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COMPARISON OF MICRONUTRIENT DEFICIENCIES FOLLOWING SLEEVE GASTRECTOMY, ROUX-EN-Y AND ONE ANASTOMOSIS GASTRIC BYPASS

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CLINICAL CONTEXT

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- Sleeve gastrectomy is the most commonly performed bariatric procedure
- Some patients are concerned about having a gastric bypass due to concerns regarding malnutrition or micronutrient deficiencies. This can lead to patients having a sleeve gastrectomy when it is not necessarily the most appropriate procedure.
- Previous comparisons have been made on the incidence of micronutrient deficiencies in sleeve gastrectomy (SG) versus Roux-en-Y Bypass (RYGB); however, limited research has been conducted to include one anastomosis gastric bypass (OAGB) within the comparison.

AIM

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The aim of this study is to compare the type and incidence of micronutrient deficiencies following either sleeve gastrectomy (SG), Roux-en-Y gastric bypass (RYGB) or one anastomosis gastric bypass (OAGB).

METHODS

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- Retrospective chart analysis of 370 patients from a single surgeon private practice database who underwent bariatric surgery between 2020 – 2023
- A total of 201 patients were included in the study; 33 who underwent RYGB, 83 who underwent SG, 85 who underwent OAGB procedures
- **Inclusion criteria**
  1. Primary cases who underwent either a RYGB, SG or OAGB with Dr Jason Wong
  2. Available bloods tests within 6 months pre-operatively, at 6 months post-operatively (+/- 1 month) and at 12 months post-operatively (+/- 1 month)
- **Exclusion criteria**
  1. Revision cases (those that had previously undergone a bariatric procedure)
  2. Patients with incomplete or incorrectly timed blood tests

PATIENT POPULATION

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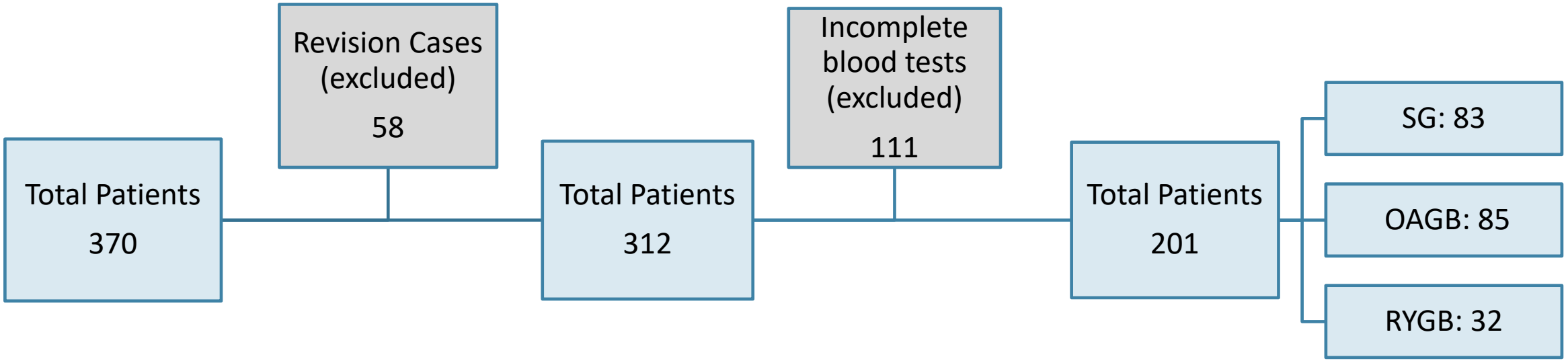

DATA COLLECTION

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- The following variables were analysed:
  1. Patient demographic details including age and gender
  2. Pre-operative diet of patient (e.g. vegetarian, coeliac, lactose free and full diet)
  3. Procedure performed; SG, OAGB, RYGB
  4. Micronutrients prior to procedure and at 6 and 12 months post-operatively
  5. Compliance with medical and allied health follow up in attending appointments and taking recommended supplements
  6. BP limb length (cm) in OAGB and RYGB cases

Micronutrients included in evaluation:

- Vitamin A
- Vitamin B12
- Vitamin D
- Iron studies
- Folate
- Magnesium
- Potassium
- Phosphate
- Selenium
- Calcium
- Zinc

BP Limb Length Categories

- OAGB: < 150, 150-199, 200-250, ≥250
- RYGB: < 50, 50-99, 100-49, ≥150

FOLLOW UP PROTOCOL

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Follow Up	Medical	Dietician
2 weeks	✓	✓
4 weeks	✓	✓
6 weeks		✓
8 weeks	✓	
3 months	✓	✓
6 months	✓	✓
12 months	✓	✓

Supplement Regime:

- 2 x BN multivitamins, 2 x Calcium daily
- Vitamin B12 weekly
- +/- vitamin D as necessary

STUDY OUTCOMES

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Primary Outcome:

- Rate of micronutrient deficiencies following SG vs OAGB vs RYGB

Secondary Outcome:

- The effect of pre-operative diet on micronutrient deficiencies pre-operatively and post-operatively
- The effect of compliance with clinical follow-up and use of supplements on incidence of post-operative micronutrient deficiencies
- The effect of BP limb length in OAGB and RYGB on incidence of micronutrient deficiencies

STATISTICAL ANALYSIS

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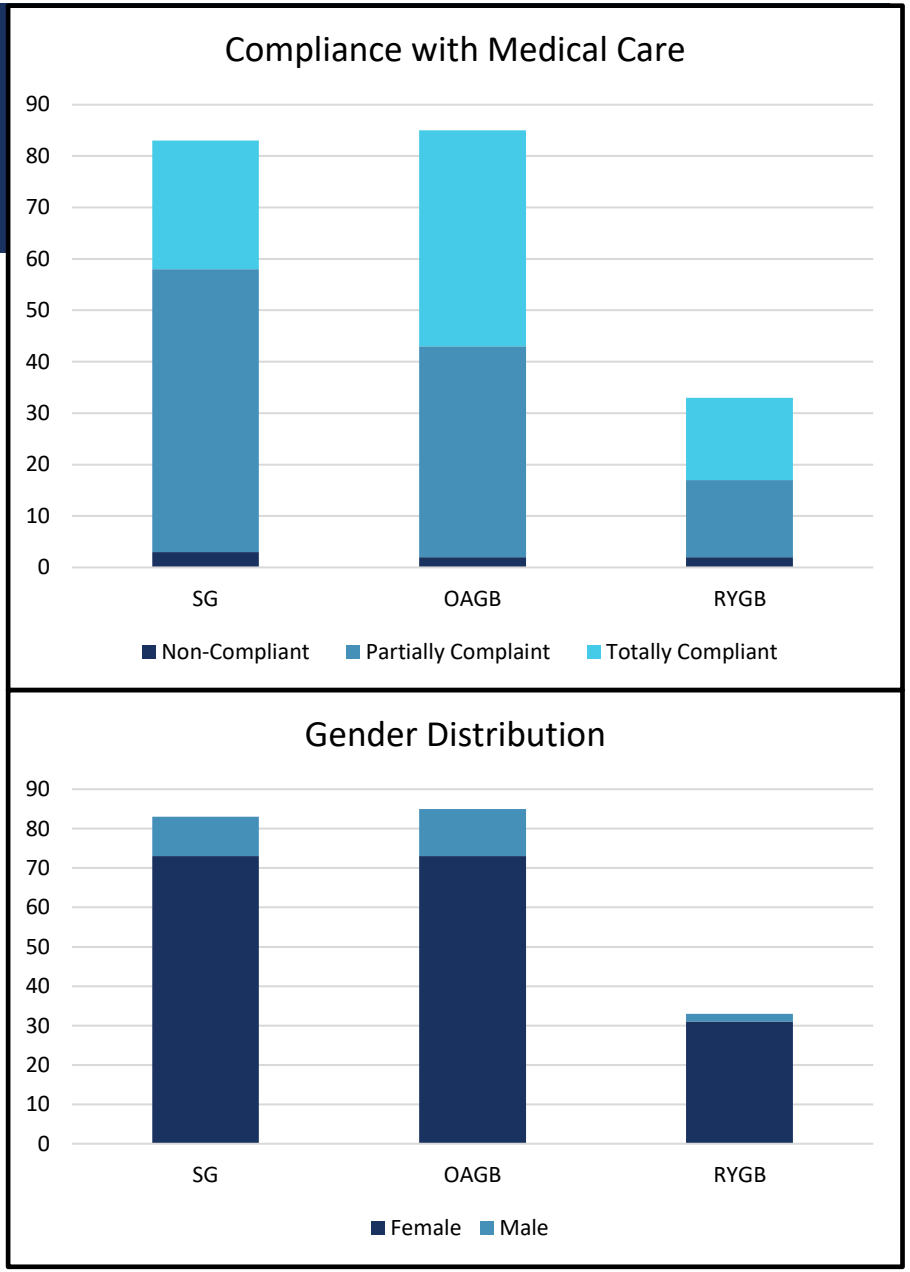
- Descriptive statistics were used for continuous variables and categorical variables were presented as a percentage
- Multivariate multiple linear regression was used to investigate the impact of the independent variables of procedure (Sleeve vs OAGB vs RYGB), preoperative diet, postoperative diet compliance and limb length on the dependent variables of micronutrient changes from preoperatively to 6- and 12- months postoperatively.

POPULATION STATISTICS

Population Demographics

- 88% were female and 12% were male
- 98% of the population had a normal pre-operative diet, with the incidence of lactose free diet and gluten free diet being 1.5% and 1% respectively pre-operatively
- The mean age across the three groups varied from 42 - 47
- The rate of compliance to medical follow up varied between 41% total compliance and 55% partial compliance
- The median BP limb length was 168cm and 93cm in OAGB and RYGB respectively

**Nil significance difference found across the population groups*



RATE OF DEFICIENCIES IN POPULATION GROUPS

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	Sleeve			OAGB			RYGB		
	0 months	6 months	12 months	0 months	6 months	12 months	0 months	6 months	12 months
Ferritin	18.3%	7.2%	10.8%	11.8%	20.2%	23.8%	12.5%	9.4%	18.8%
Total B12	2.7%	0%	4.2%	2.5%	1.61%	4.1%	0%	0%	3.2%
Folate	0%	0%	0%	0%	3.6%	4.8%	0%	3.2%	0%
Zinc	2.6%	2.%	0%	2.5%	14.6%	8.8%	12.5%	10%	12.9%
Vitamin A	3.1%	1.9%	0%	0%	0%	0%	0%	3.3%	0%
Calcium	0%	0%	0%	0%	1.2%	0%	0%	3.3%	0%
Magnesium	2.5%	0%	0%	0%	1.2%	1.2%	0%	0%	0%
Vitamin D	38.3%	0%	4.9%	34.9%	4.8%	12.9%	35.5%	3.1%	9.4%
Potassium	0%	0%	0%	0%	2.4%	0%	0%	0%	0%
Phosphate	1.5%	0%	1.8%	1.4%	0%	0%	0%	0%	0%
Selenium	0%	0%	0%	0%	0%	0%	0%	0%	0%

RATE OF DEFICIENCIES

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	0 months	6 months	12 months
Ferritin	0.54	0.01	0.14
Total B12	1.00	0.56	1.00
Folate	0.20	0.22	0.11
Zinc	0.08	0.02	0.01
Vitamin A	0.58	0.70	1.00
Calcium	1.00	0.40	0.58
Magnesium	0.10	1.0	1.00
Vitamin D	0.91	0.04	0.16
Potassium	1.00	0.65	1.00
Phosphate	0.85	0.13	0.45
Selenium	0.35	0.18	0.64

A three way analysis shows that:

- Pre-operatively there were no significant (p value < 0.05) differences between the patient population groups in any of the micronutrients measured
- At 6 months, there was statistically significant differences found in ferritin, zinc and vitamin D between the three population groups
- By 12 months, only zinc had a persistently statistically significant difference between the population groups

RATES OF DEFICIENCIES WITH BP LIMB LENGTH

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	0 months	6 months	12 months
Ferritin	0.11	0.74	0.27
Total B12	0.48	1.0	1.0
Folate	-	1.0	0.65
Zinc	0.15	0.56	0.30
Vitamin A	1.0	0.34	1.0
Calcium	-	0.18	-
Magnesium	0.30	1.0	1.0
Vitamin D	0.44	0.45	0.55
Potassium	1.0	0.51	-
Phosphate	1.0	1.0	1.0
Selenium	1.0	1.0	0.65

- No statistically significant difference was found between the different BP limb length groups

REGRESSIONAL ANALYSIS – 6 MONTHS

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	Procedure				Pre-operative Diet				Compliance with Follow Up			
	OAGB		RYGB		Lactose Free		Gluten Free		Partial Compliance		Total Compliance	
	Co-Ef.	**P value.**	**Co-Ef.**	**P value.**	**Co-Ef.**	**P value.**	**Co-Ef.**	**P value.**	**Co-Ef.**	**P value.**	**Co-Ef.**	**P value.**
Ferritin	- 28.5	0.06	- 15.0	0.47	+ 4.2	0.94	+ 13.4	0.89	+ 18.5	0.62	+ 30.8	0.42
Total B12	+ 0.06	0.10	- 11.0	- 0.21	-168.3	0.24	+ 25.9	0.9	+ 83.3	0.49	+ 118.8	0.32
Folate	- 4.0	0.03	+ 0.7	0.79	+ 5.7	0.41	+ 7.3	0.55	+ 8.5	0.07	+ 13.0	0.01
Zinc	- 2.4	0.39	+ 1.2	0.75	+ 1.2	0.91	- 0.1	0.1	+ 0.5	0.93	- 1.9	0.78
Vitamin A	- 0.2	0.15	- 0.5	0.01	+ 0.1	0.9			- 0.3	0.14	- 0.3	0.15
Calcium	- 0.1	0.88	- 0.1	0.19	- 0.1	0.14	-0.1	0.80	+ 0.1	0.84	+ 0.1	0.46
Magnesium	- 0.1	0.23	- 0.1	0.08	+ 0.1	0.08	- 0.1	0.88	+ 0.1	0.96	- 0.1	0.89
Vitamin D	- 10.3	0.01	- 5.8	0.26	- 14.3	0.31	+ 41.4	0.09	+ 7.0	0.46	+ 14.3	0.14
Potassium	- 0.1	0.01	- 0.1	0.67	- 0.4	0.02			- 0.1	0.62	- 0.1	0.29
Phosphate	+ 0.9	0.34	+ 0.9	0.51	- 0.3	0.94	+ 0.4	0.93	- 0.1	0.97	+ 0.45	0.88

REGRESSIONAL ANALYSIS – 12 MONTHS

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	Procedure				Pre-operative Diet				Compliance with Follow Up			
	OAGB		RYGB		Lactose Free		Gluten Free		Partial Compliance		Total Compliance	
	Co-Ef.	**P value.**	**Co-Ef.**	**P value.**	**Co-Ef.**	**P value.**	**Co-Ef.**	**P value.**	**Co-Ef.**	**P value.**	**Co-Ef.**	**P value.**
Ferritin	- 3.9	0.7	- 0.6	0.96	+ 2.6	0.95	- 6.3	0.92	- 22.6	0.41	- 30.6	0.27
Total B12	+ 31.3	0.41	- 16.0	0.86	+ 51.6	0.72	- 158.7	0.44	- 7.1	0.94	71.8	0.45
Folate	- 1.62	0.49	+ 0.9	0.79	- 6.9	0.43	+ 149.9	0.01	- 2.16	0.71	+ 0.1	0.99
Zinc	- 0.63	0.07	- 0.8	0.10	+ 1.3	0.28	+ 2.7	0.21	- 0.5	0.65	- 0.2	0.86
Vitamin A	+ 0.1	0.68	- 0.1	0.74	- 0.1	0.67			- 0.2	0.58	- 0.2	0.60
Calcium	- 0.1	0.57	+ 0.1	0.41	+ 0.1	0.68	- 0.1	0.60	- 0.1	0.61	- 0.1	0.65
Magnesium	- 0.1	0.04	-0.1	0.4	- 0.1	0.15	- 0.1	0.73	- 0.1	0.01	- 0.1	0.01
Vitamin D	+ 1.2	0.70	+ 0.4	0.93	+ 1.0	0.92	- 35.0	0.08	- 0.45	0.96	+ 2.0	0.83
Potassium	+ 0.1	0.04	+ 0.1	0.9	+ 0.1	0.86			- 0.1	0.95	+ 0.1	0.86
Phosphate	+ 0.1	0.65	+ 0.1	0.80	+ 0.1	0.40	+ 0.1	0.62	- 0.2	0.06	-0.1	0.15

CONCLUSIONS

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Primary Outcome:

- Micronutrient deficiencies in iron, vitamin D and zinc were found to be significantly different between patients who underwent SG versus OAGB or RYGB at 6 months post-operatively
- However, these had mostly resolved by 12 months with the only ongoing significant difference being seen with zinc

Secondary Outcome

- No significant differences were found in pre-operative diet, compliance with follow up or BP limb length in the population groups

LIMITATIONS OF STUDY

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1. Our exclusion criteria excludes the majority of non-compliant patients, which makes the effect of adherence to follow up difficult to evaluate
2. The small sample size of pre-operative diet candidates means that the conclusions drawn cannot be reliably extrapolated
3. Differences in laboratory reference ranges caused inconsistencies and made data analysis difficult

ADDITIONAL CONSIDERATIONS

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Conflict of Interest

- I have no conflict of interests to disclose

Ethical Considerations

- This study was conducted as a retrospective chart review analysis; being retrospective, this did not have any impact on patient care or outcomes going forward. The results were approved by HREC in 2024.

Financial Considerations

- This study was conducted with in-kind support by the authors listed with no internal or external funding. There are no financial conflicts of interest of any of the listed authors.