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MICRONUTRIENT DEFICIENCIES FOLLOWING LAPAROSCOPIC SLEEVE GASTRECTOMY: A PROSPECTIVE STUDY

Surgery

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ABSTRACT

Background: Laparoscopic Sleeve Gastrectomy (LSG) is increasingly used for morbid obesity. While effective for weight loss, its impact on micronutrient status is unclear. This study assessed changes in micronutrient levels after Laparoscopic Sleeve Gastrectomy. **Methods:** A prospective comparative study included 10 patients undergoing Laparoscopic Sleeve Gastrectomy at Tertiary care centre. Vitamin D, Vitamin B_{12}, Vitamin B_1, Vitamin B_6, Serum Iron, Serum Ferritin, Total Iron Binding Capacity (TIBC), Serum Zinc, and Serum Potassium were measured preoperatively and at 6 weeks, 3 months, and 6 months postoperatively. **Results**: Mean BMI was 46.35 kg/m². Mean percentage excess weight loss(EWL) at 6 months was 50.90 ± 9.49%. Preoperatively, Vitamin B_{12} and Vitamin D deficiency were present in 10% and 40% respectively. Postoperatively, significant declines occurred in Vitamin D ($p < 0.05$), Serum Iron ($p < 0.01$), Serum Ferritin ($p < 0.05$), and Serum Zinc ($p < 0.05$). At 6 months, 90% were Vitamin D deficient, 30% had Iron deficiency, 50% had Ferritin deficiency, and 70% had Zinc deficiency. **Conclusion**: Micronutrient deficiencies are common after Laparoscopic Sleeve Gastrectomy . Routine monitoring and supplementation, especially for Vitamin D, Iron, Ferritin, and Zinc, are essential.

KEYWORDS

Laparoscopic Sleeve Gastrectomy, Micronutrients, Obesity, Bariatric Surgery, Vitamin D Deficiency

INTRODUCTION

Obesity is a chronic disease with high morbidity and mortality [1]. For morbid obesity, bariatric surgery is the most effective treatment for sustained weight loss [2]. Laparoscopic Sleeve Gastrectomy (LSG) is a restrictive procedure that preserves the small intestine, theoretically minimising malabsorptive complications [3]. However, removal of the gastric fundus and reduced gastric acid production can impair absorption of Vitamin B , iron, and other micronutrients [4–6].Data from India on micronutrient trends post-LSG are limited. This study evaluates changes in Vitamin D, B , B , B , Iron, Ferritin, TIBC, Zinc, and Potassium over 6 months postoperatively.

MATERIALS AND METHODS -

Study design and setting: Prospective comparative study at Tertiary care health centre . Ethical approval was obtained.

Inclusion criteria: BMI ≥35 kg/m² with comorbidities, Age 18–65 years, Motivated, compliant candidates

Exclusion criteria: Severe cardiac/pulmonary disease, Psychological instability, Non-compliance

Preoperative assessment: Included lifestyle counselling, laboratory evaluation, and dietary modification. Baseline micronutrients: Vitamin D, B , B , B , Serum Iron, Ferritin, TIBC, Zinc, Potassium.

Surgical technique: Standard Laparoscopic Sleeve Gastrectomy(LSG) performed over a 36F bougie, starting 5 cm from pylorus to angle of His. Staple line was not reinforced. Jackson-Pratt drain placed in all cases.

Follow-up: Micronutrients measured at 6 weeks, 3 months, and 6 months. Deficiencies supplemented per standard guidelines.

Statistical analysis: SPSS v17.0. Paired t-test, McNemar's test, and Spearman's correlation used. $p < 0.05$ considered significant.

Parameters	Reference Range
Vitamin B12	250-950 pg/dl
Vitamin B1	1.56-100 ng/ml
Vitamin B6	3.12-200 nmol/l
Vitamin D	15-80 ng/ml
Serum iron	Male 60-160 ug/dl Female: 35-145 ug/dl
Serum ferritin	Male 30-400 ng/ml Female: 13-150 ug/dl
TIBC	250-400 ug/dl
Serum zinc	60-120 ug/dl
Serum potassium	3.5-5.5 mmol/l

RESULTS -

Demographics: Mean age: 37.4 years; 90% female. Mean BMI: 46.35 kg/m².Weight loss: Mean weight reduced from 113.3 ± 19 kg to 84.5 ± 10.9 kg at 6 months ($p < 0.001$) (**Table -1**). Mean %EWL at 6 months: 50.90 ± 9.49% (**Table -2**)

Table 1: Mean Weight In Study Group

	Pre op	6 weeks	3 months	6months
Range of weight (kg)	92-160	84-140	81-128	72-108
Mean weight (kg)	113.3+/- 19	100.7+/- 16.53 P=0.00 (s)	92.2 +/- 14.35 P= 0.001 (s)	84.5 +/- 10.92 P= 0.001 (s)

Table 2: Percentage Mean Excess Weight Loss (EWL)

Time Point	Range of EWL (kg)	Mean % EWL
6 weeks	6.26 – 33.90	22.39 ± 9.18
3 months	24.07 – 57.59	37.04 ± 11.69
6 months	38.18 – 62.83	50.90 ± 9.49

Micronutrient Changes:

Vitamin D: Declined significantly from 26.0 ± 17.0 ng/ml to 10.8 ± 8.3 ng/ml ($p < 0.05$); deficiency increased from 40% to 90% (Table 3).**Vitamin B :** Dropped from 481 pg/ml to 230.8 pg/ml; deficiency rose to 80% but non-significant (**Table 4)** . **Serum Iron**: Declined significantly ($p < 0.01$); 30% deficient. **Serum Ferritin**: The mean values of serum Ferritin at pre op, 6 weeks, 3 months and 6 months postoperatively are shown in **table 5** . At 6 weeks: the range of Ferritin levels was 23-227(ng/ml) with mean level of 115±50.09 (ng/ml). This difference from pre-operative level was statistically significant(s) as p value was 0.000 using pair t test. At 3 months: the range of Ferritin levels was 15-115(ng/ml) with a mean level of 89±29.87 (ng/ml). This difference from pre-operative level was statistically significant(S) as p value was 0.032 using pair t test. At 6 months: the range of Ferritin levels was 13-98 (ng/ml) with a mean level of 71.7±26.77 (ng/ml). This difference from pre-operative level was statistically significant (S) as p value was 0.045 using pair t test. There was no patient who was deficient in Serum ferritin preoperatively, 6 weeks and 3 months,

however the number increased to 5 (50%) at end of 6 months which was found to be statistically significant (S) as p value is 0.042 using Mcnemar's test.

Serum Zinc:

Their mean values of serum Zinc at pre op, 6 weeks, 3 months and 6 months postoperatively are shown in **table 6**. At 6 weeks: the range of Zinc levels was 44-104 (µg/dl) with a mean level of 77.7±18.55 (µg/dl). This difference from pre-operative level was statistically significant (S) as p value was 0.000 using pair t test. At 3 months: the range of Zinc levels was 42-98(µg/dl) with a mean level of 71.5±17.74(µg/dl). This difference from pre-operative level was statistically significant (S) as p value was 0.001 using pair t test. At 6 months: the range of levels Zinc was 38-74(µg/dl) with a mean level of 56.1±9.73 (pg/dl). This difference from pre-operative level was statistically significant (S) as p value was 0.022 using pair t test. There was no patient who was deficient in Serum Zinc preoperatively, however the number of deficient patient increased to 2 (20%) at end of 6 week and 3 months. At the end of 6 month 7 patients (70%) which were found to be statistically significant (S) as p value is 0.03 using Mcnemar's test.

Vitamin B , B , TIBC, Potassium: Declined but not statistically significant. A **positive correlation** was found between weight loss and serum levels of vitamin B12 , vitamin D, Iron, Ferritin, Zinc, TIBC, Potassium except Vitamin B1 and B6

Table 3 : Mean Serum Vitamin D levels

	Preop	6weeks	3months	6 month
Range of vitamin D(ng/ml)	11-53	9-45	6-37	3-32
Mean vitamin D level(ng/ml)	26+/-17.04	20.4+/-13.61 P=.001(s)	14.4+/-10.16 P=.007(s)	10+/-8.31 P=.039(s)
No. Of patients deficient	4	6 P=0.5(ns)	7 P=0.25(ns)	9 P=0.49(s)

Table 4 - Vitamin B12 Levels in Follow Up

	Pre-op	6 weeks	3 months	6 months
Range of Vitamin B12 (pg/dl)	172 – 654	160 – 574	148 – 518	142 – 499
Mean Vitamin B12 levels (pg./dl)	481 ± 155.43	359 ± 111.59 p = .047(S)	271 ± 105.66 p = .058(NS)	230.80 ± 108.37 p = .170(NS)
No of patients deficient of Vitamin B12	1 p = 1.00(NS)	1 p = .125(NS)	5	8 p = .016(S)

Table 5 - Mean Values Of Iron Indices

Parameter	Pre op	6 weeks	3 months	6 months
Serum Iron (µg/dl) – Range	45 - 128	37 - 110	36 - 98	32 - 86
Mean Serum Iron (µg/dl)	89.6 ± 27.54	77.7 ± 25.61 (p=.000 S)	66.7 ± 22.69 (p=.000 S)	55.7 ± 20.76 (p=.001 S)
No. of patients deficient	0	0	0	3 (p=>1 S)
Serum Ferritin (ng/ml) - Range	37 - 248	23 - 227	15 - 115	13 - 98
Mean Serum Ferritin (ng/ml)	142 ± 52.47	115 ± 50.09 (p=.000 S)	89 ± 29.87 (p=.032 S)	71.7 ± 26.77 (p=.045 S)
No. of patients deficient	0	0	0	5 (p=0.042 S)
TIBC (µg/dl) – Range	320 - 398	298 - 328	263 - 290	230 - 268
Mean TIBC (µg/dl)	358 ± 23.89	304.7 ± 15.1 (p=.082 NS)	275.7 ± 11.18 (p=.017 S)	252 ± 14.72 (p=.621 NS)
No. of patients deficient	0	0	0	4 (p=>1 NS)

Table 6 - Mean Serum Zinc Level

Parameter	Pre op	6 weeks	3 months	6 months
Range of Serum Zinc (µg/dl)	64 - 118	44 - 104	42 - 98	38 - 74
Mean Serum Zinc (µg/dl)	93.9 ± 19.79	77.7 ± 18.55 (p=0.000 S)	71.5 ± 17.74 (p=0.01 S)	56.1 ± 9.73 (p=0.022 S)
No. of patients deficient	0	2	2	7 (p=0.03 S)

Normal Value of Zinc = 60 - 120 µg/dl

DISCUSSION:

Our findings show that LSG, despite being a restrictive procedure, leads to significant micronutrient deficiencies within 6 months, particularly Vitamin D, Iron, Ferritin and Zinc. This aligns with reports from other series [7–10]. The presumed low deficiency risk in LSG may be misleading, especially in populations with pre-existing deficits. Vitamin D decline is consistent with sequestration in adipose tissue, reduced sun exposure, and possible hepatic metabolism alterations [11]. Iron and Ferritin depletion likely result from reduced gastric acid and altered diet. Zinc deficiency, seen in 70% of patients, can cause alopecia, taste disturbances, and delayed healing [12].

Clinical implication: Routine postoperative biochemical surveillance and early supplementation are mandatory.

CONCLUSION:

Laparoscopic Sleeve Gastrectomy **(LSG)** achieves significant weight loss and percentage of excess weight loss (EWL) >50% at 6 months. Postoperative deficiencies in Vitamin D, Iron, Ferritin, and Zinc are common. Mandatory micronutrient monitoring and supplementation should be standard care.

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