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Original article

Prevalence of electrolyte and nutritional deficiencies in Chinese bariatric surgery candidates

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Abstract

Background: Electrolyte and nutritional deficiencies have been reported in Western populations seeking bariatric surgery. However, data are scarce for Chinese patients.

Objectives: To investigate the prevalence of electrolyte and nutritional deficiencies in Chinese bariatric surgery candidates and to explore their associations with patients' demographic data.

Setting: University hospital, China.

Methods: Demographical data of 211 patients presenting for bariatric surgery were collected on gender, age, body mass index (BMI) and waist circumference (WC). Blood biochemical data were collected on some nutrients (hemoglobin, albumin, globulin, folate, vitamin B12, calcium, phosphorus, iron, ferritin, magnesium, parathyroid hormone [PTH], and vitamin D) and some electrolytes (potassium, sodium, and chloride).

Results: Deficiencies were found for hemoglobin (2.8%), albumin (11.8%), globulin (1.4%), folate (32.2%), vitamin B12 (4.7%), corrected calcium (13.7%), phosphorus (10.4%), iron (9.0%), ferritin (1.9%), vitamin D (80.0%), potassium (5.7%), sodium (7.6%), and chloride (15.6%). Secondary hyperparathyroidism was found in 17.3%; no hypomagnesemia was encountered. A significant correlation was observed between age and folate, corrected calcium and PTH levels (r = .257, –.206, and .273, respectively; $P < .05$). Greater BMI was associated with lower albumin and folate (r = –.338 and –.370, respectively) and with higher globulin and phosphorus levels (r = .267 and .138, respectively). Folate deficiency was more common in the 18- to 30-year-old age group ($P = .042$) and the patients with BMI >45 kg/m^2 ($P = .001$). WC had an association with rates of albumin, folate, and corrected calcium deficiencies, as well as hemoglobin, albumin, and globulin, folate, phosphorus, and ferritin levels.

Conclusion: Electrolyte and nutritional deficiencies are common in Chinese bariatric surgery candidates. Routine evaluation of electrolyte and nutritional levels should be carried out in this population. (Surg Obes Relat Dis 2016;12:629–634.)

Keywords: Nutritional deficiencies; Electrolyte deficiencies; Obesity; Bariatric surgery; Chinese population

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As a chronic health problem, the prevalence of obesity has been found in more and more countries [1], including China, one of the most populous countries in the world. The percentage of general obesity in Chinese people had increased from 2.9% to 11.4% for men and from 5.0% to 10.1% for women between 1993 and 2009; the prevalence of central obesity has increased significantly as well [2]. Obesity can result in some serious co-morbidities, such as type 2 diabetes mellitus (T2D), hypertension, dyslipidemia,

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obstructive sleep apnea, joint degeneration, heart disease, and some cancers [3].

Bariatric surgery has been accepted as the most effective approach for treating obesity; it can not only provide sustained weight loss but also improve co-morbidities [4]. Nevertheless, some complications may occur after surgery, of which electrolyte and nutritional deficiencies are major problems [4]. A few research studies based on Western populations have indicated that electrolyte/nutritional deficiencies are already present before bariatric surgery [5–8]. The prevalence of these deficiencies may exacerbate postoperatively because patients will intake and absorb less, which can result in serious postoperative problems [6].

Although prebariatric electrolyte/nutritional deficiencies have been reported, studies on this topic are still quite few, especially for Asian populations. In addition, different living environment and dietary habits may lead to difference in electrolyte/nutritional deficiencies from one country to another [9]. As an Asian country, China has its specificity. For a given age, gender, and body mass index (BMI), the Chinese population has more abdominal adiposity and wider waist circumference (WC) compared with matched Western populations, which make them more susceptible to metabolic diseases [1]. Using the World Health Organization criterion for Chinese populations, a BMI $\geq$ 27.5 kg/m^2 is classified as general obesity, lower than that for Westerners (BMI $\geq$ 30 kg/m^2) [10]. Nevertheless, the connections between electrolyte/nutrient data and patients' demographic data, such as WC, have not been well tracked yet. What's more, the development of bariatric surgery in China is much slower than that in Western countries. Although most Chinese surgeons realize the risk of postbariatric electrolyte/nutrient deficiencies, some have not paid enough attention to preoperative deficiencies, and even not evaluated electrolyte/nutritional status systematically, including at our own facility. We did not examine serum vitamin D and parathyroid hormone (PTH) in the early stage.

To our knowledge, very limited studies evaluating electrolyte/nutritional status in Chinese prebariatric patients have been performed and almost none have been published in English. In light of this, our present study attempts to investigate the prevalence of electrolyte/nutritional deficiencies in Chinese bariatric surgery candidates and to explore their associations with patients' demographic data.

Patients and methods

We retrospectively reviewed the patients who were admitted to our hospital seeking bariatric surgery between September 2011 and September 2015. According to the BMI classifications for Chinese populations by the World Health Organization [10], inclusion criteria for the study were patients aged 18 to 65 years and a BMI $\geq$ 35 kg/m^2 or a BMI $\geq$ 27.5 kg/m^2 with T2D or metabolic syndrome that cannot be controlled by lifestyle alternations and medical treatment. Exclusion criteria were patients who had previous bariatric procedures, mental diseases, alcohol addiction, chronic renal failure, or who were taking multivitamin supplements or mineral supplements. Written informed consent was obtained from all participants, and this study was approved by the local ethics committee.

Demographic data were collected on gender, age, WC, height, and weight. BMI was defined as weight (kg) divided by height squared (m^2). Blood biochemical data were collected on some nutrients (hemoglobin, albumin, globulin, folate, vitamin B12, calcium, phosphorus, iron, ferritin, magnesium, PTH, and vitamin D) and some electrolytes (potassium, sodium, and chloride). Calcium levels were corrected by albumin concentrations using this formula: corrected calcium (mmol/L) = total calcium (mmol/L) + .02 $\times$ [40 − serum albumin (g/L)].

Fasting blood samples were drawn from peripheral vein in the morning and then analyzed by the clinical laboratory of our hospital. Hemiglobincyanide method was used for measuring hemoglobin; dye combination method for albumin; chemiluminescence immunoassay for ferritin, 25(OH) D, PTH, folate, and vitamin B12; colorimetric for iron and calcium; enzyme kinetic analysis for magnesium and phosphorus; and ion selective electrode for chloride, sodium, and potassium.

To explore the associations between electrolyte/nutritional status and patients' demographic data, the patients were divided into several subgroups as follows:

- Gender: men and women.
- Age: 18 to <30 years, 30 to <40 years, 40 to <50 years, 50 to <65 years
- BMI: 27.5 to <35 kg/m^2, 35 to <40 kg/m^2, 40 to <45 kg/m^2, and $\geq$45 kg/m^2
- WC: 90 to <110 cm, 110 to <130 cm, 130 to <150 cm, and $\geq$150 cm

Statistical analysis was performed using the Statistical Product and Service Solutions version 13.0 (SPSS 13.0, SPSS Inc. Chicago, IL, USA). Continuous data were presented as mean $\pm$ standard deviation and categorical data were expressed as percentage (%). Subgroups were compared using χ^2 or Fisher's exact test for electrolyte/nutritional deficiencies. Pearson or Spearman coefficients were used for correlation analysis according to the results of normality test. Statistical significance was considered by $P < .05$.

Results

In total, this study enrolled 211 patients (95 men, 116 women) with a mean age of 33.3 $\pm$ 11.1 years. Baseline BMI and WC were 39.3 $\pm$ 8.6 kg/m^2 and 120.9 $\pm$ 20.6 cm. The rates of preoperative electrolyte/nutritional deficiencies are presented in Table 1.