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EFFECT OF INTERDIALYTIC WEIGHT GAIN ON DEVELOPING METABOLIC SYNDROME AND HIGH BLOOD PRESSURE IN HEMODIALYSIS POPULATION

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ABSTRACT

Background: Metabolic syndrome (MS) has prominent effect on different aspects of the health. The aim of this study was to identify whether interdialytic weigh gain (IDWG) has any effect on prevalence of MS and blood pressure (BP) in hemodialysis (HD) population.

Material and Methods: Study was performed on 300 patients in four HD centers in Iran. Inclusion criteria: age ≥16 years, at least 6 month on HD, and availability of all requested demographic and laboratory parameters. Exclusion criteria: incomplete data at analysis time and anticipated life expectancy less than 6 months. Participants were divided into two groups according to IDWG between two sessions of HD; Group-A had IDWG<3 kg and Group-B had IDWG ≥3 kg. First, prevalence of MS and its components were evaluated, then they were compared with each group.

Results: Three hundred HD patients were enrolled for the study, 173 men (57.7%) and 127 women (42.3%) with mean age of 61.7±14.2 years. Prevalence of MS was 50.3 %(151), [hypertension 83.7% (251), diabetic mellitus 52%(156), high TG level 34.3%(103), low HDL cholesterol 48.3%(145) and 41.3% (124) had abdominal obesity]. Age and duration of dialysis was not significantly associated with MS. Female had more significant MS. Male subjects had not significant abnormality in glucose metabolism (P:0.86), while females had more significant low HDL cholesterol levels (P<0.001). Hypertension, stroke and CHD were more frequent in MS group compared with no MS (79.5% vs. 64.4%, P=0.004), (30.5% vs.17.4%, P=0.008) and (27.8% vs.14.1%, P= 0.004), respectively. MS did not influence lab values, except for white blood cells count (P<0.0002).

The percentage of MS in group-A was 52.2%(59) and in group-B 49.2%(92), and there was no significant difference between two groups.

Conclusions: This study showed there is no correlation between IDWG ≥3kg and occurrence of MS. Also, there was no association between greater IDWG and occurrence of higher BP and higher rate of CHD and CVA.

Introduction

The metabolic syndrome is a complex pattern of disorders that were described in 1988(1), and its features consist of three or more of the following risk factors: waist circumference >102 cm in men or >88 cm in women; serum triglyceride level ≥150 mg/dl; HDL-cholesterol level<40 mg/dl in men or 50 mg/dl in women; BP≥130/85mmHg and/or use of antihypertensive medications; or serum glucose level ≥110 mg/dl and/or use of insulin or hypoglycemic medication

The National Cholesterol Education Program, Adult Treatment Panell III (ATP III), in 2001 defined MS as a new approach for traditional cardiovascular disease (CVD) risk factors (2). Metabolic syndrome is a major health problem in the world and is associated with the risk of developing CVD, type II diabetes mellitus and a significant risk factor in development of chronic kidney disease (CKD) in general population (3, 4). The International Diabetes Federation estimated about a quarter of the adult population has MS (5). Prevalence of MS in dialysis population still is unknown (6, 7). Cardiovascular disease remains the leading cause of death for patients with end-stage kidney disease (8); and traditional and nontraditional CVD risk factors are responsible for this occurrence (9). However, individual MS risk factors have been shown a paradoxical effect, inverse association with mortality in dialysis populations or so-called 'reverse epidemiology'(10).

The aims of this study was to clarify whether interdialytic weight gain (IDWG), between two sessions of dialysis, have any possible effect for developing MS or increased the risk of HTN and CVD in this population.

Material and methods

This study was conducted at four HD centers affiliated with two Universities of Medical Sciences in Zanjan and Tehran, Iran during March 2012. The presence of MS in 300 HD patients was investigated. Metabolic syndrome was defined according to the ATP III as the presence of three or more of the following risk factors: waist circumference >102 cm in men or >88 cm in women; serum triglyceride level ≥150 mg/dl; HDL-cholesterol level <40 mg/dl in men or 50 mg/dl in women; BP≥130/85mmHg and/or use of antihypertensive medications; or serum glucose level ≥110 mg/dl and/or use of insulin or hypoglycemic medication (1). Inclusion criteria included patients' age ≥16 years with more than 6 months on maintenance HD. Incomplete data at analysis time or anticipated life expectancy less than 6 months were considered as Exclusion criteria. All of the patients signed consent form prior to data collection. Participants were divided into two groups according to IDWG between two sessions of dialysis. Patients of Group-A had IDWG <3 kg and patients of Group-B had IDWG ≥3 kg. All examination and laboratory values were collected when patients reached to their dry weight. Dry weight was defined to achieve an edema-free state and no orthostatic hypotension at the end of HD session. Abdominal circumference was measured at the level of 1 cm above the umbilicus with the participant in the supine position. To assess CHD and stroke, medical history and medical records of patients were used. Serum pre-dialysis cholesterol, triglycerides, LDL cholesterol, HDL-cholesterol, fasting glucose, hemoglobin (Hgb), albumin (Alb), calcium, phosphor and PTH were measured. Individuals who administered antihypertensive or anti-diabetic medications were considered to have hypertension and diabetic mellitus, respectively. Also, if average of the first 2 random glucose measurements was ≥200 mg/dl, patient was classified as having abnormal glucose metabolism. To evaluate the efficacy of dialysis, KT/V was calculated. Blood pressure and weight were measured by staff of dialysis unit shortly before and after the HD session and their amount have been recorded. Duration dialysis, age, gender and the case of ESRD were extracted from patients' records and were saved. The HD protocol for all patients was: 4 hours of using hemophane membranes and blood flow rate of 300-350 mL/min with bicarbonate basis.

Statistical analysis

Statistical analyses were performed using SPSS software. Normality of data was assessed by the Kolmogorov–Smirnov test using Lilliefor's correction. Results were expressed as mean ±1 SD, frequency or median. Comparisons of demographic and clinical characteristics between two groups and those subjects with and without MS were performed using Student's t-test, chi-squared

test or the Mann–Whitney U-test, depending on data distribution. Differences in the proportions of categorical secondary outcome events between those with and without MS were evaluated by the Chi squared test. P-values <0.05 were considered significant.

Results

Three hundred HD patients [173men (57.7%), 127 women (42.3%), and mean age of 61.7 ± 14.2] were enrolled in this study. Table-1 shows demographic data.

Prevalence of MS in this study was 50.3% (151/300); and characteristics of participants are shown in Table-2. According to the Table-2, patients with MS had significantly higher BMI (p<0.001), FBS (p <0.001), and TG (p < 0.001). The most common element of the MS among patients were HTN 83.7% (251), followed by elevated low HDL cholesterol 48.3% (145), diabetic mellitus 52% (156), abdominal obesity 41.3% (124) and triglycerides 34.3% (103). Abdominal obesity was demonstrated more in diabetic mellitus (50.6%) than HTN (35%) or other patients (16.7%). Overall, prevalence of MS was not significantly associated with age, BUN, creatinine, Ca, P, Alb, HGB, and Kt/V.

Prevalence of MS in male patients was 40.5% (70/173) and in female was 63.8% (81/127). Elements of MS in male and female were as follow: HTN (m:84.4% , f: 82.7%, p=0.79), DM (m: 52.6%, f:51.2%, P:0.8), low HDL cholesterol (m: 35.8%, f: 65.4%; P< 0.001), abnormality in glucose metabolism m: 46.2%, f:47.2%, P<0.001), elevated triglyceride (m:27.2%, f: 44.1%, p=002), and abdominal obesity (m: 26.6%, f: 61.4 %, p<0.001).

As shown in Table-3, MS was diagnosed in 92 patients (49.2) in group-A (IDWG<3 kg) and 59 patients (52.2%) in group-B (IDWG ≥3 kg). There were no significant differences between two groups in terms of prevalence MS, all elements of MS, and other lab values.

Discussion

End-stage of renal disease has become a global public health challenge because of high prevalence CVD and premature death (11). At all stages of CKD, sodium and water overload may cause plasma volume expansion, LV dilatation, and LV hypertrophy; particularly in dialysis patients. IDWG is a marker of nutrition, high BP, and it influences survival of HD patients(12). It is shown that BP can be controlled by adjustments of ultratrafiltration during dialysis and by restriction of dietary sodium intake(13). Although MS appears to be a risk factor for CKD progression, but there are not much studies to evaluate prevalence of MS in dialysis subjects (14, 15).

This study evaluated the prevalence of MS in HD patients and identified whether IDWG has any effect on blood pressure, CHD and stroke. It was shown that prevalence of MS was 50.3% (151/300); MS was not associated with age, but gender had influenced on the rate of MS. Also, MS was a significant risk factor for CHD, stroke and high BP as demonstrated in Table-2. In this study, there was no significant association between serum BUN, Cr, Alb, Ca-P product, CRP, ferritin and Kt/V. It was determined that anemia and disordered bone mineral metabolism did not have any effect on development of MS in HD patients. Also, as Table-3 shows, there was no association between IDWG ≥3 Kg and developing of Ms; and IDWG≥3 Kg did not influence the amount of BP.

Some investigators have reported that tighter control of salt and fluid may affect nutritional status and inadequate intake of protein and calorie(16). However, more study is needed to determine how much salt is acceptable for HD patients to control fluid and their blood pressure.

Limitation: Amount of patients' salt consumption and BP at home during the study were not checked.

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Table 1: Demographic, Metabolic, and Laboratory Features of Patients on Hemodialysis

Variable	Value
Age, y	61.7 ± 14.2
Sex (Female, Male)	127,173
Diabetes Mellitus	156 (52%)
Cardiovascular events	63(21%)
Cerebrovascular accident	72(24%)
Metabolic features	
Hypertension	251 (83.7%)
Systolic BP, mm Hg	132.3 ± 22.3
Diastolic BP, mm Hg	77.1 ± 11.4
Low HDL	145 (48.3%)
Abnormal glucose metabolism	140 (46.7%)
Elevated triglycerides	102 (34%)
Abdominal obesity	124 (41.3)
Serum laboratory features	
Fasting Blood Sugar, mg/dL	121.4 ± 61.7
Cholestrol, mg/dL	157.7 ± 42.1
Triglyceride, mg/dL	149.7 ± 90.5
HDL, mg/dL	44.8 ± 10.6
Blood urea nitrogen, mg/dL	76.7 ± 46.5
Creatinine, mg/dL	8.7 ± 2.5
Sodium, mEq/L	138.8 ± 3.5
Potassium, mEq/L	5.21 ± 0.7
Calcium, mEq/L	9.03 ± 0.7
Phosphorus, mEq/L	4.9 ± 1.2
Alkaline Phosphatase, IU/L	313(65-2230)
iPTH, ng/L	244.5 (8 – 2000)
Serum Uric acid, mg/dL	7.0±1.49
Hemoglobin, g/dL	11.4 ± 7.6
PLT	178000 (67000 – 623000)
Ferritin, U/L Iron, mg/dl TIBC, mg/dl	618.2 ± 719.4 78(25-221) 285.5± 61.2
Alb, mg/dL	4.1 ± 2.3
AST, U/L	18(4 - 211)
ALT, U/L	17 (5 – 137)
CRP	20 (0 – 120)
Other Datas	
Duration of dialysis (months), median (min-max)	48 (12 -192)
Kt/V	1.21 ± 0.25
BMI	24.07± 4.13
Interdyalitic weight gain	2.32± 0.48

Table 2: Demographic, and laboratory features of HD patients with and without MS

variables	MS, No n: 149	MS, yes n: 151	P Value
Age(median (min – max)	65(20-90)	65(36-84)	<0.001
Gender Female male	46(30.9%) 103(69.1%)	81(53.6%) 70 (46.4%)	0.18
Diabetes Mellitus	39 (26.2%)	117 (77.5%)	<0.001
Cardiovascular events	21(14.1%)	42(27.8%)	0.004
Cerebrovascular accident	26(17.4%)	46(30.5%)	0.008
Death	44(29.5%)	56(37.1%)	0.16
Metabolic features			
Hypertension	116 (77.9%)	135(89.4%)	0.007
Systolic BP, mm Hg(median (min – max))	130 (80-200)	130(90-200)	0.43
Diastolic BP, mm Hg (median (min – max))	80 (50-100)	80 (50-110)	0.88
Low HDL	29 (19.5%)	116 (76.8%)	<0.001
Abnormal glucose metabolism	34(22.8%)	106 (70.2%)	<0.001
Elevated triglycerides	18(12.1%)	85 (56.3 %)	<0.001

Abdominal obesity	22 (14.8%)	102(67.5%)	<0.001
Serum laboratory features			
Fasting Blood Sugar, mg/dL(median (min – max))	88(60-450)	123(55-381)	<0.001
Cholestrol, mg/dL	147.3 ± 33.1	168.0 ± 47.3	<0.001
Triglyceride, mg/dL(median (min – max))	128(38 -668)	109(52-510)	<0.001
HDL, mg/dL	48.7 ± 9.8	41.0± 10	<0.001
Blood urea nitrogen, mg/dL(median (min – max))	66(19-259)	60.9(17-252)	0.46
Creatinine, mg/dL	8.8 ± 2.7	8.5 ± 2.3	0.22
Sodium, mEq/L	139.1±3.6	138.5±3.4	0.17
Potassium, mEq/L	5.3±0.8	5.13±0.6	0.08
Calcium, mEq/L	9.1±0.7	8.9±0.7	0.12
Phosphorus, mEq/L	4.92±1.3	4.89±1.1	0.8
Alkaline Phosphatase, IU/L	301(65-2230)	318(91-1708)	0.73
iPTH, ng/L (median (min – max))	254(11-2000)	225.5(8-1516)	0.24
Serum Uric acid, mg/dL	7.1±1.6	6.9±1.4	0.27
Hemoglobin, g/dL	10.8±2.0	10.7±1.7	0.68
PLT (median (min – max)	176000(80000-12200)	180000(67000-501000)	0.6
Ferritin, U/L (median (min – max)	539(12-2500)	397(13-1888)	0.056
Iron, mg/dL (median (min – max)	76(19-212)	78(25-221)	
TIBC, mg/dL	294.71±54.8	276.5±65.8	0.01
Alb, mg/dL	4.1±0.6	3.9±0.5	0.6
AST, U/L (median (min – max))	18(4-96)	18(5-211)	0.7
ALT , U/L (median (min – max))	17(7-137)	17(5-137)	0.47
CRP (median (min – max)	20(0-120)	0(0-120)	0.07
Other Datas			
Duration of dialysis (months), mean± SD (min-max)	48(12-192)	36(12-144)	0.41
Kt/V	1.18±0.25	1.24±0.24	0.06
BMI	22.9±3.7	25.2±4.2	<0.001
Weight before dialysis (kg), mean± SD	63.02±12.9	69.2±12.0	<0.001
Weight after dialysis(kg), mean± SD	60.82±12.0	66.7±11.7	<0.001
Interdialytic weight gain(kg), mean± SD	2.2±1.1	2.44±1.1	<0.07

Table 3: Comparison of weight and laboratory variables between two groups of MS

variables	Group A IDWG<3 kg	Group B IDWG≥3 kg	P Value
Age (median(min-max))	65(20-90)	65(36-84)	0.18
Gender (Female/male)	85/102	42/71	0.16
Metabolic Syndrome			
Diabetes Mellitus	98(52.4%)	58(51.3%)	0.85
Cardiovascular events	39(20.9%)	24(21.2%)	0.93
Cerebrovascular accident	45(24.1%)	27(23.9%)	0.97
Metabolic features			
Hypertension	153(81.8%)	98(86.7%)	0.26
Systolic BP, mm Hg, before HD	110{ 80-180)	120 (90-200)	0.22
Diastolic BP, mm Hg, before HD	70 (60 – 90)	80 (50-110)	0.31
Systolic BP, mm Hg, after HD	105(80-170)	110(90-200)	0.53
Diastolic BP, mm Hg, after HD	80(50-110)	70(50-90)	0.14
Low HDL	86(46%)	59(52.2%)	0.29
Abnormal glucose metabolism	89(47.6%)	51(45.1%)	0.67
Elevated triglycerides	62(33.2%)	41(36.3%)	0.58
Abdominal obesity	76(40.6%)	48(42.8%)	0.74
Serum laboratory features			
Fasting Blood Sugar, mg/dL	97(55-450)	98(60-318)	0.75
Cholestrol, mg/dL	156.5±40.8	159.8±44.2	
Triglyceride, mg/dL	111(38-533)	122(58-510)	0.12
HDL, mg/dL	45.7±11.1	43.3±9.5	0.04
Blood urea nitrogen, mg/dL	64(17-242)	62(19-259)	0.73
Creatinine, mg/dL, mg/dL	8.3±2.6	9.3±2.2	0.001
Sodium, mEq/L	139.2±3.6	138.2±3.1	0.017
Potassium, mEq/L	5.1±0.8	5.3±0.8	0.17
Calcium, mEq/L	9.0±0.7	9.1±0.7	0.54
Phosphorus, mEq/L	4.9±1.3	4.8±1	
Alkaline Phosphatase, IU/L	300 (65-1708)	328 (91-2230)	0.051
iPTH, ng/L	238(11-1532)	280(12-2000)	0.27
Serum Uric acid, mg/dL	6.9±1.5	7.2±1.4	0.1
Hemoglobin, g/dL	10.7±1.8	10.9±1.9	0.35
PLT	179000(67000-558000)	174000(80000-623000)	0.64
Ferritin, U/L	420(12-2500)	530(13-501)	0.25
Iron, mg/dL	77(19-186)	76(24-221)	0.65
TIBC, mg/dL	285.7±60.5	285.3±62.5	0.95
Alb, mg/dL	4.0±0.6	3.9±0.5	0.31
AST, U/L	18(5-96)	19(4-211)	0.26
ALT, U/L	17(5-137)	17(8-137)	0.18
CRP	20(0-120)	20(0-120)	0.95
Other Datas			
Duration of dialysis (months), median (min-max)	39.6(12-156)	48(12-192)	0.013
Kt/V	1.2±0.25	1.24±0.25	0.17
BMI	23.5±4.1	25.0±4.0	0.002
Weight before dialysis(kg), mean± SD	63.7±12.4	70.1±12.6	<0.001
Weight after dialysis(kg), mean± SD	62.1±12.3	66.7±12.4	0.002
Interdialytic weight gain(kg), mean± SD	1.66±0.7	3.41±0.7	<0.001

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