Original Research

Short-Term Cardiometabolic Risk Reduction After Bariatric Surgery

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Introduction: Clinically severe obesity, defined as a body mass index (BMI) ≥40 kg/m^2, increases cardiovascular risk and results in elevated mortality. The objective of this study was to examine the short-term health benefits after bariatric surgery. Using commonly recognized scoring systems, we assessed the short-term reduction of calculated cardiometabolic risk following bariatric surgery.

Methods: Short-term cardiovascular risk reduction was assessed prospectively in 50 consecutive, morbidly obese patients (45 women, 5 men, age 39.3 ± 8.97 years, BMI 50.67 ± 12.25 kg/m^2) using the following scales: the Finnish Diabetes Risk Score, Reynolds Risk Score, Italian "Progetto Cuore" score, SCORE. The follow-up data at baseline and six months were recorded in all studied patients. Patients who did not meet the inclusion criteria of particular score systems were not included in the analysis. There were no revisions, surgical failures or deaths in the study group.

Results: The average weight loss six months after bariatric surgery was 35.8 ± 10.59 kg (mean BMI 36.54 ± 5.92 kg/m^2). The most interesting result was that the median value of a 10-year risk of developing type 2 diabetes according to the FINDRISC score was 15 (IQR 15-15) at baseline vs. 13 (IQR 13-13) following surgery, p<0.001. We observed a reduction of 2 points in the majority of patients. In addition, in 29 patients it was possible to calculate the 10-year probability of developing the first major cardiovascular event using the Italian "Progetto Cuore" score; the median score decreased from 2.0 to 0.8 (p<0.001).

Conclusions: Weight loss at 6 months, as a result of bariatric surgery in this group of clinically severely obese patients at a very high risk, was especially effective as concerns the reduction of the calculated risk of diabetes, cardiovascular diseases, and related mortality.

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Cardiometabolic risk, defined by the American Diabetes Association[1] and introduced in clinical practice by Després and Lemieux,[2] is a constellation of both traditional risk factors for cardiovascular disease, including age, smoking, blood pressure values, plasma cholesterol level, diabetes, sex, and genetic susceptibility, and also emerging risk factors, including visceral obesity, insulin resistance, atherogenic dyslipidemia, prothrombotic and proinflammatory state. The combination of at least three risk factors may lead to an increase of the risk of developing cardiovascular diseases and type 2 diabetes.

According to the World Health Organization (WHO), obesity is classified as class I for BMI between 30 and 34.9 kg/m^2, class II for BMI between 35 and 39.9 kg/m^2, and class III (morbid obesity, clinically severe obesity) for BMI ≥40 kg/m^2. Bariatric surgery has been well established as being both safe and effective. It is the only proven method of achieving long-term weight control for severely obese patients. Surgical treatment of clinically severe obesity is recommended for patients

with a BMI >40 kg/m^2 or BMI >35 kg/m^2 with significant comorbidities, such as life-threatening cardiopulmonary problems (e.g. severe sleep apnea, Pickwickian syndrome, obesity-related cardiomyopathy, diabetes mellitus) and obesity-induced physical problems that interfere with lifestyle (e.g. musculoskeletal, neurological, or body size problems that preclude or severely interfere with employment, family function and ambulation), and documented ineffective dietary attempts for weight control.[3,4]

Recently, a number of noninvasive scores have been proposed for screening subjects who are at increased risk of cardiovascular diseases and type 2 diabetes. These include traditional as well as emerging cardiovascular risk factors.[5-7] With commonly used scoring systems, we assessed how morbid obesity influences the calculated cardiometabolic risk.[8] Subsequently, we calculated how weight reduction resulting from bariatric procedures reduces that risk.

Methods

Fifty consecutive patients (45 women, 5 men, age 39.3 ± 8.97 years, body mass 140.51 ± 22.56 kg, BMI 50.67 ± 12.25 kg/m^2) with morbid obesity diagnosed according to World Health Organization recommendations (i.e. BMI ≥40 kg/m^2), were prospectively included in the study.

The patients were referred to our department for a medical assessment prior to scheduled bariatric procedures. Baseline and follow-up data (six months after bariatric surgery) were collected prospectively from all subjects. They included: systolic blood pressure, total cholesterol, high-density lipoprotein (HDL)-cholesterol, high-sensitivity C-reactive protein (hsCRP), smoking status, family medical history, and anthropometric measures. The patients' cardiometabolic risk was assessed using selected currently available risk scores, including the Systematic COronary Risk Evaluation (SCORE), the Finnish Diabetes Risk Score (FINDRISC), the Reynolds Risk Score (RRS), and the Italian "Progetto Cuore" (IPC) score. Patients who did not meet the inclusion criteria of particular score systems (e.g. age, diabetes) were not included in the analysis.

The general characteristics of the study group are presented in Table 1.

Weight reduction surgeries can be grouped into three main categories: predominantly malabsorptive procedures, predominantly restrictive procedures, and a mixture of both.

Table 1. General characteristics of the study group.

	Before surgery	6 months after surgery
Age, years	39.3 ± 8.97	
BMI, kg/m^2	50.67 ± 12.25	36.54 ± 5.92
Hypertension, n (%)	44 (88)	21 (42)
Diabetes, n (%)	8 (16)	8 (16)
Dyslipidemia, n (%)	29 (58)	28 (56)

Our patients underwent vertical banded gastroplasty (VBG) or Roux-en-Y gastric bypass (RYGB). The former is a predominantly restrictive procedure, the latter is a mixture. In VBG, a part of the stomach is permanently divided to create a smaller pre-stomach with a narrow outlet pouch, the volume of which is about 20 mL, and a larger lower part. Appropriate assessment of the upper gastric pouch volume and the calibration of the connecting stoma diameter are critical for postoperative success.

RYGB is the most commonly performed operation for weight loss worldwide. In RYGB, the surgeon creates a small gastric pouch (with a volume of about 20-30 mL) usually using a stapler device and connects it to the jejunum. There were no revisions, surgical failures or deaths in study group.

SCORE

The SCORE system estimates a 10-year risk of the first fatal atherosclerotic event, whether heart attack, stroke, or other occlusive arterial disease, including sudden cardiac death.[7,8] The SCORE database combines data from 250,000 patients, 7000 recorded fatal cardiovascular events, and 12 European cohort studies. Its charts are calibrated for Poland. It is based on risk factors that include smoking, age, sex, systolic blood pressure, and total cholesterol.

FINDRISC

Morbid obesity is often accompanied by different metabolic abnormalities, such as diabetes, impaired glucose tolerance, and impaired fasting glucose (in our study group 16% of patients had diabetes). It is well known that all morbidly obese patients are at high risk of diabetes. Some clinical studies suggest that weight loss as a result of lifestyle modification, drug treatment, or bariatric surgery, even in the short period after surgery, prevents the emergence of diabetes mellitus. The FINDRISC score predicts the 10-year risk of developing type 2 diabetes with 85%

accuracy.[7] It estimates this risk based on age, BMI, waist circumference, physical activity, diet, treatment of hypertension, blood glucose level, and family history.

RRS

The RRS is a risk equation that includes the conventional cardiovascular disease risk factors (total cholesterol, HDL cholesterol, systolic blood pressure, smoking status) in addition to a parental history of heart disease before age of 60 (a measure of genetic risk) and hsCRP. The RRS for women was validated using data from 24,558 women; the RRS for men was developed using data from 10,724 men. It estimates the 10-year risk of heart attack, stroke, or other heart disease event.[5]

IPC

The IPC score assesses the probability of developing the first major cardiovascular event (myocardial infarction or stroke) over the following 10 years. It takes into account the values of eight risk factors: sex, age, diabetes, smoking, systolic blood pressure, serum cholesterol, HDL cholesterol and anti-hypertensive medications.[8]

Statistical analysis

The characteristics of the study group were presented using descriptive statistics: means and standard deviations for continuous data, medians and interquartile ranges (IQR) for ordinal data, counts and percentages for qualitative data. The distributions of the different scores were obtained by comparing the degree to which pre- and post-surgery scores deviated from normality, as indicated by significant results of the Shapiro–Wilk test (all $p<0.05$). Hence, the effect of surgery (change of scores after 6 months vs. baseline) was analyzed using nonparametric methods, the Wilcoxon signed-rank test and the sign test. For all statistical tests, the significance level was set at $\alpha=0.05$ (two-sided).

Results

The average weight loss at six months after bariatric surgery was 35.8 ± 10.59 kg (from 140.51 ± 22.56 kg to 103.39 ± 13.25 kg). The mean BMI at six months was 36.54 ± 5.92 kg/m^2.

We were able to calculate the baseline and follow-up values of FINDRISC for 42 patients (84%). Eight patients were excluded from the analysis because of diabetes. The median FINDRISC value was 15 (IQR 15-15), which meant a high risk of developing diabetes. Six months later the median value was 13 (IQR 13-13), which meant a moderate risk of developing diabetes in the next 10 years ($p<0.001$). The FINDRISC score decreased by 2 points in the majority of patients. The results of the analysis are given in Table 2.

We were able to calculate the 10-year risk of a future heart attack, stroke, or other major heart disease using the RRS in only 18 patients (the unique exclusion criterion was age) and we did not observe any statistically significant decrease ($Z=-2.326$, $p=0.020$). The results are given in Table 3. However, after surgery almost all patients were reclassified into lower risk categories. We observed the greatest calculated decrease in cardiovascular risk using this algorithm. In one case there was a 1-point increase in cardiovascular risk.

We were able to calculate the 10-year probability of developing the first major cardiovascular event using the IPC score in 29 patients. Eleven patients were excluded because they did not meet the inclusion criterion of age (the individual risk score can only be applied to individuals aged 35-69 years). Nobody was excluded because of extreme risk factors (systolic arterial pressure >200 mmHg or <90 mmHg, total serum cholesterol value >320 mg/dL or <130 mg/dL, HDL cholesterol >100 mg/dL or <20 mg/dL). At baseline the median IPC score was 2.0, approximate-

Table 2. Baseline and follow-up values of the Finnish diabetes risk score (FINDRISC).

	n	Min	Max	Mean	SD	Median	Lower quartile	Upper quartile
Baseline	42	10	20	15	2	15	15	15
Six months post surgery	42	8	18	13	2	13	13	13
FINDRISC delta	42	-4	0	-2	1	-2	-2	-2

SD – standard deviation.

Table 3. Baseline and follow-up values of the Reynolds risk score (RRS).

RRS	Frequency	Percent	RRS six months post surgery	Frequency	Percent	RRS delta	Frequency	Percent
1	2	16.67	1	8	66.67	-5	2	16.67
2	6	50.00	2	2	16.67	-3	1	8.33
3	1	8.33	4	1	8.33	-1	5	41.67
4	1	8.33	6	1	8.33	0	3	25.00
7	1	8.33				1	1	8.33
11	1	8.33						

Table 4. Baseline and follow-up values of the Italian "Progetto Cuore" (IPC) score.

	n	Min	Max	Mean	SD	Median	Lower quartile	Upper quartile
Baseline	29	0.8	10.0	2.9	2.4	2.0	1.6	3.1
Six months post surgery	29	0.4	6.3	1.6	1.4	0.8	0.7	1.8
IPC delta	29	-5.7	0.7	-1.3	1.2	-1.1	-1.4	-0.7

SD – standard deviation.

ly 3 times higher than that of a patient of the same age with optimal levels of all modifiable risk factors. However, the IPC score decreased to 0.8 six months after the bariatric surgery ($p<0.001$), almost reaching a level similar to that of healthy individuals. The results of the analysis are shown in Table 4.

Using the above described algorithms, we observed that the baseline and follow-up median values of SCORE were 1 vs. 1 ($p=0.070$), respectively. The calculated risk decreased in all studied cases (19 patients, others were excluded by the age criterion). Changes observed in the SCORE scale did not reach the conventional significance level ($Z=-1.809$, $p=0.070$), probably because of the high number of observations with no change observed in a relatively small sample (10 out of 19 patients), which effectively reduced the power of the test.

Discussion

Favorable health outcomes six months after bariatric surgery have been widely reported and we also reported them here (Table 1). Many published studies have proven that morbid obesity and other less commonly recognized risk factors are important predictors of future cardiometabolic risk. To our knowledge, there is no published study that assessed bariatric surgery as a potential therapeutic intervention for short-term cardiovascular risk reduction. However, cardiometabolic diseases remain the leading cause of mortality, morbidity, and a deteriorated quality of life. That is why, in our opinion, it is necessary to detect patients at risk of cardiovascular events and diabetes and to stratify them.

The term "cardiometabolic risk" includes both traditional, well-documented parameters of the metabolic syndrome, such as age, smoking, blood pressure, cholesterol level, diabetes, sex, and genetic susceptibility, and non-traditional, new risk factors—the so-called "emerging factors"—such as visceral obesity, insulin resistance, atherogenic dyslipidemia, prothrombotic and proinflammatory state.

Recently, we have observed a decrease in the incidence of well-documented cardiometabolic risk factors. However, at the same time, there has been a rapid rise in the incidence of emerging risk factors. Moreover, a significant worldwide increase in the incidence of both obesity, or even morbid obesity, among adults and children could be observed. Therefore, it seems very important to identify and to manage patients who are at increased risk of cardiovascular events.

The key finding of the present study is that bariatric surgery is a good therapeutic intervention that can target cardiometabolic risk in a group of morbidly obese patients. The results suggest that a period of only six months following bariatric surgery is enough for body weight to be effectively reduced. It also favorably affects key cardiometabolic risk factors, especially diabetes, hypertension, and dyslipidemia. Based on our findings, we recommend using the IPC score to predict the 10-year probability of developing the first major cardiovascular event, and FINDRISC to predict the 10-year risk of developing type 2 diabetes.

Conclusion

It is very important to calculate cardiometabolic risk appropriately in groups of patients at risk and then to find an adequate therapeutic approach. In our opinion, in this group of morbidly obese patients at very high risk, bariatric surgery is especially effective for the short-term reduction of the calculated risk of diabetes, cardiovascular disease, and related mortality, as we confirmed by using adequate algorithms. We recommend using selected scales (IPC, FINDRISC) to assess cardiometabolic risk in the routine evaluation of patients.

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