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The bariatric surgery patient

Nutrition considerations

Background

Bariatric surgery is an effective method of weight loss for the treatment of morbid obesity. It is more effective when combined with nutritional care, which is sometimes complex, always ongoing and differs between surgical procedures. In Australia, the three most common bariatric surgical procedures are the adjustable gastric banding, sleeve gastrectomy and the Roux-en-Y gastric bypass.

Objective

This article introduces the nutritional and dietary considerations for each procedure, and provides practical advice to support the general practitioner's role in managing patients who are considering, or who have had, bariatric surgery.

Discussion

While bariatric procedures influence the volume of food consumed, none of the procedures necessarily improve the quality of food consumed or compliance with recommended supplement usage, leaving nutrition care and food choice important lifelong considerations. Ongoing coordinated care by the GP, that links with the bariatric dietitian and others in the health management team, maximises the benefits and health outcomes for the patient through ongoing monitoring of nutritional status, prevention of nutrient deficiencies and maximising long term weight loss.

Keywords

bariatrics, bariatric surgery; morbid obesity; nutrition therapy

Bariatric surgery is currently the most effective and sustainable method of weight loss for the treatment of morbid obesity.¹⁻³ Morbid obesity is defined as a body mass index (BMI) greater than 40 kg/m².⁴ Bariatric surgery is also recommended for people with comorbidities at a BMI of 35 kg/m² or more.⁴

Morbid obesity reduces life expectancy by 5–20 years.^{2,5-7} Bariatric surgery not only reduces body weight, it reduces (and sometimes resolves) comorbidities, such as diabetes and obstructive sleep apnoea, and improves quality of life.⁶⁻⁸ In Australia, the three most common bariatric surgical procedures are the adjustable gastric band (AGB), sleeve gastrectomy (SG), and the Roux-en-Y gastric bypass (RYGB).⁹ Details about these surgical

procedures is beyond the scope of this article; information is available online from The Obesity Surgery Society of Australia and New Zealand.¹⁰

The aim of this article is to explore the nutrition and dietary considerations for these three surgical procedures.

Pre-operative assessment and advice

Baseline nutrition-related biochemistry

Between 35–80% of bariatric candidates are in a state of 'high calorie malnutrition' and show some dietary deficiency pre-operatively,⁷ with a reported prevalence of 60–80% for vitamin D, 24% for folate, 14.5% for selenium and up to 35% for iron.¹¹⁻¹⁷ Nutrient-poor food choices, chronic dieting cycles, side effects of medications to treat comorbidities and other factors contribute to this state of 'malnutrition' masked by an ample energy intake. Therefore, regardless of the bariatric procedure proposed, a comprehensive screening is recommended, ideally in sufficient time to correct deficiencies before surgery.^{3,15,18,19}

The screening tests and subsequent ongoing monitoring enable the practitioner to recognise and distinguish between pre-existing nutritional concerns and those due to post-operative complications, known deficiency risks linked to the specific procedure performed and non-compliance with recommended nutrient supplementation. *Table 1* summarises the suggested baseline pre-operative biochemical markers and profiles for all bariatric surgery candidates, and other nutrients 'at risk' related to medication usage or poor dietary quality. These investigations are in addition to a full blood count, lipid profile and diabetes markers. These nutrient marker investigations should be repeated as depicted in *Table 1*, unless a higher frequency is indicated due to the presence of other comorbidities.³

Nutrition and dietary assessment

To complement the medical nutrition screening, a comprehensive pre-operative dietary assessment by a bariatric accredited practising dietitian (APD) identifies additional factors that potentially impact on nutritional status pre and post surgery. These include dietary beliefs and behaviours, cultural background, psychosocial issues (motivation, non-hungry eating), economic factors and goal setting.³

Preparation for surgery

For 2–4 weeks immediately before surgery, most patients are advised to follow a very low energy diet (VLED).

This protocol helps reduce liver volume by up to 25%, which in turn reduces intra-operative complications.²⁰ This typically includes three VLED meal replacements daily, and is further adjusted to suit each patient’s protein and nutrient requirements. Pre-operatively, the dietitian advises about VLED product selection, addition of low carbohydrate-low joule foods, adequate hydration, stimulus control, fibre supplementation and any surgeon-specific requirements. A medication review and patient assessment for contraindications and suitability is required before starting the VLED protocol. The low carbohydrate content of VLED protocols reduces blood glucose levels suddenly. To reduce risk of hypoglycaemia, an active management plan to adjust medication and monitor blood glucose is recommended.

Post-operative nutrition care

The focus during the first 1–8 weeks post-operatively is to maintain adequate hydration, provide adequate nutrients and protein to support healing and minimise loss of lean muscle mass, and progressively return to ‘normal’ food.^{3,15}

Texture progression

After all bariatric procedures, a patient’s diet transitions from liquids to puree/blended foods, and then back onto solids.³ The duration of each transition phase depends on the procedure performed and the patient’s tolerance. The purpose of the texture progression in the case of the SG and RYGB is to preserve the staple line and enhance healing, and in all cases to prevent unnecessary gastrointestinal symptoms.¹⁵ Each phase is designed by a dietitian to ensure

Table 1. Biochemical parameters and suggested monitoring frequency classified by type of surgical procedure³

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

* At least annually but more frequently if clinically indicated

AGB = adjustable gastric band; SG = sleeve gastrectomy; RYGB = Roux-en-Y gastric bypass

Table 2. Common suggested texture progressions (classified by type of surgical procedure)

| Texture progression | Weeks after surgery for each texture | | |
|---------------------|--------------------------------------|-----------|-----------|
| | AGB | SG | RYGB |
| Fluids | Weeks 1–2 | Weeks 1–2 | Weeks 1–2 |
| Puree | Weeks 2–4 | Weeks 2–4 | Weeks 2–4 |
| Soft solids | Weeks 3–4 (optional phase) | Weeks 4–6 | Weeks 4–6 |
| Normal solids | Weeks 4–5 | Weeks 6–8 | Weeks 6–8 |

nutrient requirements match satiation within the texture permitted. Nutrient supplements and formulated specific food products may be required to ensure nutritional adequacy and maintain muscle mass yet maximise fat loss. Common progressions and durations at each phase are shown in *Table 2*.

Eating style

While bariatric procedures aim to influence the volume of food consumed, none of the procedures necessarily improve the quality of food and drinks consumed, nor a patient’s dysfunctional eating and drinking style. The different mechanisms of action of each

procedure can also have a distinct influence on specific eating behaviours.^{21–23}

The AGB creates a narrowing near the gastro-oesophageal junction to influence solid volume consumed and promote early satiety. Specific eating behaviours (*Table 3*) help minimise problems such as regurgitation and food blockages, which if left unmanaged, promote the consumption of inappropriate, less satiating food textures.²¹ After SG and RYGB, the reduced gastric volume combined with hormonal changes, taste changes and, in the case of SG, increased gastric emptying, influence eating style. Dysfunctional eating behaviour may result in discomfort, regurgitation and dumping syndrome.^{24–26}

Simple changes to a patient's eating and drinking style, as outlined in *Table 3*, can minimise the adverse symptoms and help the

patient adjust to and establish new eating and drinking behaviours.¹⁸ *Table 4* provides a brief trouble-shooting guide to some of the more common dietary related complaints/adverse gastro-intestinal symptoms reported after bariatric surgery. These symptoms and common complaints may appear early (weeks) or late (years).

Vitamin, mineral and trace element monitoring and supplementation

Lifelong vitamin and mineral supplementation is recommended after all bariatric procedures.^{3,15,18,25} Supplement selection is influenced by the procedure performed, pre-operative status and the findings during long term nutrition monitoring. Poor eating behaviour, low nutrient food choices, altered food tolerance and restricted portion size can contribute to potential nutrient deficiencies.³

Altered absorption or treatment of nutrients after RYGB and SG add to the potential for deficiencies.^{3,18,26}

Adjustable gastric banding does not impact on nutrient absorption or utilisation. Any nutritional aberrations that occur are due to dietary choice (food quality, tolerance and volume limits), drug-nutrient interactions, or other medical/aging causes.^{15,22} After AGB, a comprehensive multivitamin and mineral supplement that satisfies the gender and age specific 'nutrient reference values' for the patient is recommended.^{3,15}

After SG, early satiety and a gastric volume that is restricted to about 15% of original capacity impact on dietary intake.²⁴ Although SG does not cause malabsorption, it appears to alter nutrient utilisation, in particular of vitamin B₁₂ and iron.^{11,13} Hence, a complete multivitamin and mineral

Table 3. Eating behaviours to encourage (classified by type of surgical procedure)

| Eating behaviour | Explanation | Practical tip |
|---|--|--|
| Eat regular meals – avoid skipping meals | Due to the very small gastric volume, skipping meals results in inadequate nutrition, especially protein, as patients cannot eat more to compensate at the next meal (SG, RYGB). Going for long periods of time without food can result in nausea and hunger, therefore patients can be more likely to eat too fast or too much at the next meal, resulting in adverse side effects (AGB, RYGB, SG). | Plan meals ahead of time so appropriate choices are made Cook in bulk and freeze meals |
| Consume smaller amounts | Satiety is achieved with smaller serves but external tools/reminders may be needed to reduce over-serving (AGB, RYGB, SG). | Serve onto small side plates and child-sized bowls to moderate volume Use toddler-sized cutlery to reduce bite-volume and eating pace |
| Cut food into small pieces | Small cut-size aids the thorough mastication of food (AGB) and gives perception of more food (AGB, RYGB, SG). | Use small utensils to pick up smaller amounts of food |
| Chew well | Poor mastication increases risk of blockages (AGB) and fast eating (AGB, RYGB, SG). | Use the tongue to feel for remaining food lumps before swallowing |
| Eat slowly | Fast eating increases the risk of overeating (AGB, RYGB, SG), pain and regurgitation (AGB). | Wait at least 30 seconds between each swallow (AGB) Aim to make a meal last 20–30 minutes, but no longer than an hour |
| Avoid distraction when eating – practise mindful eating | Distracted eating is linked to overconsumption and poor food appreciation (AGB, RYGB, SG). | Make eating a pure behaviour by removing external stimuli such as the TV, computer and work |
| Avoid eating and drinking at the same time | If the patient is not diligent in allowing enough time between swallows, drinking and eating together may wash inadequately chewed food into the stomach and contribute to pain, regurgitation or blockage (AGB). The stomach capacity is small and fluids may displace capacity for solid foods (SG, RYGB) or contribute to dumping syndrome (SG, RYGB). | Do not place drinking vessels at the dining area Set a timer as a reminder to commence/cease drinking Carry a sipper bottle of water |

Table 4. Common complaints and solutions for gastrointestinal symptoms (classified by type of surgical procedure)

| Symptom | Suggested management |
|---|---|
| Nausea or vomiting | <ul style="list-style-type: none"> • Recurrent vomiting needs to be addressed urgently, particularly in the first 8 weeks after RYGB and SG surgery, as it may lead to thiamine depletion and dehydration • Vomiting could be a result of stenosis/anastomotic stricture following SG or RYGB, generally occurring around 8 weeks post-operatively (previously 10%, now 2% of patients with a good anastomosis) • Long term nausea and vomiting occur after SG and RYGB when stomach capacity is exceeded • Remind the patient not to rush through texture transition phases • Reinforce the need to dramatically reduce total volume consumed at any single time after SG and RYGB • Remind the patient to eat slowly, chew well and keep to recommended portion sizes • Suggest that eating and drinking together are incompatible, especially following SG and RYGB |
| Regurgitation or bolus food block (different from vomiting and only applies to AGB) | <ul style="list-style-type: none"> • Reinforce the eating behaviours listed in Table 3 • Recommend follow up with surgeon as band may be too tight and need adjustment (AGB) |
| Constipation (AGB, RYGB, SG) | <ul style="list-style-type: none"> • Check that the patient is not confusing reduced frequency/volume of bowel output due to reduced intake with constipation • Encourage adequate fluid (1000–1500 mL/day), high fibre intake (25–30 g/day) and exercise • Recommend fibre supplement to boost intake |
| Overly decreased appetite (common after RYGB and SG) | <ul style="list-style-type: none"> • Following SG or RYGB, five or six half volume meals spread over the day are better tolerated and help achieve an adequate protein intake • Low energy, high protein meal replacements or protein supplements may be necessary to meet protein requirements • Avoid unplanned snacking or ‘grazing’ behaviours, especially on ‘poor quality’ foods |
| Dumping syndrome (not common after AGB) | <ul style="list-style-type: none"> • More common after RYGB, SG • Encourage adequate protein and low glycaemic index carbohydrate foods • Remind patient to separate fluid and foods • Discourage highly refined and processed sugar foods and drinks |
| Diarrhoea | <ul style="list-style-type: none"> • Review dumping syndrome management • Consider that it may be a transient post-operative event • Add soluble fibre in some circumstances |

supplement high in B₁₂ is recommended, plus iron and others as required.^{3,13}

After RYGB, the changes in gastrointestinal physiology result in altered absorption or treatment of nutrients.^{3,15} In addition to a complete multivitamin and mineral supplement, specific vitamin, mineral and trace element supplements in higher doses will be required lifelong.^{3,15} The dosage and range will likely change with time in response to laboratory results, including injections of vitamins A, D, B₁₂ and iron when oral therapies are insufficient.^{3,15}

Symptoms of vitamin and mineral deficiency are commonly non-specific, and most characteristic physical findings are seen late in the course of nutrient deficiency. Laboratory confirmation will be most reliable for early diagnosis. *Table 5* provides recommendations for each of the vitamin and mineral supplementations.³

Post-operative biochemical monitoring

Nutritional deficiencies and aberrations may persist and/or only present many years post-operatively, even when the person is in weight maintenance or a regain cycle. Methodical and frequent lifelong testing for nutrient markers is recommended following all procedures.^{3,15,25} In the first year, repeat baseline tests every 6 months after RYGB and SG, on the anniversary for AGB, and then annually thereafter for all procedures (*Table 1*).^{3,15} Further tests including, but not limited to, magnesium, parathyroid hormone, carotenoids, copper and urinary oxalates may be recommended.^{3,15} Unlike AGB that requires the patient to return for band adjustment to effect continued weight loss/maintenance, RYGB or SG do not necessarily require further intervention or specific follow up care to be effective with respect

to weight loss.^{27,28} Thus, patients who have had either of these latter two higher risk procedures (with respect to nutrient status) may become lost to follow up and not have critical nutritional assessment maintained unless the patient responds to a medical practice recall alert.

Expected rates of weight loss

Many patients often have unrealistic expectations for both the rate and total weight loss expected after restrictive surgery. Although the rate of weight loss varies between surgeries and individuals, up to 4 kg weight loss per month is a reasonable expectation.²⁹ Rates are also influenced by time elapsed after surgery, energy intake relative to energy requirements, gender, age and eating motivation. Bariatric surgeries are designed to impact on true physiological hunger. But internal hunger is not the only trigger for

eating motivation. Myriad external factors trigger a person to eat and influence food choice and eating behaviour; at the surface are factors such as psychological health, obesogenic environment, peer influence, belief structure and celebrations. *Table 6* provides specific practical guidelines to support sustained weight loss.

It is not unusual for patients to regain some lost weight after surgery.²⁹ Additional dietary and psychological interventions minimise the risk of regain and are highly indicated for those who are regaining excessively.^{15,29} Patients who make

dietary and lifestyle changes facilitated by their dietitian, as an adjunct to their surgical procedure, have better nutritional and weight loss outcomes than those who have limited follow up.³⁰

Conclusion

Bariatric surgery is a reasonably safe and effective method of weight loss for the treatment of morbid obesity, and is more effective when combined with nutritional care, which is sometimes complex, always ongoing, and differs between surgical procedures. While bariatric procedures

influence the volume of food consumed, none of the procedures necessarily improve the quality of food consumed or compliance with recommended supplement usage, leaving nutrition care and food choice important lifelong considerations. Ongoing coordinated care by the GP, that links with the bariatric dietitian and others in the health management team, maximises the benefits and health outcomes for the patient through ongoing monitoring of nutritional status, prevention of nutrient deficiencies and maximising long term weight loss.

Table 5. Recommendations for vitamin and mineral supplementation (classified by type of surgical procedure)³

| Daily minimum supplement | SG | RYGB | AGB |
|--|--|--|--|
| Routine adult multivitamin plus mineral (includes iron, folic acid and thiamine) | Two chewable initially, then solid | Two chewable initially, then solid | One chewable initially, then solid |
| Elemental calcium | 1 200–1 500 mg (from diet and as citrate supplements in divided doses) | 1 200–1 500 mg (from diet and as citrate supplements in divided doses) | 1 200–1 500 mg (from diet and as citrate supplements in divided doses) |
| Vitamin D | 3 000 IU vitamin D (titrated to therapeutic levels) | 3 000 IU vitamin D (titrated to therapeutic levels) | 3 000 IU vitamin D (titrated to therapeutic levels) |
| Vitamin B ₁₂ | As needed to maintain B ₁₂ levels | As needed to maintain B ₁₂ levels | Within routine supplement levels |
| Total iron | 45–60 mg (from multivitamin + additional supplements) | 45–60 mg (from multivitamin + additional supplements) | If indicated to satisfy NRV if dietary intake plus routine supplement insufficient |
| Other | Further variation to the basic supplement recommendation is required to maintain nutritional status if dietary intake plus routine supplements is insufficient, and for pregnancy planning | | |

Table 6. Guidelines to support healthy long term weight loss and manage suboptimal weight loss

| Guideline | Specifics |
|---|---|
| Eat nutrient-dense foods and balanced meals | Encourage adequate amount and variety of lean meat or meat alternative, whole grains, reduced/low fat dairy, vegetables/salad, fruits and a modest amount of unsaturated oil/nuts/seeds as per dietary guidelines for Australians |
| Establish a regular eating pattern to avoid meal skipping | Plan for three mealtimes daily with structured mid-meal snacks, as and if required to minimise grazing and impulse eating |
| Avoid energy-dense, nutrient poor foods | Replace foods such as chips, chocolate, sugar, lollies, biscuits, pastries, fried foods, processed meats with more nourishing core foods |
| Avoid kilojoule containing drinks | Make water the drink of choice in order to minimise non-essential kilojoule sources such as fruit juice, alcohol, 'energy' drinks, sports drinks, cordials, soft drinks, excess milk |
| Support mindful consumption and manage 'non-hungry' eating | Refer to dietitian for advice and/or psychologist to learn mindfulness techniques and manage habitual/emotional/other eating triggers |
| Take recommended vitamin and mineral supplements | Monitor biochemistry and encourage compliance with supplements even if feeling well or the active weight loss phase has ceased |
| Exercise and become more active within abilities | Encourage at least 30 minutes of moderate intensity physical activity on most, preferably all days as per the National Physical Activity Guidelines for Adults |
| Monitor weight to identify relapse early | Refer to dietitian and other health professionals for intervention program |
| Maintain ongoing follow up with surgeon, dietitian and psychologist | Frequency to be individually determined by each health professional |

Resources

Obesity Surgery Society Australia New Zealand (OSSANZ). www.ossanz.com.au/nutrition.htm
Find a bariatric dietitian: <http://daa.asn.au/for-the-public/find-an-apd/>.

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