Medical management of diabetes after bariatric surgery

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Abstract

Several studies indicate that bariatric surgery frequently leads to resolution or improvement of type 2 diabetes in overweight patients. However, the medical postoperative management requires lifelong counselling, monitoring and nutrient supplements in patients in remission as well as in patients who continue to be diabetic. The aim of such management is to avoid nutritional deficiencies, and to delay diabetes relapse by optimizing the control of risk factors. To this end, diet and pharmacological prescriptions, including vitamin and mineral supplements, are indispensable, despite the fact that specific recommendations, until now, have been lacking for these particular patients.

Keywords: Bariatric surgery; Diabetes; Nutritional deficiency; Medical management; Review

Introduction

Patients with type 2 diabetes (DT2) are often able to achieve remission of their hyperglycaemia or reduce their required medication following bariatric surgery. In a recent systematic review and meta-analysis [1], 78.1% of diabetic patients showed complete disease resolution and, in 86.6% of cases, the diabetes was either improved or resolved. Fasting glucose levels, insulinaemia and haemoglobin A1c (HbA1c) levels can also decline significantly after bariatric surgery. Also, these favourable responses were maintained for 2 years or more, and were more frequent and pronounced in patients with early diabetes onset, and whose surgical procedures were associated with greater percentages of weight loss such as the roux-en-Y gastric bypass (RYBP). A randomized controlled trial comparing the laparoscopic band with optimized medical...
approaches in patients with DT2 clearly demonstrated that surgically treated patients had a 5.5 relative risk of remission ($P < 0.001$) [2]. Today, the available data convincingly suggest that early surgical intervention for overweight DT2 patients may be clinically appropriate in those for whom operative risks are acceptable. This means that, in the near future, the indications for bariatric surgery are set to drastically increase in overweight [body mass index (BMI) $> 30$ kg/m$^2$] DT2 patients. However, before this happens, it is important to be better able to assess the risks associated with bariatric surgery in order to design the optimal postoperative, long-term, medical management and lifestyle modifications required in this particular category of patients.

2. Benefits of bariatric surgery in diabetes: the postoperative period

More than a decade ago, it was shown that DT2 patients had fewer disease complications and longer lives following bariatric-surgery-induced diabetes resolution [3]. Surgery is not only followed by a significant resolution or improvement of diabetes, but also leads to a significant benefit in mortality [4] with, for example, lower disease-specific death rates for diabetes ($-92\%$) and coronary artery disease ($-59\%$) [5]. In general, bariatric surgery is particularly useful for the management of factors responsible for the high risk of cardiovascular disease. However, it would be unwise to consider DT2 patients whose diabetes was resolved after surgery as if they were the same as non-diabetic patients. The pathophysiology of DT2 suggests that these patients should continue to be treated as potential diabetics with residual risk, despite improvements in the main measurable risk factors such as blood pressure, serum lipid concentrations, insulin resistance and serum markers of inflammation. Indeed, these patients remain at risk of diabetes in the future, and the resolution of their diabetes and related risks are not necessarily definitive. However, it may also be postulated that, as in non-diabetic subjects, persistent weight loss, a healthy diet and increased physical activity will remain the cornerstones of a programme to prevent or delay the recurrence of diabetes and its complications.

3. The dietary challenge: maintaining weight loss and avoiding nutrient deficiency

Bariatric surgery is certainly the most effective tool in the management of obesity and diabetes so far, but it also presents a difficult dietary-management challenge. The role of the clinician is to carefully monitor and support their patients during the long-term changes they will have to make in eating and activity behaviours, while also aiming to both optimize the results of surgery and prevent any nutritional complications related to the procedure. Given this context, the long-term maintenance of the weight loss and the subsequent metabolic benefits is more challenging than the initial weight reduction. Although the diet then becomes of major importance, until now, precise guidelines have been lacking [6].

Bariatric surgery—and especially RYGP, which is the procedure most frequently associated with resolution of diabetes—results in considerable changes and alterations in the digestive process. This results in a non-negligible risk of iatrogenic pathological syndromes such as functional complications (vomiting, dumping syndrome and diarrhoea), metabolic disorders (hypoglycaemia due to pancreatic cell hyperplasia) and nutritional dysfunction (due to an imbalance between digestive secretions, such as acids, enzymes and hormones, and nutrients). Moreover, bariatric surgery is frequently associated to selective food intolerance and more-or-less voluntary dietary restrictions that have consequences that may be more serious in DT2 patients [7].

Few data are available on the specific consequences of RYGB on meal digestion and absorption in diabetic patients. The absorption of carbohydrates starts early in the duodenum, but is limited in the foregut because of the reduced absorptive surface, and the shorter interaction time between polysaccharides and pancreatic enzymes. The resulting large amounts in fructose and polyols lead to diarrhea. As for lipids, reductions in hydrolysis and micella formation are associated with a decrease in lipid and liposoluble-vitamin absorption. Also, the frequent distaste for meat reported after these surgical procedures [8] leads to a decrease in enzyme absorptions, while the reduced intestinal absorptive surface due to exclusion of the duodenum may result in protein deficiency. Nevertheless, such a risk—more often seen with biliopancreatic-diversion procedures—is limited with RYGP.

Micronutrient deficiencies have been widely described after bariatric surgery [9–12], and is of particular importance in diabetes because such deficiencies in micronutrients and microconstituents such as polyphenols are linked with the prevention of oxidative stress. Mitochondrial production of reactive oxygen species (ROS) due to up-regulated glucose oxidation is thought to play a crucial unifying role in the pathogenesis of long-term diabetic complications [13]. An overproduction of ROS contributes to the reduction of glucose-stimulated insulin secretion and to beta-cell apoptosis. ROS also induce a relative increase in levels of oxidized LDL (low-density lipoprotein)-cholesterol particles, which contribute to the patient’s risk of developing cardiovascular disease. The ideal diet needs to protect against oxidative stress. The consumption of five or more servings of fruits and vegetables every day, together with reductions in BMI score, are recommended to reduce cardiovascular disease risk through the beneficial combination of micronutrients, antioxidants, phytochemicals and fibre from these foods, which is often limited after surgery [8]. Nevertheless, although surgical procedures have the advantage of reducing chronic hyperglycaemia and intake of excess high-calorie foods responsible for the production of extracellular ROS (eROS), they also have the disadvantage of leading to deficiencies in the micronutrients and microconstituents involved in antioxidant processes.
The most common micronutrient deficiencies of concern are of vitamins B12 and D, iron and calcium. Other micronutrient deficiencies that can lead to serious complications include thiamine, folates and fat-soluble vitamins. Also, some deficiencies may be of particular concern in diabetics. The accumulated evidence, for example, suggests that low vitamin D levels are associated with impaired glucose metabolism and an increased risk of DT2 [14].

Furthermore, diabetes is associated with alterations in the metabolism of copper, zinc and magnesium, the absorption of which may be profoundly altered after gastric bypass surgery. Copper, for example, is an essential cofactor in many enzymatic reactions in several systems, including those of oxygen radical scavengers and mitochondrial respiration, and may be deficient following bariatric surgery [15,16]. It is postulated that other trace elements more directly involved in islet β-cell function and insulin sensitivity, such as chromium, may also be deficient after such surgery.

4. Long-term postoperative diet

Diet is a major part of the postoperative management strategy in DT2 patients after bariatric surgery. It has important additional health effects, as it can improve the tolerability of the surgical procedure, as well as contribute to the resolution of DT2 in the long term and the control of other risks factors of cardiovascular disease. Further studies, however, are required to define the most appropriate diet for DT2 patients treated by bariatric surgery.

4.1. Patients that are still diabetic

Counselling, monitoring, and nutrient and mineral supplementation are essential for the prevention of nutritional and metabolic complications after bariatric surgery, including in diabetic patients. However, patients who remain diabetic have a greater need for specific dietary advice to help them achieve good glycaemic control based on eating healthy foods with a low glycaemic load and low in saturated fats. A diet that is rich in unsaturated fats and simple carbohydrates with a low glycaemic index, and relatively rich in protein from lean sources and from a wide variety of foods, has proved to be best suited for the management of diabetes.

4.2. Patients in remission

As for patients whose DT2 was resolved after bariatric surgery, there is no good reason to believe that another diet should be prescribed, as diet is the best means, along with physical activity, of preventing diabetes and its cardiovascular complications. Nevertheless, in practice, some alterations in the diet are often necessary to counteract food intolerance and to minimize the mechanical complications associated with the surgical procedure. Judicious monitoring with periodic dietary screening can limit excessive food exclusions, such as meat, to avoid the risk of protein deficiency, and cooked mixed vegetables and fruit may be easier to tolerate than eating them raw. In general, and particularly in cases of the dumping syndrome, limiting the ingestion of simple sugars is necessary. Also, having frequent small meals that include proteins and fibre is useful [17].

As micronutrient deficiencies are commonplace following obesity surgery, it is justified to routinely prescribe an oral multivitamin supplement to ensure that patients receive all of the recommended daily allowances. However, it has been demonstrated that such supplementation does not always prevent deficiencies or cover all mineral needs. For this reason, it may be better to prescribe additional calcium, vitamin D, vitamin B12 and iron as supplements as well.

5. Pharmacological management

There is no place for antidiabetic oral agents in patients whose diabetes has been resolved by surgery. However, the benefits of protective agents against cardiovascular risk such as aspirin, statins or fibrates need to be discussed with each patient on an individual basis. Also, in those who are still diabetic, the dosages of their antidiabetic medications—whether insulin or oral—often need to be decreased. In theory, it is more important to maintain insulin sensitivity rather than resort to insulin-secreting agents to avoid the possible risk of nesidioblastosis seen in the milder forms of diabetes.

However, so far, there has been no controlled trial of the optimal type of supplements and dosages to be prescribed after RYGB. A multivitamin supplement is recommended and should eventually be adapted to any specific deficiencies that arise [20], while particular care needs to be taken concerning vitamin D, iron, vitamin B12 and folic acid. A formula adapted to French requirements has been well described by Poitou-Bernert et al. [10].

6. Prevention of postprandial hyperinsulinaemic hypoglycaemia

Symptoms such as palpitations, tremor, sweating and hunger similar to those experienced with late dumping syndrome, or more severe symptoms such as confusion or loss of consciousness, may occur postprandi ally. These complications, which are mostly observed 1 or 2 years after RNYB, are due to hyperinsulinaemic hypoglycaemia that is related to diffuse islet hyperplasia, with a large number of islet cells and no evidence of insulinoma, and probably secondary to elevated GLP-1 (glucagon-like peptide 1) levels. Although this complication appears to
be less common in patients with preexisting diabetes, its prevention by diet is of particular interest. Indeed, small meals low in carbohydrates (and also with a low glycaemic index), and higher in protein and in unsaturated fats, may prevent it [18,19].

7. Conclusion

Surgical intervention for overweight DT2 patients may be pertinent for those in whom the operative risks are acceptable. However, lifelong dietary counselling and monitoring, and nutritional supplementation, are required for the treatment and prevention of nutritional complications, and for the prevention of diabetes relapse. Also, pharmacological treatments need to be discussed according to the particular risk factors and metabolic situation present in each given patient.

Conflicts of interests

The authors have reported no conflict of interests.

References