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ORIGINAL ARTICLE

Effect of a resistance exercise training program on bone markers in hemodialysis patients

Effet d'un programme d'exercice de résistance sur les marqueurs osseux chez des patients en hémodialyse

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Exercise;
Bone markers;
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Summary
Objective. — The aim of this study was evaluate the effects of resistance exercise on bone markers in HD patients.
Material and methods. — Twenty-six patients undergoing hemodialysis were assigned to either an exercise group (EG — $n = 14$) or a control group (CG — $n = 12$). The EG performed approximately six months of intradialytic resistance exercise program (using elastic bands and leggings with both lower limbs) monitored thrice weekly (72 sessions), while the CG received standard care. Plasma bone markers (osteoprotegerin — OPG, osteocalcin — OC, Osteopontin — OPN and intact parathyroid hormone-iPTH) were measured by Luminex.
Results. — OPG levels increased significantly after resistance training in EG (from 6.8 ± 1.8 to 7.8 ± 1.8 ng/L, $P = 0.02$), whereas OC, OPN and iPTH did not change.

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Conclusion. — In summary, resistance exercise may have contributed to the increase in OPG plasma levels and probably to the prevention of bone loss among HD patients who participated in the exercise program.

MOTS CLÉS
Exercice ;
Marqueurs osseux ;
Maladie rénale chronique ;
Ostéoporose ;
Hémodialyse

Résumé
Objectif. — Cette étude a évalué les effets de l'exercice de résistance sur les marqueurs osseux chez les patients hémodialysés.
Matériel et méthodes. — Vingt-six patients ont été assignés soit à un groupe d'exercice (GE, N = 14) soit à un groupe témoin (GT, N = 12). Le programme d'exercices de résistance intradialytique ont effectué environ six mois (utilisant des bandes élastiques et des jambières des membres inférieurs) surveillés trois fois par semaine (72 séances), tandis que le CT a reçu des soins standard. Les marqueurs osseux plasmatiques (ostéoprotégerine-OPG, ostéocalcine-OC, ostéopontine-OPN et hormone parathyroïdienne intacte-iPTH) ont été mesurés par Luminex.
Résultats. — Les taux d'OPG ont augmenté de façon significative après les exercises (de 6,8 ± 1,8 à 7,8 ± 1,8 ng/L, p = 0,02), alors que les niveux du OC, OPN et iPTH n'ont pas changé.
Conclusion. — En résumé, l'exercice de résistance peut avoir contribué à l'augmentation des taux plasmatiques d'OPG et probablement à la prévention de la perte osseuse chez les patients HD qui ont participé au programme d'exercices.

1. Introduction

In chronic kidney disease (CKD), bone quality and quantity can deteriorate quickly. In fact, low bone mass is common in hemodialysis (HD) patients. This accelerated bone loss is due to an abnormal bone remodeling process that affects bone mineral density (BMD) and increases bone resorption, leading to osteopenia and osteoporosis [1—3].

Several biochemical markers are evaluated to diagnose bone mineral disorders in CKD patients. Serum osteocalcin (OC) has been shown to be as reliable as intact PTH (iPTH) for evaluating bone turnover in HD patients. In addition to OC [4], osteopontin (OPN) is used as a biochemical marker of bone formation [5]; furthermore, osteoprotegerin (OPG) is a useful biomarker for mineral bone disorders in CKD patients [6].

The nuclear receptor activator kB (RANK) system and its receptor, the receptor activator of nuclear factor kB ligand (RANKL), have recently been studied in HD patients. RANKL is essential in osteoclast formation, fusion, activation, and survival, resulting in bone resorption and bone loss, but the effects of RANKL are counteracted by OPG [7]. Normal bone remodeling and stable bone mass depend on the balance between OPG and RANKL. OPG controls the catabolic effects of RANKL, limiting the formation, activity, and survival of osteoclasts [8].

Some studies have demonstrated the effects of physical exercise on bone metabolism and observed that high-intensity resistance training and activities with impact loading can be effective in promoting osteogenic stimuli, increasing BMD and maintaining bone health [9,10]. Indeed, regular physical exercise may improve physical functioning and resistance exercise effectively changes bone metabolism [11,12]. It was showed that an intradialytic resistance exercise training program was effective to improve the femoral neck BMD and *T*-score in CKD patients [13].

Although the mechanisms for explaining how resistance exercise may increase BMD are unclear, the mechanical load on bone during resistance exercise might place a high-tension load at the muscle-bone interface, which may stimulate bone formation through the periosteal apposition and modeling process. This concept is supported by studies that have reported an increase in markers of bone formation in non-CKD patients after resistance exercise [14—17].

To date, it is unclear whether strength training affects the catabolic processes involved in bone density and muscle mass in CKD patients [18]. Vigorous or moderate physical activity is associated with skeletal muscle mass, but they are not associated with surrogate markers for mineral bone disorders in HD [19]. However, there have been few studies on the effects of resistance exercise on bone markers in HD patients. Therefore, the aim of this study was to evaluate the effects of resistance exercise on bone markers of HD patients.

2. Materials

2.1. Patients

This prospective study enrolled 42 HD patients (54.8% men, 47.9 ± 13.3 years, dialysis time period of 39.0 (26.0, 62.0) months) at the Renal Vida Clinic in Rio de Janeiro, Brazil. The stages and the number of patients throughout this study are shown in the flowchart of patients (Fig. 1). Fourteen patients (71.4% men) were designated to the exercise group (EG) and 12 patients (58.3% men) were allocated to the control group (CG). The participants were selected by consecutive sampling of a hemodialysis clinic ward.

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