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Original article

Preoperative micronutrient status in morbidly obese patients before undergoing bariatric surgery: results of a cross-sectional study

Eva Wolf, M.Sc.[a,b], Markus Utech, M.D.[a], Peter Stehle, Ph.D.[b], Martin Büsing, M.D.[a], Birgit Stoffel-Wagner, M.D.[c], Sabine Ellinger, Ph.D.[b,d,*]

[a]Department of General and Visceral Surgery, Klinikum Vest, Knappschaftskrankenhaus Recklinghausen, Recklinghausen, Germany
[b]Department of Nutrition and Food Sciences, Nutritional Physiology, University of Bonn, Bonn, Germany
[c]Department of Clinical Chemistry and Clinical Pharmacology, University Hospital Bonn, Bonn, Germany
[d]Faculty of Food, Nutrition and Hospitality Sciences, Hochschule Niederrhein, University of Applied Sciences, Mönchengladbach, Germany

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Abstract

Background: Reliable information on micronutrient status before bariatric surgery is needed to optimize preoperative nutritional status and postoperative nutritional therapy.

Objective: To investigate the pro-/vitamin and mineral status and its association with nutrient intake in morbidly obese patients seeking bariatric surgery

Setting: Klinikum Vest, Recklinghausen, Germany.

Methods: The cross-sectional study investigated retinol, ascorbic acid, tocopherol, and β-carotene (high-pressure liquid chromatography), 25-hydroxycholecalciferol (enzyme-linked immunosorbent assay), and calcium, phosphate, and magnesium (photometry) in serum/plasma in 43 patients (body mass index: 52.6 ± 10.5 kg/m^2) before sleeve gastrectomy. Albumin, parathyroid hormone, and alkaline phosphatase were analyzed. Data were compared with accepted cutoff values. Dietary intake was estimated by 3-day food records, and nutrient intake was compared with recommended values.

Results: One third of participants had ascorbic acid concentrations <28 nmol/L. All patients had β-carotene levels ≤.9 μmol/L, although retinol was below the cutoff value (<.7 μmol/L) in only 5%. Tocopherol/cholesterol-ratio was always >2.8 μmol/mmol. Of the patients, 84% had 25-hydroxycholecalciferol levels below 50 nmol/L. Parathyroid hormone was elevated in 23% (>6.5 pmol/L). Calcium, magnesium, and alkaline phosphatase were always, and phosphate was mostly (98%) above cutoff values. Intake of retinol (23%), ascorbic acid (55.8%), vitamin D (90.7%), tocopherol (48.8%), and β-carotene (<2.0 mg/d; 37.2%) were often below recommendations. Correlations between serum/plasma concentrations and nutritional intake and associations between low concentrations and inadequate intake were not observed.

Conclusions: Many morbidly obese patients in Germany suffer from deficiencies in multiple micronutrients, particularly vitamin D, ascorbic acid, and β-carotene before sleeve gastrectomy. Measurement of preoperative micronutrient status will help supplement patients before, and optimize nutritional therapy after, surgery. (Surg Obes Relat Dis 2015;▮:00–00.) © 2015 Published by Elsevier Inc. on behalf of American Society for Metabolic and Bariatric Surgery.

Keywords: Bariatric surgery; Obesity; Micronutrients; Nutritional deficiencies; Dietary intake; Preoperative nutritional assessment; Nutritional recommendations

Obesity is a prevalent public health problem reaching epidemic proportions worldwide [1]. Specifically, the percentage of morbidly obese adults (body mass index [BMI]

*Correspondence: Sabine Ellinger, Ph.D., Faculty of Food, Nutrition and Hospitality Sciences, Hochschule Niederrhein, University of Applied Sciences, Rheydter Str. 277, 41065 Mönchengladbach, Germany.
E-mail: Sabine.Ellinger@hs-niederrhein.de

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≥40 kg/m^2) has increased disproportionally throughout the past decade [2]. Excessive obesity is associated with various co-morbidities, including hypertension, insulin resistance, and other disorders generally known as the metabolic syndrome. Often, conservative treatments to reduce weight are ineffective due to low compliance. Bariatric surgery in combination with lifestyle changes can be long-term effective to improve quality of life, to reduce co-morbidities, and to increase life expectancy [3].

Despite excessive energy intake, obese patients are at risk of deficiency for essential micronutrients due to their preferred consumption of food that is high in energy but low in nutrient density [1]. Insufficient nutritional status preoperatively, i.e., low plasma concentrations of antioxidants, may be a risk factor for surgical complications; moreover, malnourishment may worsen postoperatively due to food intolerance and reduced food intake [4]. Consequently, information on micronutrient status before surgery is needed to optimize pre- and postoperative nutritional therapy. Reliable plasma/serum analyses of micronutrient status in morbidly obese patients are still limited; earlier studies mostly focused on vitamin D [5–11]. A 25-hydroxycholecalciferol (25-OHD) deficiency was frequently observed before [5–11] and after bariatric surgery [12]. Vitamin D deficiency (i.e., 25-OHD levels <50 nmol/L) leads to abnormalities in calcium, phosphorus, and bone metabolism, which favors osteomalacia by lowering bone mineral density [13]. In addition, 25-OHD concentrations between 50–75 nmol/L are associated with disorders in lipid and carbohydrate metabolism [14] and may therefore increase cardiovascular risk [15]. Because obesity is often associated with chronic inflammation [16], insufficient availability of antioxidant pro-/vitamins may contribute to oxidative processes. When planning the study, few data for ascorbic acid [10,17,18], β-carotene [19], retinol [7,17] and tocopherol status [7,17] in serum or plasma were available. In morbid obesity, β-carotene [20], as well as tocopherol status [21], is known to be inversely associated with BMI, and chronic low levels of these micronutrients compromise their availability to tissues [19]. Therefore, morbid obesity may lead to increased micronutrient requirements and/or may impair luminal nutrient uptake. Unfortunately, none of the above-mentioned studies related extracellular micronutrient status to nutrient intake.

The primary aim of the present study was to assess the status of micronutrients in morbidly obese patients seeking bariatric surgery. The secondary aim was to correlate extracellular nutrient levels with the corresponding nutrient intake.

Materials and methods

Patients

Following a monocenter cross-sectional study, 43 consecutive participants (≥18 yr) scheduled for bariatric surgery were recruited at Klinikum Vest, Recklinghausen, Germany, from April to June 2012. Inclusion and exclusion criteria were defined according to the S3 guidelines "bariatric surgery" [3]. Ingestion of dietary supplements was defined as further exclusion criteria. The study protocol was approved by the Ethics Committee of Bonn University (no. 019/12) and by the Ethics Committee of the General Medical Council Westphalia-Lippe and the Medical Faculty of Munster. Written informed consent was obtained from all participants before enrollment.

Blood sampling

Venous blood was collected after an overnight fast between 8:00 and 10:00 a.m., 2 weeks before surgery. Blood was collected in tubes coated with ethylenediaminetetraacetic acid (EDTA) for the analysis of retinol, ascorbic acid, tocopherol, β-carotene, and parathyroid hormone (PTH) or no anticoagulant for the determination of 25-OHD, albumin, alkaline phosphatase (AP), calcium, magnesium, phosphate, creatinine, and cholesterol.

Preparation of blood samples

Within 1 hour of blood sampling, samples were centrifuged (2000 × g, 4°C, 10 min) to obtain plasma and serum, respectively. For ascorbic acid analysis, EDTA plasma was stabilized with a solution of metaphosphoric and perchloric acid, as described previously [22], and the supernatant obtained after centrifugation was analyzed. In samples analyzed for retinol, tocopherol, and β-carotene, 10 μL of .05% (w/v in ethanol) butylhydroxytoluol was added to the EDTA plasma (500 μL) to protect against lipid peroxidation. Aliquots were stored at –30°C in Recklinghausen for future analyses of pro-/vitamins and PTH. After the study was completed, the samples were transported to Bonn on dry ice and stored at –80°C until analysis.

Anthropometric data

Height and weight were determined under standard conditions (fasting state, light clothes without shoes) using a medical scale (Soehnle, Murrhardt, Germany) adapted for persons with a weight up to 300 kg. The BMI was calculated as ratio of weight and height squared (kg/m^2) and evaluated according to the criteria of the World Health Organization for obesity [1].

Energy and nutritional intake

The dietary intake was determined by self-completed standardized 3-day food records. Quantities of foods consumed were estimated by using common household measures (e.g., slices, cups, pieces, teaspoons). To minimize inaccuracies, the participants were instructed in verbal and written form how to fill the records. A dietician reviewed all