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Improving Protein and Vitamin D Status of Obese Patients Participating in Physical Rehabilitation

Janine T. Baer, PhD, RD, CNP

College of Nursing, University of Cincinnati, Cincinnati, OH, USA

Keywords

Sarcopenic obesity; arthroplasty; protein malnutrition; vitamin D deficiency.

Correspondence

Janine T. Baer, PhD, RD, CNP, College of Nursing, University of Cincinnati, 3110 Vine St., Cincinnati, OH 45219-2068.
E-mail: jbaer7777@gmail.com

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Abstract

Purpose: Sarcopenia and vitamin D deficiency increase risk of disability outcomes associated with a million hip and knee replacements annually. The purpose of the present study was to identify protein and vitamin D inadequacy in arthroplasty patients, and observe the effect of supplementation on metabolic markers on protein and vitamin D status.

Methods: One hundred and eighty obese arthroplasty patients admitted for inpatient rehabilitation, positive for protein and vitamin D insufficiency, received supplemental protein and vitamin D.

Results and Conclusion: Following supplementation, normalization of protein and vitamin D status was achieved. Nutrient supplementation during physical rehabilitation provided an efficient and effective means to reverse nutrient deficiency in an obese, orthopedic population.

Clinical Relevance: Inpatient physical rehabilitation is an opportune environment for nurses to provide education and intervention of nutrient supplementation, which may lessen consequences of sarcopenic obesity and related frailty disorders.

Introduction

The two greatest epidemiological trends are the obesity epidemic and the aging population (Roubertoff, 2004). In reviewing research related to interventions for obesity in older adults, Sturn, Ringel and Andreyeva (2009) found that comorbidities associated with obesity contribute to functional decline and the pathogenesis of disability. However, these outcomes may also be associated with sarcopenia (Jensen & Hsiao, 2010). According to Stenholm, Harris and Rantaven (2008), sarcopenia is a condition observed in older people who demonstrate excess energy intake, insufficient protein status, physical inactivity, decreased muscle strength/mass, low-grade inflammation, and insulin resistance. Sarcopenia is a major

contributor to physical frailty in older adults (Paddon-Jones, Short, Campbell & Volpe, 2008), including obese older adults (Villareal, Banks & Siever, 2004). Evidence indicates that when obesity, protein insufficiency, and muscle impairment coexist, they act synergistically on the risk of developing multiple health-related outcomes including increased fall risk, osteoporosis, and fracture (Aubertin-Lehudre, Lord & Labonte, 2008). These outcomes are associated with over a million hip and knee replacements annually (Ori, 2009). Such conditions and outcomes have been traditionally associated with our "old" (75–84 years) or "oldest" old (≥ 85 years) age groups (Stenholm et al., 2008). However, sarcopenia with resultant fall risk, fracture, and associated arthroplasty interventions is now beginning to be observed in record

numbers in our “young-old” overweight population of individuals 51–74 years (Ori, 2009).

Vitamin D is essential for optimal bone health and muscle function. Vitamin D insufficiency is associated with insulin resistance, obesity, fall risk, fracture risk, and bone/joint pain (Holick, 2007). Serum vitamin D levels are inversely related to fall risk (Bischoff-Ferrari et al., 2009) and fracture risk (Henderson, 2012). Hypovitaminosis D is prevalent in all races, age groups, and ethnic backgrounds (Holick, 2007), including patients presenting for a variety of orthopedic surgeries ranging from trauma to planned arthroplasty (Bogunovic, Kim, Beamer, Nguyen & Lane, 2010). In a study characterizing hypovitaminosis D in adult patients scheduled to undergo orthopedic surgery, 43% had low levels of vitamin D (25OHD <30 ng/mL), and two of every five of those patients were positive for frank vitamin D deficiency (25OHD <20 ng/mL). Insufficient and deficient vitamin D levels place patients at risk for osteomalacia, secondary hyperparathyroidism, and may negatively impact orthopedic surgery patient outcomes (Bogunovic et al., 2010).

Purpose

The purpose of the present study was to characterize the extent of protein and vitamin D inadequacy among overweight arthroplasty patients discharged to inpatient rehabilitation, and observe the effect of supplementation on metabolic markers of protein and vitamin D status.

Design

The present project was a prospective case study of a convenience sample of overweight patients admitted to inpatient short-term stay (up to 90 days), physical rehabilitation status post elective knee or hip arthroplasty

during the months of December 2009–December 2010 following approval by our institutional review board. Elective arthroplasty patients were selected because they represent our “newest” population at risk for sarcopenia; overweight “young-old” adults aged 50–74 years with protein and nutrient insufficiencies, who generally have fewer existing comorbid complications. Patient exclusion criteria included swallowing disorders, GI disorders, tube-feeding, and incidence of existing wounds, renal or liver disorders as well as diagnoses of CHF and COPD.

Methods

Patients who provided informed consent were screened as follows: protein status (serum prealbumin), inflammation (serum Erythrocyte Sedimentation Rate [ESR]); Vitamin D (serum 25OHD). Patients whose blood tests showed insufficiencies were put on facility formulary for protein (Prosource Plus 15 g protein/30 mL), omega 3-fatty acids (1,000–2,000 mg fish oil PO QD), and vitamin D (ergocalciferol 50,000 IU either once, or two-three times/week). Patients participated in both physical therapy and occupational therapy. Each session was approximately 30–45 minutes (physical therapy) and 20–30 minutes (occupational therapy) at least 6/7 days/week. Patients ate all meals in the facility dining room and were weighed weekly. Follow-up bloodwork was completed every 2 weeks for prealbumin and ESR. Vitamin D (25OHD) was assessed monthly. The study end point was at day 60 of stay at which time all markers were measured.

Findings

From an eligible pool of 212 patients, 180 patients (60 men and 120 women) consented to participate. All of the subjects were obese (BMI <30) and positive for protein malnutrition as evidenced by low serum prealbumin lev-

Table 1 Physical and metabolic characteristics of 180 arthroplasty patients*

Characteristics	Men (n = 60)	Women (n = 120)	Normal Range†
Age (years)	57 ± 7	66 ± 5	
Body Mass Index	39.3 ± 6.6	32.7 ± 7.3	
Prealbumin (mg/dL)	10.4 ± 2.6	9.3 ± 4.9	17.0–34.0
ESR (mm/hour)	12 ± 1.6	28 ± 3.3	Men: 0–20 Women: 0–30
Vitamin D (25OHD3) (ng/mL)	17.8 ± 11.9	10.4 ± 3.7	Deficiency <20 ng/mL Insufficient <30 ng/mL

*mean ± SD.

†Medlab, OH.

els (Table 1). Although prealbumin is a negative responder to increased inflammation, the elevated ESR was not so high as to be the only explanation for decrease in prealbumin. These findings suggest that in the patient population studied, a primarily “young-old” population is part of our increasing sarcopenic obese population.

Insufficient protein status in aging individuals is related to metabolic effects of aging as well as decreased dietary intake. In addition to the decreased anabolic effect of amino acids in aging individuals (Volpi, Mittendorfer, Brasmsen & Wolfe, 2000), aging is associated with insulin resistance (Frujita, Glynn, Timmerman, Rasmussen & Volpe, 2009). Currently, it is recommended that older adults consume at least 1.0 g/kg/day of protein. This is higher than the current RDA of 0.8 g/kg/day for all adults (Chernoff, 2004).

Protein status is directly related to healing, muscle mass, and muscle function, all of which are important in promoting health and strength as well as in preventing disease, frailty, and disability. Supplementation with standard “med pass” or “health shake” type formula was not an option for protein repletion as these obese individuals required protein, not calories. The liquid protein supplement used allowed patients to increase protein intake by 30 g/day for only 100 kcal. An equivalent serving of low-fat protein such as skim milk (3.5 cups) or very lean meat (4 oz) would provide approximately 300 kcal. Patients were educated on low-calorie high-quality protein foods as well as high-quality protein supplements during the course of their rehabilitation stay. The majority of the patients indicated that they would select the supplement postdischarge, both for the kcal “savings” and for decreased serving size.

All of the women and the majority of the men who participated in the study were observed to be deficient in serum vitamin D (25OHD < 20 ng/mL) (Table 1). This occurred despite several of the women indicating that they regularly consumed an over-the-counter calcium supplement that contained vitamin D. The current RDA

Key Practice Points

- Protein malnutrition occurs in overweight adults and is associated with frailty and disability.
- Sarcopenic obesity is observed in our “young-old” population.
- Arthroplasty patients are likely to be deficient in protein and vitamin D.
- Adequate protein and vitamin D status is associated with decreasing frailty and disability.

for vitamin D is 600 IU for adults aged 51–70 years of age and 800 IU/day for adults >70 years of age (Institute of Medicine, Food & Nutrition Board, 2010). This updated RDA has come under scrutiny for being too low to have protective effects against falls and fractures. According to Bischoff-Ferrari et al. (2009), at least 800 IU/day vitamin D is associated with fall prevention. Over-the-counter calcium and vitamin D supplements contain much less vitamin D (400 IU/2 tabs) compared with the recommended intake of at least 800 IU vitamin D/day to prevent fall and fracture risk (Henderson, 2012). Dietary intervention is not an effective strategy for vitamin D repletion. Vitamin D content of foodstuffs, even fortified foodstuffs, is insufficient to reverse deficiency in a timely manner. Furthermore, the overweight patient does not need the extra calories one would need to consume to meet recommended intake/day. Several options for vitamin D supplementation, both D2 (cholecalciferol) and D3 (ergocalciferol), are available in over-the-counter formularies. We used the vitamin D2 50,000 IU as daily intake is not required to replete status in a timely manner.

Conclusions

The results of this case study show that supplementation, in a controlled environment, was effective in repletion of protein and vitamin D deficiency in a physical rehabilitation setting (Table 2). The compromised

Table 2 Metabolic markers of 180 patients 60 days following supplementation*

	Men (n = 60)	Women (n = 120)	Normal Range†
Prealbumin (mg/dL)	18.6 ± 1.5†	21.4 ± 2.3†	17.0–34.0
ESR (mm/hour)	9 ± 0.8	12 ± 1.2†	Men: 0–20 Women: 0–30
Vitamin D (25OHD3) (ng/mL)	35.4 ± 7.9†	38.6 ± 8.4†	Deficiency <20 ng/mL Insufficient <30 ng/mL

*mean ± SD.

†significantly different from baseline, p < 0.05.

protein and vitamin D status of obese older adults presenting to our facility for physical rehabilitation demonstrates that there is a need to educate providers and nurses on the reality of protein and vitamin D malnutrition in obese individuals, including those who are presenting for or have had orthopedic surgery. The ability to reverse protein and vitamin D malnutrition with supplementation demonstrates efficacy of this intervention without undesirable side effects such as added weight gain.

Clinical relevance

Approximately 34% of Americans are overweight (BMI >25) and another 34% are obese (BMI >30). Based on their predictive equations using epidemiological data, researchers at Harvard University predict that America's obesity epidemic would not plateau until at least 42% of adults achieve a BMI of >30 (Brandt, 2010). The CMS reports that more than 30% of men and women in the Medicare population are estimated to be obese (McTigue, Hess & Ziouras, 2006), and have recently approved provider reimbursement specific to obesity screening and counseling as a public health measure of intervention for the "silver tsunami." As part of this intervention, nurses need to be educated on the "new look" of our malnourished "young-old" through "oldest-old" populations as well as specific at-risk nutrient deficiencies associated with disability related to sarcopenia in our overweight and obese patient population, specifically protein and vitamin D status. The physical rehabilitation inpatient setting is an opportune environment for providers and nurses to educate, provide intervention, and reinforce compliance with supplementation that might not otherwise occur in the outpatient setting.

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