Post-operative Biochemistry Surveillance: Is There More to Know?

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BACKGROUND

- One Anastomosis Gastric Bypass (OAGB)
- Sleeve Gastrectomy (SG)
- Roux-en-Y Gastric Bypass (RYGB)

Preoperatively deficiencies are corrected

Post-operatively, we monitor patient's biochemistry at three, six, twelve, eighteen and twenty-four months

AIM

- Our intention was to look at postoperative biochemistry for the duration of our customary two-year follow up period.
- To assess, whether we are over testing or over treating our patients.

METHODS

- Retrospective biochemistry review of the 2018 – 2019 cohort.
- Calculated percentages of patients with deficiencies requiring supplementation.
- Compared nutritional effects of different interventions by measuring relative risk at different follow up intervals.

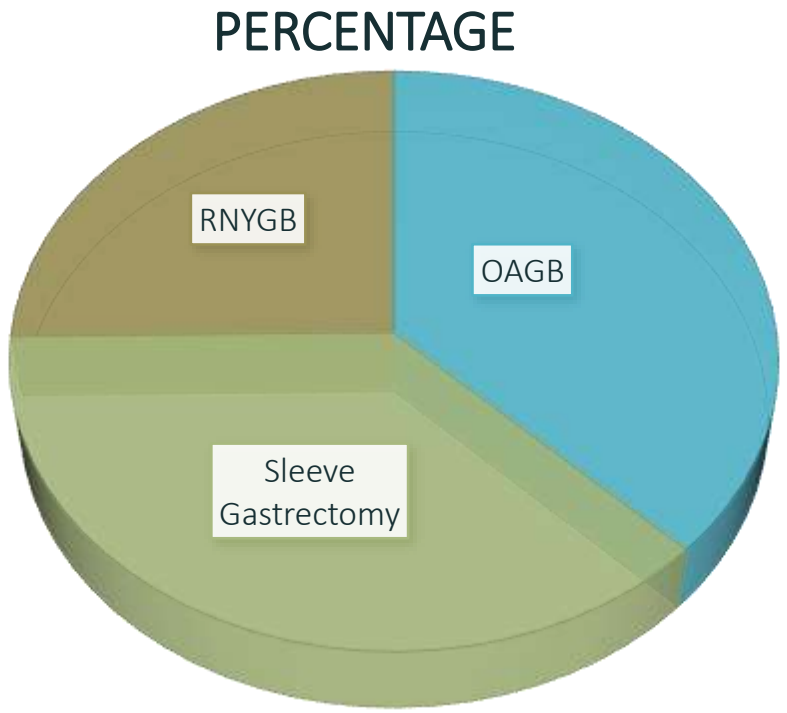
RESULTS

Total Number of Bariatric surgeries: n = 222

OAGB Patients, n=83 (37.4%)

SG Patients, n=83 (37.4%)

RYGB Patients, n=56 (25.2%)



RESULTS

Zinc

- Hair loss
- Pica
- Taste changes
- Erectile dysfunction
- Night blindness
- Dermatitis

Attention in vegetarian and vegan patients

- Zinc levels were found to be significantly low in our studied cohort (requiring additional supplementation)
- Significant difference was found between Interventions at different time intervals

Chi Square : $p<0.018$

	Post-operative Biochemistry Monitoring Period				
Total Bariatric surgeries, n = 222	3 months	6 months	12 months	18 months	24 months
OAGB Patients, n=83 (37.4%)					
Number of patients with Zn ≤ 10	9	10	22	11	4
Lowest Zn value found per period	8.3	7.9	6.5	6.9	8
OAGB attended blood tests per period	44 (53%)	44 (53%)	52 (62%)	39 (47%)	21 (25%)
Percent of attendees with Zn ≤ 10	20%	23%	42%	28%	19%
SG Patients, n=83 (37.4%)					
Number of patinets with Zn ≤ 10	4	9	14	4	1
Lowest Zn value found per period	9	8.2	7.9	7.3	10
SG attended blood tests per period	48 (57%)	53 (64%)	49 (59%)	28 (34%)	8 (10%)
Percent of attendees with Zn ≤ 10	8.0%	17%	29%	14%	12%
RYGB Patients, n=56 (25.2%)					
Number of patients with Zinc ≤ 10	5	5	7	8	3
Lowest Zn value found per period	8.6	8.2	7.3	3.8	8.8
RYGB attended blood tests per period	47 (84%)	37 (66%)	19 (33%)	16 (29%)	13 (23%)
Percent of attendees with Zn ≤ 10	11%	14%	37%	50%	23%

Zinc : Subgroup Analysis

Relative Risk at 3 Months	Relative Risk at 6 Months	Relative Risk at 12 Months	Relative Risk at 18 Months	Relative Risk at 24 Months
OAGB/Sleeve = 0.22/0.08= 2.5	OAGB/Sleeve = 0.23/0.17= 1.35	OAGB/Sleeve = 0.42/0.29= 1.44	RYGB/sleeve = 0.50/0.14= 3.57	RYGB/sleeve = 0.23/0.12= 1.91
OAGB /RYGB= 0.20/0.11= 1.88	OAGB/RYGB= 0.23/0.14=1.64	OAGB/RYGB= 0.42/0.37=1.14	RYGB/OAGB= 0.50/0.28= 1.78	RYGB/OAGB= 0.23/0.19= 1.21

RESULTS

Copper

Deficiency may be caused by excess zinc intake, malabsorption and GI losses

Signs and symptoms of deficiency:

- Immune system impairment
- Bone demineralisation.

Attention in vegetarian and vegan patients

- Risk of copper deficiency is very low
- Rather high copper levels were found in our cohort
- No Significant Difference between interventions (p value = 0.26)
- This could be due to low zinc levels in our cohort (commonest cause reported in literature)
- Can be treated by giving patients Zinc (prevents copper from accumulating in liver and GI tract)

	Post-operative Biochemistry Monitoring Period				
Total Bariatric surgeries, n = 222	3 months	6 months	12 months	18 months	24 months
OAGB Patients, n=83 (37.4%)					
Number of patients with CU > 22	8	5	5	2	2
Number of patients with CU < 11	0	0	0	1	1
Highest CU value found per period	27.2	36.4	28.7	27.2	24.7
Lowest CU value found per period	n/a	n/a	n/a	10.1	9.3
OAGB attended blood tests per period	44 (53%)	44 (53%)	52 (62%)	39 (47%)	21 (25%)
Percent of attendees with CU > 22	18%	11%	10%	5%	9%
Percent of attendees with CU < 11	0%	0%	0%	3%	4%
SG Patients, n=83 (37.4%)					
Number of patients with CU > 22	15	13	9	9	3
Number of patients with CU < 11	1	2	1	1	0
Highest CU value found per period	36.4	40.5	26.2	29.8	28.3
Lowest CU value found per period	9.9	9.7	9.4	9.1	n/a
SG attended blood tests per period	48 (57%)	53 (64%)	48 (58%)	28 (34%)	8 (10%)
Percent of attendees with CU > 22	31%	25%	19%	32%	37%
Percent of attendees with CU < 11	2.0%	4%	2%	4%	0%
RYGB Patients, n=56 (25.2%)					
Number of patients with CU > 22	11	7	2	3	2
Number of patients with CU < 11	0	0	1	0	0
Highest CU value found per period	27.5	25.1	27.5	36.7	25.9
Lowest CU value found per period	N/A	N/A	10.5	N/A	N/A
RYGB attended blood tests per period	47 (84%)	37 (66%)	19 (33%)	16 (29%)	13 (23%)
Percent of attendees with CU > 22	23%	19%	11%	19%	15%
Percent of attendees with CU < 11	0%	0%	5%	0%	0%

RESULTS

B12

- Numbness
- Tingling
- Difficulty walking
- Memory loss

Who is at risk of deficiency

- Bariatric patients
- PPI use
- Chronic inflammation: IBD, celiac
- ETOH use

Vegetarians & vegans at increased risk

- Our studied cohort showed, high B12 levels across interventions and no significant difference between groups was found. (p:0.6)
- Excess B12 is excreted by body and does not have any serious implications.
- Most common cause of raised B12 level in general population is recent B12 injection.

	Post-operative Biochemistry Monitoring Period				
Total Bariatric surgeries, n = 222	3 months	6 months	12 months	18 months	24 months
OAGB Patients, n=83 (37.4%)					
Number of patients with low B12	0	0	1	1	0
Lowest B12 value found per period	n/a	n/a	186	150	n/a
Number of patients with high B12	6	7	19	19	10
Highest B12 value found per period	896	1887	1895	1712	1857
Blood tests attended per period	27 (33%)	23 (28%)	38 (46%)	35 (42%)	19 (23%)
Percent of attendees with low B12	0%	0%	3%	3%	0%
Percent of attendees with high B12	22%	30%	50%	54%	52%
SG Patients, n=83 (37.4%)					
Number of patients with low B12	0	0	0	0	0
Lowest B12 value found per period	n/a	n/a	n/a	n/a	n/a
Number of patients with high B12	13	12	22	11	4
Higest B12 value found per period	1616	1876	1795	1683	1736
Blood tests attended per period	41 (49%)	40 (48%)	42 (51%)	24 (29%)	7 (8%)
Percent of attendees with low B12	0%	0%	0%	0%	0%
Percent of attendees with high B12	32.0%	30%	52%	46%	57%
RYGB Patients, n=56 (25.2%)					
Number of patients with low B12	0	0	0	0	0
Lowest B12 value found per period	n/a	n/a	n/a	n/a	n/a
Number of patients with high B12	8	9	3	6	3
Higest B12 value found per period	1558	1755	863	1570	915
Blood tests attended per period	34 (61%)	26 (46%)	11 (20%)	15 (27%)	12 (21%)
Percent of attendees with low B12	0%	0%	0%	0%	0%
Percent of attendees with high B12	24%	35%	27%	40%	25%

RESULTS

Haemoglobin

- Fatigue
- Dizziness
- Breathlessness
- Chest pain
- Pallor
- Pica
- Brittle, spoon-shaped nails
- Inability to maintain body temperature

Attention in vegetarian and vegan patients

	Post-operative Biochemistry Monitoring Period				
Total Bariatric surgeries, n = 222	3 months	6 months	12 months	18 months	24 months
OAGB Patients, n=83 (37.4%)					
Number of patients with low Hb	4	8	6	5	5
Lowest Hb found per period	102	74	89	80	61
Blood tests attended per period	29 (35%)	25 (30%)	46 (55%)	38 (46%)	21 (25%)
% of attendees with low Hb	14%	32%	13%	13%	29%
SG Patients, n=83 (37.4%)					
Number of patients with low Hb	5	5	2	4	2
Lowest Hgb found per period	104	99	91	87	87
Blood test attended per period	42 (50.%)	45 (54%)	45 (54%)	31 (37%)	8(10%)
% of attendees with low Hb	11%	11%	4%	13%	25%
RYGB Patients, n=56 (25.2%)					
Number of patients with low Hb	2	2	1	2	3
Lowest Hgb found per period	107	104	103	102	91
Blood tests attended per period	39 (70%)	32 (57%)	17 (30%)	17 (30%)	13 (23%)
% of attendees with low Hb	5%	6%	6%	12%	23%

- Hb levels show declining trend over time, with worst levels at 24 months.
- Except OAGB which showed low levels 6 Months as well (p=0.05, May be a type 2 error).

BIOMEMISTRY MONITORING WOLDWIDE

TABLE 3 Postoperative care and biochemical monitoring

Postoperative care and biochemical monitoring	Grade, evidence level, range of evidence
Recommendations	
•Specialist postoperative dietetic support should be provided including individualized nutritional supplementation, support and guidance to achieve long-term weight loss and weight maintenance	Grade D ES 4
•People who have bariatric surgery should have a postoperative follow-up care package within the bariatric surgery service for a minimum of 2 years. This should include monitoring nutritional intake, dietary and nutritional assessment, advice and support	Grade D ES 4
•People discharged from bariatric surgery service follow-up should undergo monitoring of nutritional status at least once a year as part of a shared care model of management	Grade D ES 4
Urea and electrolytes, renal and liver function tests	
•Monitor renal and liver function 3, 6 and 12 months in the first year and then at least annually	GPP
Haematinics	
Full blood count and ferritin	
•Check full blood count and serum ferritin at regular intervals post-surgery	Grade B ES 2 (2+ to 2−)
•Consider the following frequency of monitoring of full blood count and ferritin levels: 3, 6 and 12 months in the first year and at least annually thereafter so that changes in status may be detected	GPP
Folate	
•Check serum folate levels at regular intervals post-surgery	Grade B ES 2 (2+ to 2−)
•Consider the following frequency of monitoring of serum folate levels: 3, 6 and 12 months in the first year and at least annually thereafter so that changes in status may be detected	GPP
Vitamin B12	
•Check vitamin B12 levels at regular intervals following SG, RYGB and malabsorptive procedures such as BPD/DS	Grade B ES 2 (2++ to 2−)
•Consider the following frequency of monitoring of vitamin B12 levels: 3, 6 and 12 months in the first year and at least annually thereafter so that changes in status may be detected	GPP
Vitamin D, calcium and parathyroid hormone	
Vitamin D	
•Check serum 25-hydroxycholecalciferol (D) levels at regular intervals post-surgery	Grade B ES 2 (2+ to 2−)
•Serum 25-hydroxycholecalciferol D levels of 75 nmol/L or greater are considered sufficient.	Grade D ES 4
•Ensure total 25-hydroxycholecalciferol D (D3 and D2) is measured if patient is on vitamin D2 supplements, e.g., ergocalciferol	GPP
•Consider the following frequency of monitoring of vitamin D levels: 3, 6 and 12 months in the first year and at least annually thereafter so that changes in status may be detected	GPP
Calcium	
•Check serum calcium levels at regular intervals	GPP
•Consider the following frequency of monitoring of serum calcium levels: 3, 6 and 12 months in the first year and at least annually thereafter so that changes in status may be detected	GPP
Parathyroid hormone	
•Check parathyroid hormone (to exclude primary hyperparathyroidism) if it has not been checked prior to surgery	GPP
Fat-soluble vitamins A, E and K	
Vitamin A	
Zinc	
•Check serum/plasma zinc levels at regular intervals following SG, RYGB or BPD/DS	Grade B ES 2 (2+ to 2)
•Consider monitoring serum/plasma zinc levels at least annually following SG, RYGB or BPD/DS	GPP
•Check serum/plasma zinc levels if unexplained anaemia, hair loss or changes in taste acuity	GPP
Copper	
•Check serum copper levels at regular intervals following SG, RYGB or BPD/DS	Grade C ES 2 (2− to 2)
•Consider monitoring serum copper levels at least annually following SG, RYGB or BPD/DS	GPP
•Check serum copper levels if unexplained anaemia or poor wound healing	GPP
•Serum copper should be monitored in patients taking zinc supplements and vice versa	GPP
Selenium	
•Check serum selenium levels if there is chronic diarrhoea, metabolic bone disease, unexplained anaemia or unexplained cardiomyopathy	Grade D ES 4
•Check serum selenium levels at regular intervals following RYGB	Grade D ES 2 (2−)
•Check serum selenium levels at regular intervals following malabsorptive procedures such as BPD/DS	Grade C ES 2 (2+)
•Consider monitoring serum selenium levels at least annually following RYGB or malabsorptive procedures such as BPD/DS	GPP
Thiamine	

A suggested schedule for postoperative biochemical monitoring is listed in Table 4. Patients who develop micronutrient deficiencies may need more frequent monitoring.

Table 4.

Schedule for Postoperative Micronutrient Monitoring

	6 months	12 months	18 months	24 months	Annually
Vitamin B_{12}	X	X	X	X	X
Folate	X	X	X	X	X
Iron, ferritin	X	X	X	X	X
25-hydroxyvitamin D	X	X	X	X	X
Calcium	X	X	X	X	X
Intact PTH	X	X	X	X	X
24-hour urinary calcium	X†	X†		X†	X†
Thiamine	Optional	Optional	Optional	Optional	Optional
Vitamin A				Optional	Optional
Zinc	Optional	Optional		Optional	Optional
Copper		Optional†			Optional†

Table modified from the Endocrine Society Clinical Practice Guideline (39)

Examinations should be performed after RYGB or BPD DS. All of these could be suggested for patients submitted to restrictive surgery where think deficiencies are less common. Some surgeons perform additional early biochemical evaluation 3 months postoperatively, and the AACE TOS ASMBS Clinical Practice Guidelines suggest evaluation earlier than 6 months for some micronutrients (22)

† Recommendation from the AACE TOS ASMBS Clinical Practice Guidelines (22)

Nutrient marker	Post-operative at 6 months	Annual*
Iron studies	RYGB 6–12 months AGB, SG optional at 6 months	RYGB, and optional AGB, SG
Vitamin B12 (methylmalonic acid optional)	At 3–6 months if supplemented (AGB, SG, RYGB)	AGB, SG, RYGB
Folic acid (RBC folate, homocysteine)	RYGB 6–12 months AGB, optional SG at 6 months	RYGB, and optional AGB, SG
25-vitamin D	Optional	AGB, SG, RYGB
Vitamin A	RYGB	RYGB every 6–12 months
Vitamin E	Optional	Optional
Zinc	Optional	Optional
Thiamine	Persistent vomiting (SG, RYGB)	Persistent vomiting (SG, RYGB)
Parathyroid hormone	Optional	Optional
Magnesium	Optional	Optional
Selenium	Optional	RYGB
Copper	Optional	Optional persistent unresolved problems with iron levels

General Important Considerations

- Type of procedure
- Clinical Signs and Symptoms
- Diet recall
- Patient report on adherence to supplementation
- Vegan & vegetarian diet
- History of inflammatory GI disease

CONCLUSION

- Post-operative micronutrient monitoring is important.
- Higher risk of zinc deficiency at 3 months, this trend continues till 12 months for OAGB, 12 months for Sleeve and 18 months after RYGB
- Patients with OAGB may require closer monitoring and consideration of additional zinc supplementation/higher doses
- Hb deficiencies worsen with time, there is room for further study with a larger cohort to further study if there is a difference in OAGB compared to other groups
- We need to consider further research for Copper and B12 supplementation and review current recommendations according to findings

Thank You!