol Dial Transplant 2002;17(9):1 639-42.
29. Szerlip HM, Weiss J, Singer I. Profound hyperkalemia without electrocardiographic manifesttations. Am J Kidney Dis 1986;7(6): 461-5.