Nutritional Status of Sleeve Patients, Micronutrients and Vitamins: Pre-op

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1 Introduction

1.1 Problem Statement

The LSG procedure involves major gastric resection as 60–80% of the stomach capacity is removed including the ghrelin producing fundus [28]. Accordingly, weight loss occurs through a combination of food restriction and a hormonal mechanism [19]. The consequences of the limited oral intake, food intolerance, and malabsorption following LSG are a major nutritional concern in the short and long term. Studies have shown that micronutrients including iron, thiamin, folate, vitamin B_{12}, and vitamin D are the most affected post LSG procedure [6, 10, 31]. Worth noting is the fact that obesity is associated with nutritional deficiencies [7, 26, 27, 35]. These deficiencies might be further exacerbated post LSG procedure. Severe nutritional deficiencies after bariatric surgeries may lead to anemia Brolin et al. [9, 8], bone mass loss [12], protein malnutrition [16], peripheral neuropathies [18], visual impairment [24], Wernicke encephalopathy Aasheim et al. [2, 3], and fetal malformations [21]. Beside the nutritional deficiencies, it is also important to mention that some studies reported undesirably high micronutrients levels post LSG surgery [1, 31]. Excess level may progress into toxicity which is also associated with devastating conditions.

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2 Literature Review

2.1 Nutritional Concerns Pre Bariatric Surgeries

Obesity is associated with low micronutrient levels. Although, obese individuals have excess energy stores, they are quite often not well nourished (Fig. 1). Many obese subjects have already existing nutritional deficiencies before bariatric procedures. These deficiencies commonly include iron, vitamin B_{12}, thiamin, folate, and vitamin D [7, 27, 35]. Screening and correction of micronutrient deficiencies

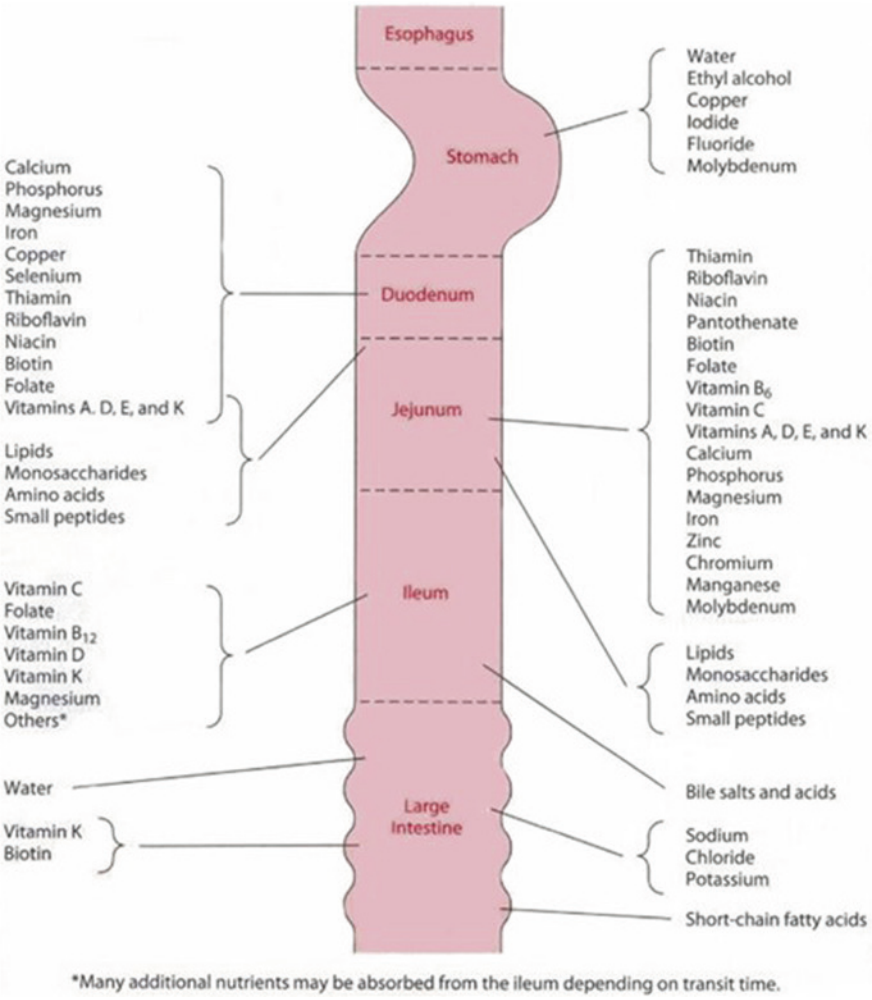

Fig. 1 Sites of nutrients absorption in gastrointestinal tract

preoperatively are crucial, as these deficiencies may be more exacerbated post bariatric procedures.

Several studies have examined nutritional deficiencies among morbidly obese patients prior to bariatric procedures. An overview of selected studies representing nutrients status pre bariatric procedures is shown in Table 1. Schweiger et al. [26] studied nutritional deficiencies in 114 bariatric candidates who underwent surgery between 2006 and 2008. The prevalence of pre-operative nutritional deficiencies was: 35% for iron, 24% for folate, 24% for ferritin, 3.6% for vitamin B_{12}, 2% for phosphorous, and 0.9% for calcium. Hemoglobin and Mean Corpuscular Volume (MCV) levels were low in 19% of the patients. High levels of Parathyroid Hormone (PTH) were found among 39% of the patients. No hypoalbuminemia was encountered. Low iron and ferritin were more common in females than males (40.8% vs.14.3%) and (31.8% vs. 0%), respectively. Similarly, another study conducted in Saudi Arabia by Al-Mulhim [4] evaluated nutritional status in 112 patients prospectively. Pre-operatively, 64% of the patients had one deficiency and 11% had more than one. Deficiencies rates were reported as follows: hemoglobin 24%, iron 11.6%, vitamin D 60%, vitamin B_{12} 1.8%, and folate 0.9%.

3 Discussion

3.1 Nutritional Status Pre LSG Surgery

3.1.1 Nutritional Deficiencies Pre LSG

Nutritional deficiencies among LSG candidates are commonly attributed to unhealthy dietary and lifestyle habits (Moizé et al. [23]; Aasheim et al. [2, 3]. Obese individuals often displace nutritious foods with high calorie foods that are rich in refined carbohydrates and fat. Moreover, chronic dieting, which is common among obese individuals, might further deteriorate their nutritional status as a result of food restrictions. Besides diet and lifestyle, a further explanation includes the volumetric dilution factor. Obese individuals have relatively high amounts of total body water, and their extracellular compartment appeared to be more expanded than the intracellular compartment [33]. Aasheim et al. [2, 3] suggested that the low micronutrient levels might be related to the dilution effect of the extracellular fluid on micronutrient concentrations. The following sections will address pre-operative status for each nutrient parameter studied.

3.1.2 Protein Deficiency Pre LSG: Albumin and Transferrin

Reports of albumin status vary widely in literature as percentage of low albumin ranged from 0–27% before LSG [31, 10, 22, 25, 26]. Since obesity is associated with chronic low grade inflammation, acute phase protein levels, including albumin and transferrin, might be altered [34].

Table 1 Selected studies of nutrients status pre bariatric surgeries

Percentage of patients with low nutrients level																
Study	Design	n	B_1	B_6	B_9	B_{12}	A	D	Hgb	Ferritin	Fe	Mg	Phos	Ca	Zinc	Albumin
Ben-Porat et al. [6]	Prospective	192			32	13		99	15	7	47					
van Rutte et al. [31]	Prospective	200	6 3↑	3 21↑	24	12 1↑	0 72↑	81	5	7	38	2	14	1	0	0
Coupaye et al. [10]	Prospective	43	37	19	7	2	16	91	2					5		7
Gjessing et al. [15]	Retrospective	150			23	16 2↑		47 1↑	1 1↑					5 3↑		1 21↑
Moizé et al. [22]	Prospective	61	0	75		3		90	10	8	31	38		3	8	5
Saif et al. [25]	Retrospective	82	9					75	21	0	7	18	5	10		27
Damms-Machado et al. [11]	Prospective	54		11	6	9	0	83			29			0		
Moizé et al. [23]	Prospective	231	7		16	2		68	22	10	26	29		5	32	1
Al-Mulhim [4]	Prospective	112			1	2		60	24		12	6	5	0		
Toh et al. [29]	Retrospective	232			0	2		57	6	1	16					1
Schweiger et al. [26]	Retrospective	114			24	4			18	24	35		2	1		0
Gehrer et al. [14]	Prospective	136	0	0	3	3		23			3			0	14	6

↑ High; excess nutrient level, Hgb = Hemoglobin, Fe = Iron, Mg = Magnesium, Phos = Phosphorous, Ca = Cal

3.2 Vitamins Deficiencies Pre LSG

3.2.1 B Vitamins Deficiencies Pre LSG

Vitamin B_{12} was the only B vitamin that showed considerable deficiency prevalence prior to LSG (13–16%) [16, 15, 31]. However, several studies had also reported significant deficiencies in vitamin B_1, B_6, and folate [6, 31, 10, 22, 26]. These variations in B vitamins status may be partially explained by the differences in the extent of food fortifications between countries. It can also be related to food and supplement intake. Chronic alcoholism can be a contributing factor to vitamin B_1 deficiency as alcohol interferes with the active transport of vitamin B_1 across the intestinal wall and hastens its excretion in urine [13, 20].

3.2.2 Vitamin D Deficiency Pre LSG

A prevalence of vitamin D deficiency can be seen in previously reported studies, falling in the range of 60–91% [4, 10, 31, 22, 25].

Several reasons can be attributed to vitamin D deficiency in current LSG candidates. One reason is the decreased dietary consumption of vitamin D rich sources including fortified dairy products. A second reason is the reduced exposure to sunlight. The psychological status of the obese individual and the cultural and lifestyle factors of the population might further explain the limited sun exposure. A third possible reason of vitamin D deficiency is the sequestration of vitamin D in adipose tissues. The degree of adiposity appears to be inversely correlated with vitamin D levels. Correspondingly, several studies reported that obese individuals tend to have lower levels of vitamin D due to its increased uptake in adipose tissue [17, 30, 32]. A fourth reason for deficiency might be related to the decreased synthesis of vitamin D by the liver as a result of impaired liver function due to fatty liver disease, which is common among obese individuals [5]. Lastly, regarding the variation in vitamin D deficiency prevalence in the literature, it can also be related to the geographical, seasonal, and fortification policy differences.

3.2.3 Anemia and Iron Deficiency Pre LSG

Based on low hemoglobin levels as an indicator for anemia, anemia was observed in 18–24% in previously reported literature [4, 23, 25, 26]. However, anemia is variably reported in the literature, as others observed a much lower prevalence (1–5%) [10, 15, 31]. Iron biochemical parameters such as ferritin, serum iron, and transferrin saturation indicated poor iron status pr-eoperatively. Low ferritin was found in 24% of patients as reported by Schweiger et al. [26]. Low serum iron was observed in half of the patients before surgery according to Ben-Porat et al. [6] data (47%). On the contrary other previous studies reported a much lower prevalence in term of low ferritin (1–10%) [6, 23, 29, 31] and serum iron levels (7–29%) [4, 11, 25, 29].

The high percentages of pre-operative anemia and iron deficiency may be attributed to the inadequate iron intake due to poor dietary choices. It can also be attributed to the dominance of female gender (75%) in the reproductive age in

LSG candidates. Women in the reproductive age are at increased risk of iron deficiency anemia due to blood loss through menstruation. Furthermore, blood investigation of ferritin, serum iron, and transferrin saturation were not part of the routine preoperative assessment, hence, these tests might only be requested when deficiencies were suspected.

4 Excess Micronutrient Level Pre LSG

Some patients were found to have excess micronutrient levels which are consistent with data reported by van Rutte et al. [31]. This excess level might be due to consuming large doses of over the counter supplements by the patient's own initiative or by intense preoperative nutritional optimization from healthcare providers.

5 Conclusions and Recommendations

The rising prevalence of obesity is causing a parallel increase in the use of bariatric surgery. LSG is an effective procedure for morbid obesity management. Nutritional status is one of the main concerns in bariatric field. However, little is known about the nutritional status as well as the optimal nutritional care plan post LSG at longer term. Nutritional deficiencies were already present in LSG candidates as seen in multiple previous studies. Vitamin D, vitamin B_{12}, and iron deficiencies were the most commonly observed before surgery.

The current data emphasize the importance of pre and post-operative nutritional assessment. Since nutritional deficiencies are common among obese individual, optimizing LSG candidates before surgery is crucial to avoid further deterioration. Routine screening and adequate supplementation are vital post LSG to prevent and correct nutritional problems at an early stage. Data on iron, vitamin B_{12} and folate prove that these parameters deserve more attention particularly in females in the childbearing age. However, it is important to note that supplementation should be tailored to patient laboratory test to prevent excessive rise towards toxic level. Health care providers should be aware of vitamins toxicity risks, particularly vitamin B_6 and its adverse effect leading to neuropathy.

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