The Role of Metabolic Acidosis on Malnutrition in Patients with Maintenance Hemodialysis

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ABSTRACT

Background: Malnutrition and metabolic acidosis are frequently observed in patients receiving regular hemodialysis. Both conditions, malnutrition and metabolic acidosis are linked to an increased mortality rate in chronic hemodialysis patients.

Objectives: To clarify the role of hemodialysis and metabolic acidosis on malnutrition in patients receiving maintenance hemodialysis.

Patients and Methods: This is a cross-sectional study, includes 64 patients on regular hemodialysis and had metabolic acidosis. Subjective Global Assessment was used to evaluate patients' nutritional conditions and urea reduction ratio to assess hemodialysis adequacy. According to urea reduction rate , patients were allocated into two groups: group (A) includes patients with adequate dialysis and group (B) includes those with inadequate dialysis, then group (A) further subdivided into two groups according to their nutritional status, group (A1) with well-nourishment and group (A2) malnourishment. Comparing group (A) vs (B) and group (A1) vs (A2) in order to determine the relationship of metabolic acidosis and hemodialysis adequacy to malnutrition.

Results: Malnutrition was common in those patients as 32 patients (50%) had malnutrition, while just 2 patients (5.56%) with adequate hemodialysis (group A2) had malnutrition , 20 patients (71.43%) of those with inadequate hemodialysis (group B) had malnutrition.

Conclusions: Inadequate hemodialysis rather than metabolic acidosis contribute sto malnutrition in chronic hemodialysis patients.

Keywords: Hemodialysis, Malnutritional, Metabolic acidosis, Renal Failure.

دور الحماض الأيضي في سوء التغذية لدى المرضى الذين يخضعون لغسيل الكلى المداوم

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الخلاصة

الخلفية: الحماض الاستقلابي شائع بين مرضى غسيل الكلى وقد يترافق مع سوء التغذية، كما ينتشر سوء التغذية على نطاق واسع في المرضى أثناء غسيل الكلى المستدامه ، ويرتبط كل من الحماض الاستقلابي وسوء التغذية بزيادة معدل الوفيات.

الأهداف: تحديد دور غسيل الكلى المناسب في سوء التغذية لدى المرضى الذين يعانون من غسيل الكلى المنتظم.

المواد والطرق: هذه دراسة تصميمية مقطعية، تشمل ٦٤ مريضاً يخضعون لغسيل الكلى المنتظم. (HD) ويعانون من الحماض الأيضي، نحن نستخدم "التقييم العالمي الذاتي (SGA)" لتقييم الحالة الغذائية للمرضى ونسبة تخفيض اليوريا (URR) لتقييم مدى كفاية غسيل الكلى. وفقًا لـURR ، تم تخصيص المرضى إلى مجموعتين: المجموعة (أ) تضم المرضى الذين يعانون من غسيل كلى مناسب والمجموعة (ب) تضم أولئك الذين يعانون من غسيل كلى غير كافي، ثم المجموعة (أ) تنقسم إلى مجموعتين وفقًا لحالتهم الغذائية، المجموعة ((A1) مع التغذية الجيدة وسوء التغذية من المجموعة .(A2) قمنا بمقارنة المجموعة (A) مع (B) والمجموعة (A1) مقابل(A2) ، وفقًا لمتوسط مستوى بيكربونات المصل لديهم لتحديد العلاقة بين الحماض الاستقلابي وملاءمة غسيل الكلى وسوء التغذية.

النتائج: سوء التغذية هو نتيجة شائعة لدى مرضانا (٥٠%)، أولئك الذين لديهم غسيل كلوي مناسب تحسنت حالتهم التغذوية) المجموعة (A1: 94.4% بينما ٥٦.٥% فقط من المرضى الذين لديهم غسيل كلى مناسب) المجموعة (A2 و٤٣.٧١% من أولئك الذين يعانون من نقص التغذية. غسيل الكلى (المجموعة ب) كان يعاني من سوء التغذية.
الاستنتاجات: غسيل الكلى المناسب هو العامل الأكثر أهمية الذي يؤثر على الحالة التغذوية في حين أن الحماض الأيضي كان له تأثير ضئيل أو معدوم على تغذية مرضى غسيل الكلى المزمن.

الكلمات المفتاحية : غسيل الكلى، الحماض الغذائي، الأيض، الفشل الكلوي

INTRODUCTION

One of the vital functions of the kidneys is excretion of high acid load [1]. In the early stage of chronic renal failure, the kidney can compensate for high acid load by increase excretion per nephron in the remaining functioning nephrons until the glomerular filtration rate decrease to less than 40-50 m1/min/1.73 m^2, at this point the compensatory mechanisms fail and metabolic acidosis (MA) becomes apparent (MA defines as PH < 7.35 and serum bicarbonate (HCO3) < 22 mmol/l) [2].

The Serum bicarbonate level of most patients at the time of initiation of hemodialysis (HD) range between 12-20 mmol/l [3]. MA that not resolved by medical intervention is one of the main indications for HD [4].

Although HD improves MA, large number of patients still have mild to moderate MA which occurred at least in part due to inadequate HD [5].

However, some patients with adequate HD still had mild to moderate MA [6]. Malnutrition occurs because of muscle protein degradation by a hyper-catabolic state of MA , different mechanisms responsible for hyper-catabolic state among patients complaining from end stage kidney disease (ESKD) [7-9].

MA had many deleterious effects like metabolic bone disease [10] , disturbance of myocytes function and heart failure [11], disturbance of red blood cell function and decreases the oxygen liberation to the tissues [12], decrease respiratory reserve and respiratory muscle fatigue [13] and increased mortality rate [14,15] .

Otherwise, malnutrition was frequent in HD patients (20-70%) according to the tool used to evaluate malnutrition [16 ,17] and this malnutrition associated with increased mortality [18].

In addition to MA that contribute to malnutrition, other etiologies of malnutrition in HD patients include : HD considered as a chronic inflammatory state [19] , amino acid loss during HD [20,21] , anorexia in HD patients [22,23] , HD itself was hyper-catabolic state [23] , contact of blood with bio- incompatible membrane during HD [24] and over restriction of diet [25].

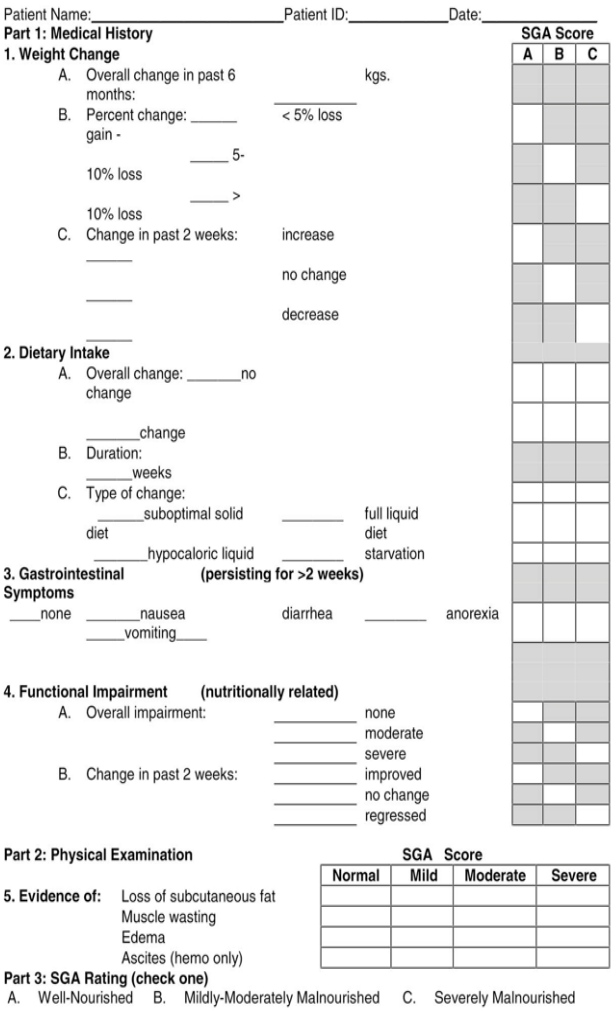
HD adequacy associated with improved mortality rate for HD patients [26].

The Aim of Current Study

To verify the role of metabolic acidosis on the development of malnutrition in maintenance hemodialysis patients.

PATIENTS AND METHODS

This is a cross sectional study conducted in HD unit of Ibin–Sina Teaching Hospital in Mosul city. The present study includes (64) patients, (33) males and (31) females, all patients were on maintenance HD for more than (3) months with MA (pH< 7.35 and serum HCO3 < 22 mmol/L). All patients asked about their ages, duration of HD, underlying cause of ERKD , detailed dietary history, unintentional weight loss, presence of gastrointestinal symptoms, stressful conditions related to surgery or intercurrent illness, functional capacity, physical examination for evidence of wasting of muscles and fat in addition to the presence of nutritionally related ascites and oedema. The “Subjective Global Assessment (SGA)” which was validated tool for assessment of malnutrition in HD patients . A 5 points score (SGA) was adopted and all patients classified in to 3 groups according to SGA : SGA- A (well nourished), SGA -B (mild to moderate malnourished) and SGA -C (severe malnourished) (Fig 1) [27,28] .


Patient Name:_____ Patient ID:_____ Date:_____

Part 1: Medical History — SGA Score: A | B | C

1. Weight Change

A. Overall change in past 6 months: _____ kgs.

B. Percent change: _____ gain - < 5% loss

_____ 5-10% loss

_____ > 10% loss

C. Change in past 2 weeks: _____ increase

_____ no change

_____ decrease

2. Dietary Intake

A. Overall change: _____no change

_____change

B. Duration: _____weeks

C. Type of change: _____suboptimal solid diet _____ full liquid diet

_____hypocaloric liquid _____ starvation

3. Gastrointestinal Symptoms **(persisting for >2 weeks)**

____none _____nausea _____vomiting____ diarrhea _____ anorexia

4. Functional Impairment **(nutritionally related)**

A. Overall impairment: _____ none _____ moderate _____ severe

B. Change in past 2 weeks: _____ improved _____ no change _____ regressed

Part 2: Physical Examination — SGA Score

	Normal	Mild	Moderate	Severe
5. Evidence of: Loss of subcutaneous fat				
Muscle wasting				
Edema				
Ascites (hemo only)				

Part 3: SGA Rating (check one)

A. Well-Nourished B. Mildly-Moderately Malnourished C. Severely Malnourished

Figure 1: 5 points Subjective Global Assessment (SGA) sheet

A pre-dialysis and post-dialysis venous blood sample were taken to measure blood urea and calculate URR (URR = (1 - [post dialysis blood urea ÷ pre dialysis blood urea]) to assess HD adequacy as well as PH and serum HCO3 were measured to diagnose MA , peripheral or central venous blood PH , HCO3 and urea can be used instead of arterial readings [29] .

Patients classified into two main groups: Group A= those with adequate HD (mean URR 0.71) and MA(mean HCO3 17.74 mmol/l) , Group B= those with inadequate HD (mean URR 49.41) and MA(mean HCO3 19.27 mmol/l).

Group A subdivided into two groups: Group A1= those with adequate HD , MA and well nutrition , Group A2= those with adequate HD , MA and malnutrition.

We compared Mean serum HCO3 between group A and group B, and between group A1 and group A2 to verify the contribution role of MA and HD on malnutrition .

RESULTS

Total number of patients was 64, with 33 males (52%) and 31 females(48%) , mean age of patients is 48 year (30-66 year) , mean duration of HD is 43 months (36-50 months) , mean blood PH is 7.263 and mean serum HCO3 is 18.41 mmol/l . Most common cause of ESKD in patients was Diabetes Mellitus which responsible for 44% of cases. 50% of patients found having malnutrition by SGA and all of them had SGA score mild- moderate malnutrition (SGA-B).

Group A include 36 patients (56.25%) and group B include 28 patients (43.75%)

Characteristics of patients in groups A & B as well as groups A1 & A2 are included in tables 1 and 2 respectively.

Table (1) Characteristics of group A & B

	Group A	Group B
Total Number	36	28
Male Female	17 (47.22 %) 19 (52.78%)	16(57.14 %) 12(42.86%)
Mean URR (%)	70.99	49.41
Mean HCO3±SD (mmol/l)	17.74± 4.08	19.27±2.37
SGA-A	34 (94.44%)	8 (28.57)
SGA-B	2 (5.56%)	20 (71.43%)

Table (2) Characteristics of group A1 & A2

	Group A1	Group A2
Total No.	34	2
Male	16 (47 %)	1 (50%)
Female	18(53 %)	1 (50%)
MeanS.HCO3±SD (mmol/l)	17.84±17	16.00 ±1.4

Comparison of serum HCO3 between groups (A Vs B) and (A1 Vs A2) are statistically insignificant with p- value 0.082 and 0.543 respectively . This finding indicate that metabolic acidosis had little or no effect on nutritional status (table 3)

Table (3) Comparison of S. HCO3 between different groups

Group	No	Mean HCO3 ± SD (mmol/l)	p- value
A	36	17.74±4.08	0.082
B	28	19.27 ± 2.37	
A1	34	17.84 ± 17	0.543
A2	2	16.00 ± 1.4	

DISCUSSION

malnutrition was common among patients on regular HD (20–61.8%) as 50% of studied patients had mild to moderate malnutrition(SGA-B). This is in concordance with many studies that suggest malnutrition is a common condition in chronic HD patients [16,17]. Different methods are used to assess the effectiveness of HD in patients with ESKD , one of the well known method is measurement of URR that adopted in the present study to assess HD adequacy, most of the references suggest that URR > 0.65 indicate adequate dialysis [30] .

Thirty six patients (56.25% , group A) out of 64 had adequate HD, with a mean URR of 0.71, malnutrition was rare in such group as only 2(5.56%) out of 36 had malnutrition, while malnutrition was common in those with inadequate dialysis (20 out of 28 patients (71.43%) , group B) , these finding indicated that adequate HD rather than MA had an important factor that contribute to nutritional status in HD patients , that is in concordance with other studies [26,31] . Appetite, nutritional intake, and nutritional status are all correlated with adequate dialysis; conversely, inadequate dialysis is a major contributor to both malnutrition and death [32]. Comparing serum HCO3 between group A1 (mean HCO3= 17.84 mmol/l) and group A2 (mean HCO3 = 16 mmol/l) showed a difference in their mean HCO3 but it was statistically not significant (p-value 0.543).This indicate that MA had little consequence on nutritional status; also when comparing S. HCO3 between group A and group B the result was again statistically insignificant (17.74 vs 19.27 p value 0.082), despite of high percentage of malnutrition in group (B) compared with group (A) (71.43% vs 5.56% respectively) this finding conclude that metabolic acidosis had little or no effect on nutritional status and the mild to moderate acidosis that present in patients' group with adequate dialysis result from improved appetite , nutrition (SGA- A in group A is 94.44%) and increase their protein intake which overcome the catabolic effect of MA , It seems that the lower serum HCO3 in patients with adequate HD was caused by a faster rate of endogenous acid generation from protein oxidation. This finding supported by many studies that concluded MA had contribute minimally to malnutrition in patients on regular HD [6,33,34] .

Adequate HD not just improve the nutritional status of HD patient but also improve the quality of life and reduction in kidney failure related morbidities and mortalities [35] .

CONCLUSIONS

HD adequacy is an important factor that improve nutritional status in HD patients while metabolic acidosis had little or no effect on the nutritional status.

RECOMMENDATION

We recommend frequent assessment of HD adequacy and nutritional status for patients on regular HD .

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