

Perioperative physiology and optimisation in bariatric and metabolic surgery

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14. VALORISATION

Since the mid-twentieth century, the influence of surgical procedure into metabolic disease became clearer. Starting with a report of Friedman and colleagues wherein they demonstrated in 1955 that a gastrectomy resulted in resolution of type 2 diabetes mellitus (T2DM). In the 70's and 80's, Bosello and colleagues demonstrated the key mechanisms and interplay between morbid obesity and T2DM. They observed that after a jejunoileal bypass weight loss was the primary factor in lowering hyperglycemia and decreasing insulinemia. Ackerman and Halverson found that immediately after malabsorptive bariatric surgical procedures T2DM patients became euglycemic and were freed from diabetes medication.

Nowadays, with the obesity pandemic reaching epic proportions, there is an ever-increasing need for change. More than 30% of the world population has obesity and associated comorbidities. Scientific research of the last decade has shown that bariatric surgery has effect on metabolic diseases apart from the impact of weight loss. For this reason several bariatric organisations have changed their names into societies for 'bariatric and metabolic surgery'.

RELEVANCE OF THE SCIENTIFIC RESULTS IN THIS THESIS

This thesis contains two parts, both with the purpose of understanding perioperative physiology in bariatric and metabolic surgery. The first part describes cardiopulmonary physiology before and after bariatric and metabolic surgery. Regarding cardiac physiology, specifically cardiac structure and function, patients with pre-existent left ventricular hypertrophy (LVH) and/or hypertension benefit the most from bariatric surgery. According to the available literature, bariatric and metabolic surgery will induce short-term cardiac remodelling in these patients (chapter 2).

Several methods are available to assess cardiovascular hemodynamics (e.g. blood pressure (BP)). One example is the intra-arterial BP measurement, mostly measured of the radial artery, as considered the most accurate one. Because of its invasiveness and its risk for infection it is not suitable for BP measurement in obese patients scheduled for bariatric surgery. Another measurement tool is the auscultatory sphygmomanometry, widely used in clinical practice, based on the principles of Riva-Rocci/Korotkoff. However these measurements can give an overestimation of the BP (when using the correct blood pressure cuff). The measurement device used in this thesis is the Nexfin[®]. This device continuously measures the pressure waveform in the finger and calculates the beat-to-beat brachial BP through an algorithm. The Nexfin[®] device was used in the bariatric population to determine its relation with Riva-Rocci/Korotkoff BP measurement (chapter 3) and to assess cardiovascular hemodynamics before and after bariatric and metabolic surgery (chapter 4). The Nexfin[®] device appeared to be easy to use and capable to determine a trend in cardiovascular hemodynamics. It is less dependent

on brachial blood pressure variations in relation to the circumference of the upper arm and cuff size. Therefore the Nexfin® device can be easily used for clinical and research purposes in obese individuals.

Regarding pulmonary physiology chapters 5 and 6 showed that the altered pulmonary function as a result of obesity could give potential challenges in perioperative care. Changes in pulmonary function are not solely a change in muscle function, but are interplay between muscle function, intrinsic function of the lungs and thoracic compliance (chapter 5 and 6). However predicting inspiratory muscle function might not be useful in bariatric surgery, in other specialties (such as cardiac surgery) it is standard practice (chapter 7).

The final chapter of the first part of this thesis demonstrates the integrative aspect of cardiopulmonary physiology in perioperative exercise. In chapter 8 is shown that perioperative exercise in bariatric surgery is beneficial in terms of weight loss and the reduction of cardiovascular risk factors. However, the optimal exercise regimen for which patient remains unclear. Based on the results found, we recommended an exercise regimen ideally pre- and postoperative. These exercise regimens should last for a median of 12 weeks, has an intensity of either 65% peak heart rate or 65% VO₂ max and is at least partially supervised. When implemented these exercise regimens should give additional benefit for patients before and after bariatric surgery.

The second part of this thesis focussed on two aspects of metabolic physiology; vitamin deficiencies and type 2 diabetes mellitus (T2DM) remission. Screening for nutritional deficiencies is costly. Trying to reduce the costs, an algorithm was developed (Chapter 9), to improve and optimize the screening for nutrient deficiencies after bariatric surgery. We have found that our algorithm is able to reduce vitamin D, B12, B6, B1 and ferritin examinations by 15%, 11%, 28%, 28% and 38%, respectively, without missing clinically relevant deficiencies. Also this corresponds with a potential cost savings of 14%.

The supplementation regimen of vitamin B12 deficiencies after bariatric and metabolic surgery was the focus of chapters 10 and 11. The literature review in chapter 10 showed that to treat a vitamin B12 deficiency with oral multivitamin supplements, a minimum dosage of 350 microgram was necessary. Oral supplements with lower dosages were not able to recover vitamin B12 deficiencies biochemically. Chapter 11 showed us that in a retrospective study a 6 intramuscular vitamin B12 injection regime was able to recover all vitamin B12 deficiencies. According to these two studies an oral supplement must have at least 350 microgram of vitamin B12. Secondly, an intravenous supplementation regimen should at least contain 6 intramuscular injections with a loading dose (one injection). Each injection should contain 1000 µg of hydroxocobalamin.

In the final chapter of part II (chapter 12) we have assessed the time to glycemic control after several bariatric surgical procedures. T2DM is a major burden and therefore the faster remission is achieved, the better it is for patients but also it reduces healthcare costs significantly. Our results demonstrated that in the first 30 days after surgery, patients who had a Diverted Sleeve Gastrectomy and Ileal Transposition (DSIT), or a Mini Gastric Bypass (MGB) achieved glycemic control after respectively 29 and 30 days.

POPULATION OF INTEREST

The results of this thesis are relevant for several groups of patients. Firstly, patients who were recently operated or patients who want to undergo a bariatric surgical procedure. Secondly, this thesis emphasises that bariatric surgery might be beneficial for more than just weight loss. Patients with metabolic, cardiac and/or pulmonary diseases can benefit from bariatric/metabolic surgery.

This thesis is also of interest of clinicians who treat patients with therapeutic resistant cardiac, pulmonary or metabolic diseases. Also, the contents of this thesis are of interest for expert panels, responsible for the development of national and international guidelines.

INNOVATION AND FUTURE

The impact of bariatric surgery on cardiac, pulmonary and metabolic diseases apart from its weight loss effect is becoming clearer. This is not yet reflected by the current guidelines regarding bariatric surgery.

The guidelines of the International Federation of Surgery for Obesity and Metabolic disorders (IFSO) state that surgery is warranted to patients with a BMI greater than 40 kg/m², or greater than 35 kg/m² with serious comorbidities such as type 2 diabetes mellitus. These guidelines were carefully written at that time, but nowadays these guidelines have increasing limitations. Among these limitations are that there were only moderate recommendations for diabetes and metabolic disorders, and that these guidelines are based on only open operations, whereas most procedures are now undertaken laparoscopically, which is safer with a ten-times lower operative mortality. One of the most important goals for future research is elucidating the mechanisms responsible for the remission of metabolic diseases. We have to gain more insight in the effects of bariatric and metabolic surgery on the remission of cardiac and pulmonary diseases. And so, we can help more patients with metabolic diseases.