Case Report

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2022.46.007389

Effect of Hydroxymethylbutyrate Supplementation in Body Composition, Functional Capacity and Muscle Strength in One Chronic Kidney Disease Patient in Hemodialysis

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ARTICLE INFO

Received: October 06, 2022

Published: October 18, 2022

Citation: Angel Nogueira Pérez, Graciela Álvarez García and Guillermina Barril Cuadrado. Effect of Hydroxymethylbutyrate Supplementation in Body Composition, Functional Capacity and Muscle Strength in One Chronic Kidney Disease Patient in Hemodialysis. Biomed J Sci & Tech Res 46(4)-2022. BJSTR. MS.ID.007389.

ABSTRACT

Introduction: hemodialysis technique increases catabolism, which will favor the imbalance between anabolism and muscle catabolism, and may negatively affect muscle strength and functional capacity, aggravating with inactivity and lack of exercise in patients with chronic kidney disease.

Clinical Case: patient: 50-year-old female, was evaluated over 4 months with a 3-gr module of Hydroxymethylbutyrate (HMB) supplementation, after having detected a decrease in muscle strength by hand grip strength. The effect of supplementation itself and combined with physical exercise was analyzed.

Discussion: HMB supplementation produce in the patient increased muscle mass and strength, as well as increase IGF-1 as anabolic hormone. This effect is greater if supplementation is combined with the practice of physical activity on a regular basis

Keywords: Chronic Kidney Disease; Hemodialysis; Nutritional Assessment; Functional Capacity; Hydroxymethylbutyrate (Hmb); Handgrip Strenght

Introduction

The hemodialysis (HD) technique is catabolic in itself, which will favor the loss of lean mass (therefore, a decrease in muscle mass), which can negatively affect muscle strength and functional capacity, aggravating with inactivity and lack of exercise [1], therefore it is necessary to carry out continuous and correct monitoring of the nutritional status and functionality of HD patients. The assessment should include a study of body composition (using one or more of the existing tools such as bioimpedance or anthropometry), classic biochemical parameters such as albumin, prealbumin, transferrin, total lymphocytes and C-Reactive Protein (CRP), measurement of muscle strength by hand grip strebght. A complete assessment also needs to evaluate functional capacity, through functionality tests, with the aim of preventing, detecting, and delaying the decrease of the nutritional and functional status of HD patients [2,3]. Once the muscle mass and its functionality have been assessed, adequate physical activity will be recommended (physical exercise if applicable), if it is not enough or the deterioration is severe from the nutritional or muscular point of view, the use of a nutritional supplement may be necessary (complete formula or specific module for muscle) to preserve or increase muscle mass. There are publications that show that supplementation with hydroxymethylbutriate

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(HMB) can play an important role in this objective, since it helps not only preserve but even increase muscle mass, and improve nutritional status [4,5].

Clinical Case

A 50-year-old female patient undergoing renal replacement therapy on HD, in which the effect of supplementation with an HMB module is assessed, to improve physical function. Among his medical history, he presented an episode of acute renal failure due to urological sepsis in his native country at the age of 30, type 1 obesity (OB 1, body mass index (BMI) 31), glucose intolerance with glycated hemoglobin of 6.3 (possibly due to obesity), without diabetic retinopathy, dyslipidemia on statin therapy, and treatment for hypothyroidism with levothyroxine sodium. She begins renal replacement therapy (RRT) on conventional alternating HD due to autologous arteriovenous fistula, duration of session 3:30h, 3 days a week due to adequate residual renal function. Throughout these three years, the following annual assessment scheme is performed by protocol, since the patient was not dialyzed at the reference center:

Assessment of Nutritional Status

In order to adapt the HD scheme, improve the diet and try to reach the adjusted weight by trying to reduce body weight. The assessment is made by:

1. Biochemical markers: albumin, prealbumin, transferrin, inflammatory state by CRP, urea, creatinine and kt/v, insulin-like growth factor I (IGF-I) is a polypeptide hormone, which has anabolizing effects.
2. Malnutrition-inflammation scale: Subjective Global Assessment (SGA) [6] and Malnutrition-Inflammation Score (MIS) [7], determining whether or not protein energy wasting syndrome (PEW) is present, with the classic test [8] and the simple test [9].
3. Study of body composition by BIVA monofrequency bioimpedance (Akern model BIA-101).
4. Anthropometric assessment: anatomical circumferences (waist, hip, arm), for which an inextensible tape measure was used, triceps skinfold measurement (Holtain caliper (HOL-9810ND)), BMI, and arm muscle circumference and Mid-arm muscle circumference (MAMC).

Assessment of Muscle Strength and Functional Capacity

1. Muscle strength by dynamometry: assessment of muscle strength by manual dynamometry (Baseline® model 12-0240)
2. Functionality assessment using the Short Physical Performance Battery (SPPB) as a short test and a more complete study made up of the 6 Minutes' Walk (6MWT), Time Up and Go Test (TUTG) and Sit to Stand (STS) tests [10].

In one of the assessments, a decrease in weight is observed, an improvement in body composition (with a decrease in fat mass), a slight decrease in functional capacity (decreasing the score in each of the tests), and a decrease in of muscle strength by dynamometry. These discordant results (improved body composition - worse functionality - muscular strength), can be explained when the patient tells us that once hemodialysis has started, she stops working after a year, and no longer performs physical activity as such, her work involved in itself It involved physical effort, walking long distances, he had to go up and down stairs, as well as push and move heavy loads, disappearing from his routine all this activity, currently leading a sedentary life.

In order to try to recover strength and functionality, it was decided to give the patient an HMB supplement, supporting a basic program of physical activity, for three months and observe the effect on strength and muscle mass according to the following scheme:

1. First month, an oral supplement of 3g of HMB [11] was given, and the patient carried out a lifestyle similar to the previous one.
2. In the second and third month, the oral supplement of 3 g of HMB/day was provided and basic exercise recommendations for the upper body were also given, for which the Vivifrail® program was used, which is based on the results obtained in the SPPB test.
3. In the fourth month the supplement is not given, but the prescribed physical activity continues.

Results

Figure 1 shows the evolution of functional capacity, each column corresponds to one year of evaluation, the first two columns correspond to the evaluation in the first and second years on HD, the third corresponds to the evaluation in the third year, which coincides with the start of supplementation with 3g of HMB, and the fourth at 4 months after the previous assessment. With the intervention, an improvement in the results of their functional capacity is observed, obtaining better marks in the different tests of functional capacity. In the same way after the intervention with HMB, we observed an increase in muscle strength. An increase in muscle strength values is observed from the beginning to the end of the intervention (Table 1). Table 2 shows the evolution of the anthropometric measurements in the intervention period. We observed an increase in arm circumference and arm muscle circumference, with a decrease in the triceps skinfold. The study of body composition by bioimpedance (Table 3), shows that, during the 4 months of the study, an improvement was observed in the different param-

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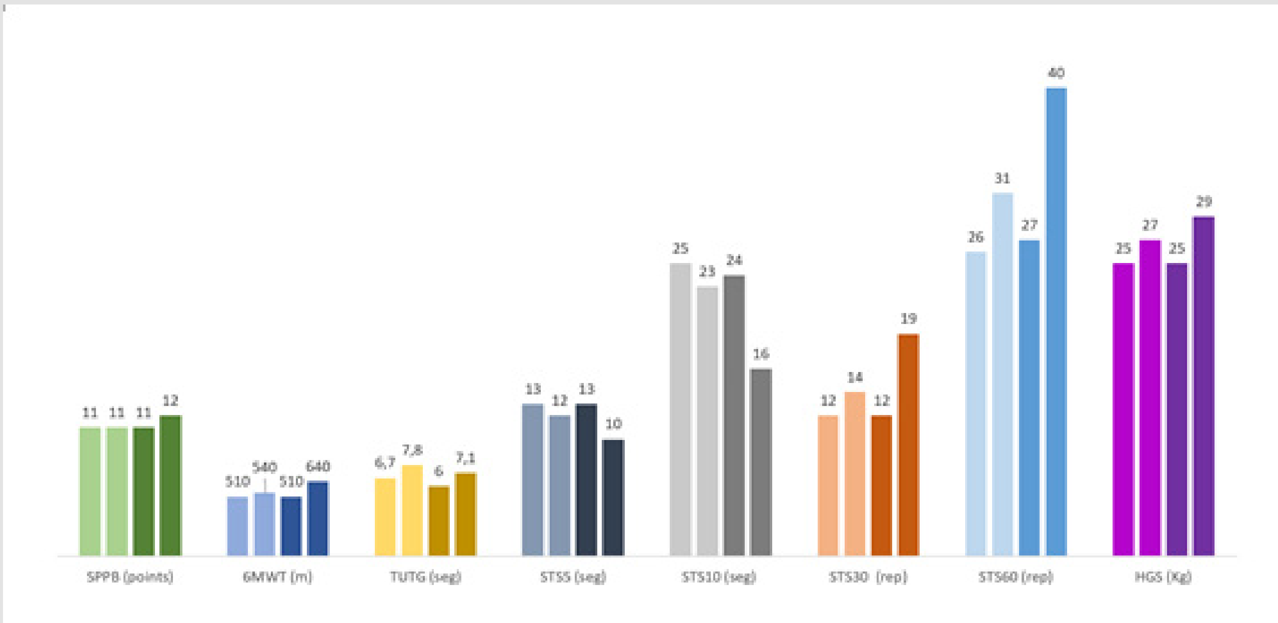
eters, improving the Phase Angle (PA), Muscle Mass (MM) and Intracellular Body Water (IBW) once the supplementation is finished. Analyzing the evolution of the biochemical parameters, during the supplementation period, an increase in prealbumin and Insulin-like growth factor I (IGF1) is observed.



Note: The first and second columns of each of the tests correspond to the first and second year of HD, the third and fourth columns correspond to the start and end of the study of the supplement with 3g of HMB. SPPB= Short Physical Performance Battery; 6MWT= 6 minutes walking test; TUTG= timed up and go; STS= sit to stand; HGS= handgrip.

Figure 1: Evolution of the results of functional capacity and muscle strength.

Table 1: Evolution of muscle strength (hand grip strength).

	Start HMB	1-month HMB	2-month HMB	3-month HMB	Non-HMB
Right HGS (Kg)	25	25	26	27	29

Note: HGS= hand grip strenght

Table 2: Evolution anthropometry.

	Weight (Kg)	Waist (cm))	Hip (cm)	Arm (cm)	TS (mm)	MAMC (cm)
Start HMB	72	86	107	33	31	32
1 month HMB	71.5	84	107	33	29	32.1
2 month HMB	71.1	83.5	106	33.5	29	32.6
3 month HMB	71	83	106	34	29	33
No HMB	71	83	105	34	29	33

Note: TS=tricipital skinfold, MAMC= Mid-arm muscle circumference

Table 3: Body composition by bioimpedance, nutritional status: biochemical and malnutrition-inflammation scales treated with HMB (HMB supplementation period).

	Start HMB	1 month HMB	2 month HMB	3 month HMB	No HMB
Weight (Kg)	72	71.5	71.1	71	71
PA	4.9	5.2	5.4	6	6.3

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%BCM	43	43.5	44.1	45.8	46.4
%IBW	49.7	50.2	50.9	52.8	53.6
%FM	49	46.8	46.8	47	47
%MM	28	29.4	29.7	30.5	30.8
BCMI (Kg/m2)	6	7	7	7	7
BMI (Kg/m2)	31	30	30	30	30
HB (g/dl)	11.5	12.4	12,1	12.3	12
Lymphocytes (mil/ mm3)	1900	1180	1640	1510	1770
Albumin (g/dl)	4.4	4.5	4.3	4.5	4.4
Prealbúmin (mg/dl)	32.19	31.16	33.90	36.80	34.20
Transferrin (mg/dl)	176	179	173	173	161
CRP (mg/dl)	0.30	0.78	0.16	0.20	0.25
IGF-1 (ng/ml)	266.6				274.8
MIS	4	3	3	3	3
SGA	13	11	11	11	11
PEW (ISRMN)	No	No	No	No	No
PEW (simple)	4	4	4	4	4

Discussion

Patient who begins with ACKD, with OB 1, is given dietary guidelines to try to reach the adjusted weight, and not be rejected due to obesity to be included in the kidney transplant list. Due to the fact that her work required physical strength, no accessory recommendations for physical exercise were made until she stopped working at HD. In the ACKD period, the patient not only maintained good functionality and muscle strength, but an improvement was observed throughout the follow-up time. A year after starting HD, her working life was stopped, but monitoring and maintaining good eating habits helped her lose weight, explaining why her functionality improved on HD, since the patient reported feeling more agile. However, the decrease in work activity negatively influenced her muscle strength, decreasing in the evaluation of the second year on HD. Upon detecting the discrepancy between improvement in functional capacity and decrease in muscle strength, the decision was made to supplement with HMB, since a supplement had to be chosen from among the existing ones and that could be prescribed in HD in patients with intolerance to HMB. glucose, which would increase muscle mass and provide minimal energy, since one of the objectives was for the patient to continue losing weight, especially from fat mass. The daily dose of HMB was 3g/day, since it is the dose prescribed to reduce the risk of sarcopenia [10,11]. Supplementation supposes an increase in appendicular muscle mass and muscle strength [12], in our case we observed an improvement in muscle strength by dynamometry, seeing a slight increase a month after starting supplementation, the physical activity performed was not prescribed with the aim of increasing muscle strength, but rather to improve or maintain functionality (vivifrail® programme), for this reason a large increase was not observed during the months in which the supplement + prescription of physical activity was prescribed.

The anthropometric measurements carried out during the follow-up that has been carried out on the patient over time show the importance of leading an active life, either by performing physical exercise on a regular basis or, as in this case, by the effect of the labor activity, improvements that are increased with the modifications in the feeding. In ACKD, not only is a decrease in body weight observed, but improvements in anthropometric measurements are observed, increasing the WBC and decreasing waist and hip perimeters with CV improvements that this entails. Once RRT was started in HD, the patient continued to lose weight, but not as strikingly as in ACKD, improving once the supplement was prescribed, increasing WBC to values in ACKD. Improvements are also observed in the study of body composition by bioimpedance, observing how the phase angle improves (remember that, in CKD, the ideal is for it to be greater than 4°), likewise an improvement in muscle mass is observed, fact that is reaffirmed with an increase in intracellular water (intramuscular water (ideal 60%). [13-16]. Biochemically, in the supplementation study, the patient started from good Hb, lymphocytes or Albumin data, observing that HMB supplementation led to an increase in prealbumin values, an effect described in previous studies [17], decreasing once it is left. In addition to an increase in the values of IGF-1, as an anabolic hormone [18,19], the increase being appreciated especially when supplementation is combined with an increase in physical activity, maintained once the supplementation is stopped [20].

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Conclusion

Adequate nutritional advice together with an increase in physical activity, abandoning a sedentary lifestyle, constitute the necessary tools to preserve a good functionality in CKD patients. Weight loss together with an active life will favor the functional capacity of patients with CKD. Supplementation with HMB will lead to an improvement in body composition, seeing this improvement from the first month of supplementation. Likewise, it will improve the levels of Prealbumin and IGF-1 as an anabolic hormone. To observe a greater effect on muscle mass with an HMB module, as in our case, regular physical activity should be prescribed, since a possible effect of supplementation without it, may only have the effect of slowing down catabolism.

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ISSN: 2574-1241

DOI: 10.26717/BJSTR.2022.46.007389

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