CHAPTER 1

General introduction

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Obesity

Obesity, which is defined as a body mass index (BMI) of 30 kg/m² or higher, is increasing all over the world, with a prevalence of 1.9 billion adults who were overweight (BMI ≥ 25 kg/m²), of which 600 million people were obese (BMI ≥ 30 kg/m²) (1). The World Health Organization (WHO) has estimated that 1.6% of the total health budget in Europe (300 billion euros) was spend on diseases directly caused by obesity. Even more, obesity is associated with an increase in annual health-care costs of 36% and medication costs of 77% compared to people of average weight. Combined with all its comorbidities, obesity can be considered a burden for humanity as well as the individual patient (2).

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As obesity has always been regarded as preventable, the WHO Global Strategy was mainly focused on prevention by creating awareness on diet, physical activity and health (2).

In the Netherlands the epidemic is still on the rise with 15% of the population suffering from obesity. The incidence of morbid obesity (BMI ≥ 40 kg/m²) is unknown (2). The prevalence of morbid obesity in the Netherlands the epidemic is still on the rise with 15% of the population suffering from obesity. The prevalence of morbid obesity (BMI ≥ 40 kg/m²) is unknown (2). At the beginning of the twenty-first century, the minister of Public Health, Welfare and Sports (PWS) (Volksgezondheid, Welzijn en Sport, (VWS)) assigned a commission who formulated an advice concerning prevention, monitoring and treatment of overweight and obesity (3).

The generally accepted method to classify weight in underweight, normal weight, overweight, obesity and morbid obesity is by BMI, also known as the Quetelet index which is the weight in kilograms related to the height in centimetres (kg/m²) (5). Although the value of BMI is much debated, it is still the most frequently used parameter since it is easy to interpret and only a measuring tape and weight scale are required (5). Based on BMI, different weight categories are defined (4,5), Table 1. Furthermore, obesity itself can be defined in classes of one till three associated with the health risks, class I carrying a high risk, class II very high risk and class III an extremely high risk, Table 1.

Morbid obesity is associated with several severe comorbidities e.g. cardiovascular diseases; some types of cancer; diabetes mellitus type II (DM II); dyslipidaemia; hypertension; osteoarthritis and obstructive sleep apnoea (OSA) resulting in an important threat to the individual and global health (6). (Morbid) obesity is associated with enormous health care costs for society, the PWS estimated in 2012 that 1.6% of the total health budget (74.9 billion euro’s) was spend on diseases directly caused by obesity. Even more, obesity is associated with an increase in annual health-care costs of 36% and medication costs of 77% compared to people of average weight. Combined with all its comorbidities, obesity can be considered a burden for humanity as well as the individual patient (7).
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Figure 1. Map mean BMI worldwide female 2016

Source: www.who.int; 2016

Figure 2. Map mean BMI worldwide male 2016

Source: www.who.int; 2016
Introduction

Table 1: The International Classification of adult underweight, overweight and obesity according to BMI

<table>
<thead>
<tr>
<th>Classification</th>
<th>BMI (kg/m²)</th>
<th>Principal cut-off points</th>
<th>Additional cut-off points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td></td>
<td>&lt; 18.50</td>
<td>&lt; 18.50</td>
</tr>
<tr>
<td>- Severe thinness</td>
<td>&lt; 16.00</td>
<td>&lt; 16.00</td>
<td></td>
</tr>
<tr>
<td>- Moderate thinness</td>
<td>16.00 - 16.99</td>
<td>16.00 - 16.99</td>
<td></td>
</tr>
<tr>
<td>- Mild thinness</td>
<td>17.00 - 18.49</td>
<td>17.00 - 18.49</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>≥ 25.00</td>
<td>≥ 25.00</td>
<td></td>
</tr>
<tr>
<td>- Pre-obese</td>
<td>25.00 - 29.99</td>
<td>25.00 - 27.49</td>
<td>27.50 - 29.99</td>
</tr>
<tr>
<td>Obese</td>
<td>≥ 30.00</td>
<td>≥ 30.00</td>
<td></td>
</tr>
<tr>
<td>- Obese class I</td>
<td>30.00 - 34.99</td>
<td>30.00 - 32.49</td>
<td>32.50 - 34.99</td>
</tr>
<tr>
<td>- Obese class II</td>
<td>35.00 - 39.99</td>
<td>35.00 - 37.49</td>
<td>37.50 - 39.99</td>
</tr>
<tr>
<td>- Obese class III</td>
<td>≥ 40.00</td>
<td>≥40.00</td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from WHO 1995, WHO 2000 and WHO 2004

Recently several studies suggest an ‘obesity paradox’ despite all the negative effects of being overweight. Patients who are overweight or obese have a stronger survival after cardiovascular intervention or kidney disease. Although this seems a contradiction, this paradox is seen in patients already suffering from diseases. Hence, it could be hypothesized that a different pathophysiology in the treated diseases exists between patients with and without obesity (8;9). Further elaboration concerning this subject is outside of the research of this dissertation.

Currently, several treatment options for (morbid) obesity exist, starting with conservative treatment such as diets, most of the time combined with exercise. Surgical treatment of morbid obesity (bariatric surgery) has the best results in terms of weight loss and sustainability (10). Randomized controlled trials and meta-analyses show that dieting and exercise are of limited and inferior value compared to surgical treatment (10). Despite the successes of bariatric surgery, it is important to acknowledge that surgical treatment can cause complications, often due to the anatomical alterations created by surgery. As this dissertation mainly consists of surgical therapy, the conservative and medical therapy for obesity are outside its scope and will therefore not further being discussed.

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At first bariatric surgery was mostly known as weight loss surgery. However, over the
decennia its indication had become increasingly metabolic due to the good results on
decreasing and even curing metabolic syndrome with regard to diabetes, hypertension
and dyslipidaemia (11). Therefore, bariatric surgery is now mostly considered as metabolic
surgery, increasing its applicability for patients with a BMI below 35-40 kg/m² but suffering
from obesity associated diseases (12). International guidelines allow patient with a BMI ≥ 40.0
kg/m² or ≥ 35.0 kg/m² with two or more obesity associated comorbidities to be considered
for bariatric surgery (13).

Bariatric surgery exists of diverse procedures with different mechanisms. First of all, there is
restrictive surgery, reducing the size of food portions, as satiation is more rapidly achieved.
Secondly, malabsorptive surgery is an option, often bypassing a part of the intestine,
decreasing absorption of nutrients and calories. Most popular are the procedures where
restriction is combined with malabsorption.

History of bariatric surgery
The first operations designed for the purpose of weight loss were performed in the 1950’s
and existed of malabsorptive surgery. Hendrikson described in 1952 the first operation in
which the small intestine was bypassed, the jejunoileal bypass, also called the massive
intestinal bypass (14). The jejunoileal induced malabsorption by bypassing almost all of the
small intestine. Although the weight loss reached with this surgery was excellent, severe
complications occurred due to the induced global malabsorption such as diarrhoea, osteo-
porosis and night blindness (vitamin A deficiency). However, it did show how important
long term follow up is in patient who undergo malabsorptive surgery.

In 1967 a new technique of malabsorptive surgery, combined with restriction was developed
by Mason and Ito (15), the gastric bypass. This procedure has been developed based on the
weight loss shown among patients after partial stomach removal as a consequence of
gastric ulcer disease (16). After its invention, it has been further developed during the decades
till its current form, the Roux-en-Y gastric bypass (RYGB; Figure 3) which consists of a small
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till its current form, the Roux-en-Y gastric bypass (RYGB; Figure 3) which consists of a small
proximal pouch for restriction and the Roux-en-Y limb inducing malabsorption.
In its early stages, till 1994, the RYGB was an open procedure with its disadvantages. Large abdominal scars, wound infection, long duration of postoperative pain, pulmonary embolism due to immobilisation and even a mortality rate of 0.82% (16).

In the early nineties, the laparoscopic approach in RYGB (LRYGB) surgery was developed by Wittgrove et al (17). This caused an enormous increase in the performed procedures as the number of postoperative complications decreased significantly and the procedure became relatively safe. This introduction of laparoscopy decreased the mortality rate to 0.22% (a total reduction of 0.60%) (16). Nowadays, the LRYGB is the most frequently carried out bariatric procedure all over the world with over 400 thousand procedures annually (18).

In the nineties, the laparoscopic adjustable gastric band (LAGB) was invented and for the first time implanted in patients by Belachew and Le Grand (19). In the Netherlands, and all over the world, the LAGB gained in popularity during this decade and many procedures were carried out. Part of this was explained by the idea of the reversibility of the procedure (the band...
could be easily removed) and the adjustability of the band (it is possible to inflate the band, increasing the restriction on the stomach). Although the short-term results of the LAGB were promising, the long-term results turned out to be disappointing. More than 50 percent of the patients regained their weight and many and some even severe complications were seen such as band erosion through the stomach or oesophagus, band slippage and perforation (20). Therefore, the LAGB has lost its popularity in many parts of the world to other procedures such as the LRGYB and laparoscopic sleeve gastrectomy (LSG; Figure 4). However, in some countries, the LAGB is still popular as it is regarded a safe procedure which, with intensive and long term follow up, can still provide good long-term results (21).

Figure 4: Anatomic alterations after Sleeve Gastrectomy

Source: www.weightlosssurgery.ca; visited on 9th February 2018

The laparoscopic sleeve gastrectomy is more recently developed and already the second most performed procedure world-wide. With the LSG, almost 80% of the stomach is removed alongside the greater curvature with usage of staples resulting in a small, banana shaped stomach causing a restriction in food intake (22).

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In recent years, due to the disappointing long-term results of the laparoscopic adjustable gastric band as described above, many patients with such a band chose to convert this into a LRYGB or LSG, known as a revisional procedure (23).

Other procedures, such as the mini gastric bypass (single anastomosis gastric bypass), SADI-S, ilial interposition and endoscopic weight loss procedures are outside the research of the present dissertation and therefore not further explained.

Beneficial effects of bariatric surgery

Bariatric surgery, dependent on the type of procedure, is deemed successful when more than 50% of the excess weight (the kg's above the amount of kg's that create a BMI of 25 kg/m²) is lost in two years (50% EWL) (24). A 50% EWL is accomplished by more than 70 percent of the patients within two years after a LRYGB or LSG (25,26). Of the most performed procedures, the best results concerning weight loss and the reduction of weight dependent comorbidities as previously mentioned is seen with the gastric bypass, shortly followed by the sleeve gastrectomy (25). Although the duodenal switch and Scopinaro procedures have an even better effect in terms of weight loss and the reduction of obesity associated diseases, due to the creation of a 'short bowel' patients experience more complications in terms of severe vitamin and mineral deficiencies making this procedure only suitable for a selected group of patients (25,27).

Adverse effects of bariatric surgery

The performance of surgery seems an extreme option, but up till now, it is the only with good, long term results. The introduction of the laparoscopy in bariatric surgery led to an enormous reduction in complication rates and hospital stay (24,25,26). However, still a significant complication rate exists (24,25,26). These complications can be even life- threatening and have a severe impact on patient’s quality of life. Therefore, it is important to identify risk factors for developing such complications in order to anticipate by means of prevention and early treatment.

This dissertation focusses mainly on the complications after (revisional) LRYGB and LSG.

On the short term, anastomotic leakage of the gastrojejunostomy or jejunojejunostomy or leakage of the staple line in the LSG are among the most severe complications. This can cause abdominal sepsis, potential organ failure and even death (0.2%) (25,26,27). On the other hand, severe vitamin and mineral deficiencies are seen with the gastric bypass, shortly followed by the sleeve gastrectomy (25). Although the duodenal switch and Scopinaro procedures have an even better effect in terms of weight loss and the reduction of obesity associated diseases, due to the creation of a 'short bowel' patients experience more complications in terms of severe vitamin and mineral deficiencies making this procedure only suitable for a selected group of patients (25,27).

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long term, technical and metabolic complications are seen. For example, many patients suffer from vitamin deficiencies and therefore, standard suppletion regimen with adjusted multivitamins and calcium is prescribed in many centres (27). One of the more severe long-term complications of LRYGB is an internal herniation in which the small bowel herniates in one of the new windows (created by repositioning the small intestine), sometimes causing strangulation, often a reoperation in the acute setting is necessary (28). Another important long-term complication is marginal ulceration, an ulcer located at the gastrojejunostomy which carries the risk of perforation (21,32).

Aim and outline of the dissertation:
The aim of the present dissertation is twofold, resulting in two main parts and a third part including the discussion.

Part I aims to increase the knowledge concerning the pre-and postoperative assessment of patients undergoing bariatric surgery, mainly focussing on risk factors for the development of marginal ulceration (MU) followed by possibilities to prevent this MU after LRYGB. First in part I the literature is searched and investigated to provide an evidence based, current consent on marginal ulceration as shown in a systematic review. This review is followed by two retrospective cohort studies, one to identify risk factors associated with the development of MU and the second to investigate whether a prophylactic course of postoperative proton pump inhibitors can prevent the development of MU. Furthermore, it investigates the pre-and postoperative assessment of patients undergoing bariatric surgery, whether or not preoperative esophagogastroduodenoscopy is necessary, also to treat patients as prevention for possible postoperative complications, and whether patients with severe obstructive sleep apnoea (as tested with polysomnography prior to the surgery) should be admitted to the Intensive Care Unit the first postoperative night to prevent the development of cardiopulmonary complications. This part is finished with a study identifying patients preferences in perioperative information transfer, the importance of discussing complications and the manner in which the information should be provided.

Part II aims to increase the knowledge concerning some of the complications caused by bariatric surgery (apart from MU which, as mentioned, is handled in part I) with a focus on patient related risk factors for the development of such a complication shown with the BASIC. First, the safety and feasibility of revisional surgery after failed (laparoscopic) gastric
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banding into a LRYGB or LSG is assessed using the available literature. Secondly, a database study is performed to analyse the feasibility of one of the internationally used prediction models (Obesity Surgery Mortality Risk Score; OS-MRS) for postoperative mortality as a predictor of postoperative complications. Finally, the BASIC (Bariatric Surgery Index of Complications) is proposed as a model to identify patients at a higher risk of developing postoperative (severe) complications.

Part III starts with an article concerning morbid obesity and its global and social consequences followed by the general discussion which summarizes and integrates the results and conclusions of the studies presented in a structured manner including the methodological considerations, the clinical implications and some suggestions for future research.

Conclusion:

It can be concluded that morbid obesity is a major threat to individual and global health. Till now, as the world is unable to prevent the development of this disease, bariatric surgery is the best treatment option. However, in the treatment of patients with bariatric surgery two elements need to be tackled. Firstly, although much improved all over the years, the complication rate is still around the 10%. Secondly, bariatric surgery is the ultimate elective type of surgery, where its success is highly depended on patient’s adherence to the postoperative lifestyle adjustments, which is influenced by the information provided. Therefore, this dissertation tries to find possibilities to lower the postoperative complication rate, to develop a risk stratification model and to inventory patient’s information preferences.
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