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A Comparison of Diagnostic Value of Anthropometric Indices with Laboratory Criteria for Malnutrition Detection in Chronic Undergoing Hemodialysis Patients

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Abstract: Malnutrition is a main problem in undergone hemodialysis patients. Early diagnosis is important and life saving. Using anthropometric indices can help for rapid diagnoses. This study was done to compare anthropometric indices with biochemical parameters. We monitored 60 patients that underwent hemodialysis in Shaheed Rahnemoon hospital. Biochemical parameters and anthropometric indices were measured and compared. On the basis of anthropometric indices, BMI, TSF, MAC; malnutrition prevalence was 18.3%, 21.7%, 28% respectively. By using biochemical parameters include albumin, transferrin, cholesterol, Creatinine and white blood cell Count malnutrition prevalence was 8.3%, 15%, 13%, 10%, 8.3% respectively. Only MAC index has a positive correlation with serum transferrin (r=0.169, p=0.002). Sensitivity and specificity of this test is 40% and 53.33% respectively. Its Negative predictive value is 84.21%. MAC index can be used as a reliable test for rule outing malnutrition in chronic undergone hemodialysis Patients.

Key words: Malnutrition, anthropometric indices, biochemical parameters, hemodialysis

Introduction

Chromic renal failure (CRF), is a pathophysiologic process with multiple etiologies, resulting in the Inexorable attrition of nephron number and function and frequently leading to end stage renal disease. This condition results from diseases like Diabetes Mellitus, Arterial Hypertensions, and Glomerulonephritis and polycystic kidney disease (Karl Skoreki *et al*., 2001).

Pursuant to CRF, patient involve a collection of symptom and clinical sign due to accumulation of urea and others nitrogen metabolite in body (Karl Skoreki *et al*., 2001), therefore the patient permanently dependent upon renal replacement therapy (dialysis or transplantation) in order to subsistence (Karl Skoreki *et al*., 2001 ; William and Walser, 2000).

CRF patients that undergone chronic hemodialysis, involve in protein and energy malnutrition with different etiologies and mechanisms (Curtis, 2000). Old and middle-aged patient are more confronted with PEM than the youths, also their function level and life quality decline dramatically (Fouque *et al*., 2002). Eventually PEM lead to a catabolic state that result in a negative nitrogen balance (Gowers, 2003). Some biochemical parameters of nutritional state in uremic patients that can be mentioned are serum concentration of albumin, prealbumin, cholesterol transferrin white blood cell count, that all of them decline (Kuhlman *et al*., 2003). Other parameters like serum total nitrogen level and CRP are proposed (Fouque *et al*., 2002) .

Several studies have reported on that survival rate of dialyzing patients has strong interrelationship with nutritional parameters, (Kuhlman *et al*., 2003; Burrowes *et al*., 2003; Ikizier *et al*., 2002; Lewandrowski and Lewandrowski, 1999; Karl Skoreki *et al*., 2001; Mareen *et al*., 2003) namely, what more malnutrition more patient mortality.

Anthropometry is the science of measuring the human body as to height, weight, and size of component parts including measurement of skinfolds. Anthropometric indexes include height ,weight, head circumference ,body mass index (BMI), Triceps skinfold thickness (TSF), Mid upper arm circumference (MAC);that in this study has been compared with biochemical malnutrition criteria (Qureshi *et al*., 2002).

Whereas the incidence of chronic, noninfectious diseases like diabetes mellitus and arterial hypertension as main cause of CRF increase, it is expected that number of patient who need hemodialysis will grow; therefore paying to the problem of this group of patients has an important value. Since PEM is an important problem of undergone chronic hemodialysis patients that in one side decreases efficacy of hemodialysis and in the other side causes increment of mortality ;finding a rapid ,simple and economy method for a well-timed diagnosis; is the first step. As ,recurrent laboratory tests are time consuming and expensive ,using anthropometric criteria that are accessible and economy can be helpful.

In this study we compared diagnostic value of anthropometric indexes with biochemical parameters of malnutrition in chronic hemodialysis undergone patient, if it be valid and reliable, will be used as substitute or complementary method for early diagnosing of malnutrition in hemodyalising patients.

Materials and Methods

This descriptive-analytic cross sectional study was accomplished in hemodialysis Department of Shahid

Table 1: Frequency of patients according on sex and age

Age	Male	Female	Total
>20	0	3	3
20-40	8	3	11
40-60	13	11	24
60-80	13	8	21
>80	1	0	1
Total	35	25	60

Rahnemoon Hospital related to Yazd University of Medical Sciences. Sixty patients of hemodialysis department were identified by registry. The subjects (35 males and 25 females) were aged more than 16 years .A form was designed for recording patients data that had three part consisting patient profile, anthropometric indices measure and biochemical value. In first step patient profile asked from them and simultaneously anthropometric indices were measured and recorded. Patient data was corrected by referring to patient record in hemodialysis department.

Variable like age, sex, background disease, times of dialysis per week, duration of each time dialysis, overall duration of dialysis, difference of dry weight and predialysie weight were considered.

Anthropometric indices:

1. BMI (Body Mass Index): After hemodialysis patient's dry weight was measured by scale and recorded. Height was measured by standard method .Then BMI was calculated by formula: BMI = weight (kg) / height^2 (m)
2. TSF(Thickness of Skin Fold):Triceps skin fold thickness was measured by Caliper
3. MAC (Mid upper Arm Circumference): Middle upper arm circumference was measured by clothe tape measure in the middle of distance between Acromion prominence and Olecranon prominence.

TSF and MAC were measured three times repeatedly and their means was accepted as final result. Considering A-V fistula and limb edema, measuring was accomplished on sound limb.

Defined measure of anthropometric indices was considered as malnutrition: BMI<18.99kg/m^2

MAC: about this index we used MAC chart related to normal population. Measures of less than 5 percentile of normal population considered as malnutrition.

TSF: AT first, measures of less than 5 percentile were considered as malnutrition, but since results had a great difference with other criteria we used 25 percentile measures as malnutrition.

Biochemical parameters: All blood samples were sent to Shaheed Rahnemoon hospital and Shaheed Sadooqi hospitals laboratory.

To avoiding heparinization of blood samples, all were taken before connection of patients to hemodialysis machine. Serum of blood samples were separated to measure CRP, Cr, Cholestrol, Albumin. About 1 ml of each blood samples were freezed for measuring transferrin of all samples simultaneously. Transferrin was estimated using Enzymatic method by Pars Azmoon kits. Albumin was measured using Bromocresol green method by Pars Azmoon kits. Creatinine was measured by colorimetry. This was done by Jaffe method. Cholesterol was estimated using enzymatic method by Man kits. CRP was measured using Latex Agglutination method by Bionic kits. CRP, Cholesterol, and Creatinine were measured by Selectra E.

According to authorized references defined measure of biochemical parameters considered as malnutrition:

Alb<3.5g/dl, Tf<125mg/dl, Cholestrol<150mg/dl, Cr<10mg/dl, WBC<4000/mm^3.

All calculations were done using the SPSS-10 statistical software package. Anthropometric and biochemical variables were tested using Chi-Square test. The data of albumin and WBC tested using Fisher Exact test because of low numbers of malnutrition cases. All differences were considered significant at $p<0.05$.

Results

Men and women comprised 58.3% and 41.7% of the population understudy, respectively. Mean age of men was 54.37±16.9, and for women was 49.75±18.09

The patients were undergone hemodialysis a means of 16.3 months (min 1 month and max 84 months), 37 patients underwent hemodialysis 3 times a week, 19 persons tow times a week and 4 persons one time a week. Duration of hemodialysis was 3-4 hours every time.

Mean weight of men before first hemodialysis was 66.09±13.2 kg and for women was 54.68±10.5 kg. Means of patients dry weight after last hemodialysis was 63.14±13.36 kg for men and 52.88±10.4 kg for women. After dialysis men and women weight was decreased about 2.94±4.4 kg and 1.8±9.65 kg respectively. These declines were significant (p=0.003) Range of anthropometric indices and laboratory parameters are shown in Table 2 and 3.

Table 5 presents that only according to serum albumin level malnutrition is significantly different between male and female (F=0.39). According to others parameters malnutrition is not different between male and female.

Since main goal of this study was comparison of anthropometric indices of malnutrition with laboratory parameters, we were imperative to choose one test as comparison criteria. According to references and similar study serum transferrin level (Tf) was chosen.

Between three anthropometric indices (MAC, TSF, BMI); only MAC had meaningful relationship with Tf (p=0.002), although with sex separation this was exclusive to men (p=0.013). Specificity and sensitivity of this test is low,

Table 2: Range of anthropometric indices

Anthropometric indices	Minimum		Maximum		Mean	
	Male	Female	Male	Female	Male	Female
BMI(kg/m^2)	16.33	17.85	28.71	29.21	21.95	21.97
TSF(mm)	6	11	33	41	16.71	12.22
MAC(mm)	198	197	351	650	265	259

Table 3: Range of laboratory parameters

Laboratory parameters	Minimum		Maximum		Mean	
	Male	Female	Male	Female	Male	Female
Tf	68	110	220	214	152.6	160.88
Alb	1.9	1.0	6.5	6.8	4.25	3.90
Chol	73	76	328	352	198	214
Cr	0.3	2.8	16.2	11.1	8.57	7.1
WBC	1800	3000	9999	9500	6051	5964

but negative predictive value is significant (84.21%). Others laboratory parameters also compared with serum transferrin level. Serum cholesterol and Creatinine have meaningful relationship with serum transferrin level (p=0.003, p=0.000). Both have significant negative predictive value (82.14%, 76.92%).

Discussion

Protein-Energy malnutrition in undergoing hemodialysis patients is a main problem that can cause more mortality ad morbidity. So finding a rapid method for diagnosis has a great importance. The main finding noted in this report were the frequency of malnutrition according to BMI, TSE, MAC respectively 18.3%, 21.7%, 28%. In comparison with similar studies published result (Gowers, 2003; Lewandrowski and Lewandrowski, 1999) seems that in our under study group, according to BMI and TSF frequency of malnutrition is less, but according to MAC is equal to others. Considering meaningful relationship between MAC and serum level concentration of Tf, seems that frequency of malnutrition (28%) in our patients is near to reality according to MAC. Frequency of malnutrition also was evaluated according to biochemical parameters. According to studies, (Gowers, 2003; Lewandrowski and Lewandrowski, 1999) accomplished in other countries, frequency of malnutrition have been reported about 34-52%,whereas in our study it was minimally 8.3% and maximally 28%. So in our patients malnutrition is less than other reported similar studies (Gowers, 2003; Lewandrowski and Lewandrowski, 1999) even in maximum numbers. This finding is explained by short survival of our patients that don't permit to undergo chronic hemodialysis and eventually malnutrition. In optimism state may our patients have has a good nutrition.

Frequency of hypoalbominemia (<3.5g/d) was 8.3%, which is less than Keysen (24%) and SGA (34%) studies, (Fouque *et al.*, 2002; Elizabeth *et al.*, 2000). Other finding of this repot were strong relationship between MAC and Tf (P=0.0002), after that in order settle TSE and WBC (p=0.005), Cholesterol and MAC (p=0.007), Alb and MAC (p=0.037). According to above result albumin serum level has positive correlation with BMI in malnutrition diagnosis, but is not statistically significant (p=0.424). Albumin serum level has negative correlation with TSF and have reverse relationship with each other, but is not statistically significant (P=0.461). Albumin serum level has a positive correlation (r=0.27) with MAC which is meaningful (p=0.037) , so we can use serum albumin level except MAC to diagnose malnutrition precisely.

MAC sensitivity (44.44%) is more than BMI sensitivity (11.11%). Also MAC sensitivity is more than TSE sensitivity. One of our problems in this study is using anthropometric value that belongs to American society, because of lack of our standard value. Since these indices are under influence of race, inheritance and nutrition; this can influence our result unfavorably. Other problem is that, these indices are related to healthy people; and possibly indices related to hemodialysis patients are different. Authorized references like Brenner (Kasper *et al.*, 2001) don't mentioned indices related to patients that undergo dialysis.

According to BMI as age increases, malnutrition frequency increases. Malnutrition is more prevalent in diabetic and CRF patients than other undergone hemodialysis patients. Diabetic patients that undergo hemodialysis have lower BMI than other patients this show more prevalence of malnutrition in this group of patients. What, duration of hemodialysis is longer; frequency of malnutrition decreases, because malnourished patients has less survival and die soon. Therefore, patients that have better nutrition survive for

Table 4: Frequncy of malnutrition according to anthropometric indices

Anthropometric indices	Malnutrition		No Malnutrition	
	Male (%)	Female (%)	Male (%)	Female (%)
BMI	7(20%)	4(16%)	28(80%)	21(84%)
TSF	3(8.6%)	10(40%)	32(91.4%)	15(60%)
MAC	10(29%)	7(28%)	25(71%)	18(72%)

Table 5: Frequency of malnutrition according to Biochemical parameters

Biochemical parameters	Malnutrition		No Malnutrition	
	Male (%)	Female (%)	Male (%)	Female (%)
TF	5(14.3%)	4(16%)	30(85.7%)	21(84%)
Alb	4(11.4%)	1(4%)	31(88.6%)	24(96%)
Chl	5(13.9%)	3(12.5%)	31(86.1%)	21(87.5%)
Cr	4(11%)	2(10%)	34(89%)	20(90%)
WBC	3(8.6%)	2(8%)	32(91.4%)	23(92%)

longer time and undergo more hemodialysis. Old and middle aged patients are susceptible to protein-energy malnutrition than young .Blood level of biochemical parameters related to nutritional state is not under Influence of age .Therefore, blood level of these indices doesn't differ in old and young.

This study highlight using MAC, because of high NPV (84.21%) to screen malnutrition in, undergone hemodialysis patients. Also, using TSE with MAC and BMI help to diagnose malnutrition more precisely.

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