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ORIGINAL CONTRIBUTIONS

Weight Loss After Bariatric Surgery in Different Age Groups

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Abstract

Purpose Weight loss after bariatric operations may be reduced in older patients due to changes in metabolism. Some studies showed inferior weight loss in older patients compared to younger ones while others showed no such difference. In order to counsel patients about the expected weight loss after bariatric surgery, recommendations stratified by age are important.

Methods This study encompasses a retrospective analysis of 500 consecutive patients with RYGB or sleeve gastrectomies from a single institution with a mean follow-up time of 3.6 years. Patients were stratified into five groups according to age at the time point of the operation: < 30 years, 30–39 years, 40–49 years, 50–59 years, and ≥ 60 years.

Results Weight loss expressed in percent excessive body mass index loss (%EBMIL) at nadir were 86.6, 89.5, 84.0, 77.9, and 76.4% and 75.6, 78.4, 73.3, 68.0, and 69.0% at the time of last follow-up for the five groups, respectively. Weight loss was significantly higher in younger patients than in older patients for both time points. The total number of comorbidities that showed complete remission (normal values without treatment), was also significantly higher in the younger age groups.

Conclusions Primary bariatric operations yield better weight loss results and remission rates of obesity related comorbidities in younger patients, but are still effective in older individuals.

Keywords Bariatric surgery · Weight loss · Age

Introduction

Weight loss after bariatric operations may be reduced in older patients due to changes in metabolism. Some studies showed inferior weight loss after bariatric surgery in older patients compared to younger ones [1–4] while others showed no such difference. [5, 6] In order to counsel patients of different ages about the expected weight loss after bariatric surgery, age-related recommendations may be helpful and important. Therefore, this study aims at analyzing weight reduction after bariatric surgery stratified by age. Furthermore, we evaluated the remission of obesity-related comorbidities after bariatric surgery according to age.

Keypoints
- Weight loss after bariatric surgery is higher in younger compared to older patients.
- Resolution of comorbidities is more frequent in younger individuals.
- Bariatric operations achieve good to excellent mid-term results in all age groups.

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Material and Methods

Population and Study Design

This observational, single-center retrospective analysis was performed at a tertiary referral center in Switzerland. After implementation of a bariatric service at our institution in 2013 until the end of 2020, 608 patients received a bariatric operation. All patients underwent the regular bariatric follow-up according to the guidelines of the Swiss Bariatric Society and were cared for by an interdisciplinary team consisting of surgeons, endocrinologists, dietitians, psychologists, and diabetes nurses. The data for this analysis has been extracted from the electronic health records (EHR). All patients signed a general informed

consent, and data acquisition and analysis were approved by the local ethics committee. The type of operation was decided individually for each patient depending on comorbidities, findings in preoperative endoscopy, body mass index (BMI), and patient preference. There was no specific protocol to adjust the choice of operation depending on age. After exclusion of patients with revisional surgery or without written informed consent, the final analysis encompassed 500 consecutive patients with primary Roux-en-Y gastric bypass (RYGB) or sleeve gastrectomies. Patients were stratified in five groups according to age at the time of the operation: < 30 years, 30–39 years, 40–49 years, 50–59 years, and 60 years and older.

Surgical Technique

We performed standard proximal RYGB operations with a 150-cm alimentary limb and a 70-cm biliary limb. The pouch was formed with one horizontal 45-mm and two 60-mm vertical cartridges. The gastro-jejunostomy was fashioned in a linear technique using a 45-mm stapler cartridge and closure of the enterotomy with a continuous resorbable barbed suture. We started routinely closing mesenteric defects after the first 99 patients. Sleeve gastrectomies were performed starting at 4–6 cm proximal to the pylorus over a 35char. bougie without oversewing of the stapler line. All but one operation were minimal-invasive (laparoscopic or robotic).

Comorbidities Analyzed

Complete remission of comorbidities was defined as normotension without medication, HbA1c < 6% without medication, no symptoms of sleep apnea without mask therapy, and no elevation of blood lipids, respectively. For the analysis of remission of comorbidities, data 1 year postoperatively were used. To account for a potential bias due to an uneven distribution of the performed operations across the different age groups and potentially different effectiveness of both operations regarding the remission rate of comorbidities, an additional sensitivity analysis was performed.

Statistical Analysis

Data were assessed using the chi-square test for categorical variables and the Kruskal–Wallis test for continuous variables. A p value < 0.05 was considered statistically significant. The online Social Science Statistics Statistical calculator (www.socscistatistics.com) was used for statistical analysis.

Table 1 Baseline characteristics of the patients

	Total	%	< 30 years (n)	%	30–39 years (n)	%	40–49 years (n)	%	50–59 years (n)	%	60 years and older (n)	%	p value (for age group difference)
N	500		81		129		129		116		45		
Mean age	43 years		26 years		34 years		45 years		54 years		62 years		
Female	376	75	69	85	102	79	100	77	78	67	27	60	.004
Male	124	25	12	15	27	21	29	22	38	32	18	40	
RYGB	395	79	68	84	104	81	103	80	89	76	31	69	.331
Sleeve gastrectomy	105	21	13	16	25	19	26	20	27	23	14	31	
BMI at operation	43.6 kg/m^2		44.3 kg/m^2		43.1 kg/m^2		42.3 kg/m^2		44.3 kg/m^2		43.9 kg/m^2		.0834
Smoking	115	23	28	34	33	26	27	21	21	18	6	13	.0281
Arterial hypertension	197	39	15	19	23	18	58	45	75	64	26	57	< 0.00001
T2DM	139	28	9	11	14	11	40	31	50	43	26	57	< 0.00001
Sleep apnea	142	28	14	17	26	20	35	27	51	44	16	35	.0002
Dyslipidemia	216	43	28	35	42	33	59	46	68	58	19	42	.0005
Coronary heart disease	20	4	0	0	2	2	3	2	11	9	4	9	.003
Median follow-up	3.2 years		3.0 years		2.7 years		3.4 years		3.4 years		4.1 years		.195

Table 2 Complications and length of stay

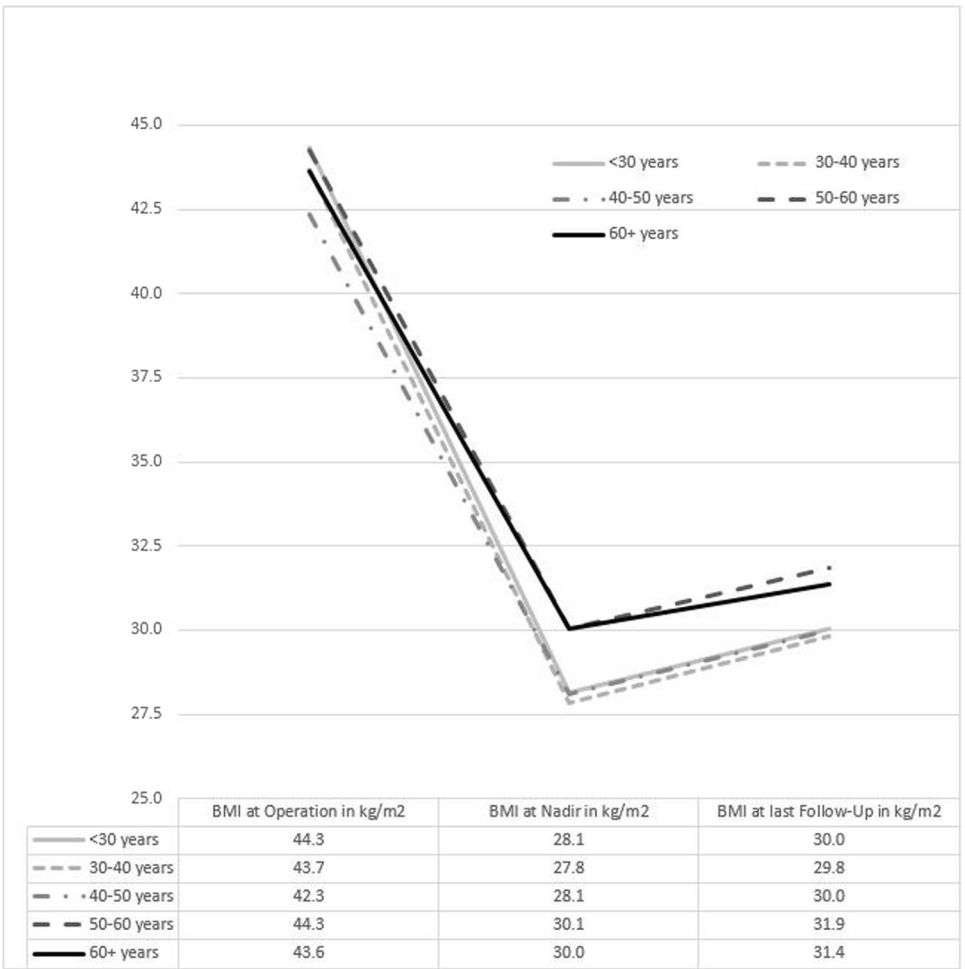
	Total	%	< 30 years (*n*)	%	30–39 years (*n*)	%	40–49 years (*n*)	%	50–59 years (*n*)	%	60 years and older (*n*)	%	*p* value (for age group difference)
Median length of stay	3		3		3		3		3		3		
Major complications	18	3.6	2	2.4	4	3.1	4	3.1	7	6.0	1	2.2	0.61
Minor complications	21	4.2	5	6.1	3	2.3	4	3.1	5	4.3	3	6.7	0.55
Leaks	10	2	0	0	3	2.3	3	2.3	4	3.4	0	0	0.41

Results

Baseline Characteristics of the Cohort

The baseline characteristics of the 500 consecutive patients undergoing a primary RYGB or sleeve gastrectomy procedure are shown in Table 1.

In total, there were 395 patients with RYGB and 105 patients with sleeve gastrectomies. The choice of procedure was not significantly different between age groups. There were more female than male patients across all age groups with an increasing percentage of male patients with older age. Comorbidities were significantly more prevalent in the older age groups whereas smoking was more common in the younger age groups. The BMI at the time of the operation tended to be somewhat lower in the age group 40–49 years, although not reaching statistical significance. Length of follow-up was similar across age groups.



	BMI at Operation in kg/m2	BMI at Nadir in kg/m2	BMI at last Follow-Up in kg/m2
<30 years	44.3	28.1	30.0
30-40 years	43.7	27.8	29.8
40-50 years	42.3	28.1	30.0
50-60 years	44.3	30.1	31.9
60+ years	43.6	30.0	31.4

Fig. 1 Body mass index (BMI) in kg/m^2 at operation, at nadir, and at the last follow-up

Complications

The median length of stay was 3 days in all age groups. There was no significant difference in major or minor complication rates between the age groups (Table 2).

Follow-Up

The mean follow-up time was 3.6 years (range 0.5–8.7) and tended to be longer in the older age groups without being statistically significant. After 1, 2, 3, 4, and 5 years, 498 of the 500 (99.6%), 393 of 453 (86.8%), 270 of 392 (68.9%), 201 of 301 (66.8%), and 115 of 228 (50.4%) possibly eligible patients presented for follow-up, respectively. Loss of follow-up was therefore 2/500 (0.4%) after 1 year, 60/453 (13.2%) after 2 years, 122/392 (31.1%) after 3 years, 100/301 (33.2%) after 4 years, and 113/228 (49.6%) after 5 years. The median follow-up time of the different age groups is shown in Table 1.

Weight Loss

Maximum weight loss (BMI nadir) was achieved 21 + / − 11 months after surgery and is shown together with BMI at last follow-up according to age groups in Fig. 1. The results of weight loss expressed in average weight loss, percent excessive BMI loss (%EBMIL), percent total BMI loss (%TBMIL), and percent total body weight loss (%TBWL) at nadir and at the time of last follow-up were significantly higher in younger patients compared to older patients and are presented in Table 3. While in the youngest age group, 25/81 (30.9%) reached normal weight and 15/81(18.5%) managed to maintain it until last follow-up; 7/45 (15.6%) and 5/45 (11.1%) achieved and maintained normal weight in the age group of 60 years and older. However, 42 of 45 patients (93.3%) in the age group above 60 years reached a maximal TBMIL of 20%, 35/45 (77.8%) a TBMIL of 25%, and 24/45 (53.3%) a TBMIL of 30% and more, which is considered a very good weight loss result. These numbers were considerably higher in the youngest age group with a maximal TBMIL of 20% or more in 78/81 (96.3%), 25% or more in 76/81 (93.8%), and 30% and more in 65/81 (80.2%), respectively. There was no significant difference of %EBMIL nor %TBMIL neither at nadir nor at last follow-up between patients with a sleeve gastrectomy and a RYGB in any of the five age groups, but 14 of the 105 patients (13.3%) with a sleeve gastrectomy were converted to a RYGB for either secondary weight regain or gastro-esophageal reflux problems.

Comorbidities

The combined number of comorbidities showing a complete remission was significantly higher in the younger age groups.

Table 3 Weight loss results

	Total	< 30 years	30–39 years	40–49 years	50–59 years	≥ 60 years	*p* value (for age group difference)
Average weight loss at nadir	41.9 + / − 12.7 kg	45.5 + / − 12.2 kg	44.5 + / − 12.6 kg	40.2 + / − 14.4 kg	40.7 + / − 14.1 kg	36.6 + / − 13.0 kg	.00004
Average weight loss at last follow-up	36.7 + / − 12.7 kg	40.1 + / − 13.8 kg	39.0 + / − 13.9 kg	34.8 + / − 15.1 kg	35.6 + / − 14.3 kg	32.9 + / − 13.1 kg	.00304
%EBMIL at nadir	83.7	86.6	89.5	84.0	77.9	76.4	.002
%EBMIL at last follow-up	73.4	75.6	78.4	73.3	68.0	69.0	< .00001
%TBMIL = %TBWL at nadir	33.9	36.1	36.2	33.2	31.9	30.7	.008
%TBMIL = %TBWL at last follow-up	29.7	31.7	31.7	28.9	27.9	27.7	.002

When analyzed separately, all assessed comorbidities tended to have lower remission rates with increasing age, but only arterial hypertension reached statistical significance (Table 4).

A separate analysis after exclusion of the patients with sleeve gastrectomy yielded the same results with significantly higher remission rates for arterial hypertension ($p = 0.07$) and combined number of comorbidities ($p = 0.0002$) in the younger age groups receiving RYGB. The number of comorbidities in patients with sleeve gastrectomies was too low to allow for a meaningful analysis of the different age groups.

Discussion

The findings of this observational retrospective analysis are twofold. First, the average weight loss after bariatric surgery is lower in older patients compared to younger individuals. Second, remission rate of obesity-related comorbidities is higher in younger individuals compared to older patients. There are several reasons for the lower weight loss in older individuals. They tend to have a lower basal metabolic rate and reduced physical activity. [7] Furthermore, there might be increasing difficulty with age to change long-standing eating and activity habits, resulting in a less pronounced weight reduction. A longer preoperative duration of type 2 diabetes (T2DM) was shown to significantly reduce the chances of remission. [8]. The prevalence of longstanding diabetes T2DM and other comorbidities is higher in older patients and may explain the reduced rate of remission. In older patients, there is also an increased likelihood that additional factors contribute to the development of comorbidities and weight loss may therefore not necessarily result in remission of the assessed comorbidities. Despite the reduced weight loss compared to younger adults, bariatric surgery is still successful in many older patients and remains the most efficient treatment of obesity and its comorbidities [9]. There is conflicting evidence concerning the safety of bariatric operations in older patients. While higher morbidity and mortality rates were found in the older compared to younger patients in a systematic review, a recent registry-based study showed similar perioperative morbidity and mortality between patients below and over 65 years of age undergoing bariatric surgery [4, 10]. The latter was confirmed in additional studies, which showed that the overall complication rate for RYGB was not significantly different between older and younger patients and that both RYGB and sleeve gastrectomies in patients aged 60 years or older were relatively safe in the short term with an acceptable complication rate and low mortality [11, 12]. Conversely, in a meta-analysis of 19 mostly retrospective studies comparing safety and effectiveness of RYGB and sleeve gastrectomies in the elderly, sleeve gastrectomies

Table 4 Remission of comorbidities

	Total	%	< 30 years (*n*)	%	30–39 years (*n*)	%	40–49 years (*n*)	%	50–59 years (*n*)	%	≥ 60 years (*n*)	%	*p* value (for age group difference)
Arterial hypertension	97/197	49	12/15	80	15/23	65	32/58	55	24/75	32	14/26	54	.0012
T2DM	89/139	64	6/9	67	12/14	86	28/40	70	30/50	60	13/26	50	.193
Sleep apnea	89/142	63	12/14	86	18/26	69	23/35	66	27/51	53	9/16	56	.188
Dyslipidemia	91/216	42	15/28	54	19/42	45	28/59	48	21/68	31	8/19	42	.208
Total	366/694	53	45/66	68	64/105	61	111/192	58	102/244	42	44/87	51	.0001

were significantly safer with regard to complications, mortality, and postoperative healthcare utilization [13].

The strength of our study is a real-world setting encompassing a representative and comparably large sample size with consecutive inclusion of individuals across all age groups over a time period of almost 8 years. Previous studies comparing older and younger patients after bariatric surgery had relatively small sample sizes especially in the group of older patients and compared only two groups with a cutoff of 60 or 65 years. Average follow-up in these studies was considerably shorter, and follow-up rates were lower than in our analysis. The retrospective study of Fernandez-Ananin has a similar number of older patients and comparable follow-up but includes only sleeve gastrectomies, whereas in our study patients with RYGB and sleeve gastrectomies were included [3]. Furthermore, baseline-characteristics of our age groups and weight loss of our population were similar to previous studies, corroborating the robustness of our analysis. Nevertheless, we have to acknowledge several limitations. This was a retrospective analysis with all its limitations and possible confounders. In this context, we acknowledge also a slightly decreasing number of RYGB compared to sleeve gastrectomies with higher age, resulting in a potential bias regarding the remission rates of comorbidities. Nonetheless, a sensitivity analysis in the RYGB population corroborated our overall findings. Additionally, this was a single center study including mainly patients with Caucasian ethnicity, limiting the applicability of our findings to other ethnicities. Despite an excellent follow-up rate for the first 2 years, there was an increasing number of patients lost to follow-up in the following years resulting in a possible bias. Furthermore, because of the low complication rates of bariatric operations in general, our sample is too small to compare the safety of bariatric operations across age groups.

Conclusion

Primary bariatric surgery results in increased weight loss and higher remission rates of obesity-related comorbidities in younger patients compared to older individuals. Nevertheless, bariatric surgery is highly effective in terms of weight reduction and remission of obesity-related comorbidities in the elderly population.

Declarations

Ethical Approval This retrospective analysis was approved by the local ethics committee. (EKNZ 2022–01656).

Informed Consent Informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors declare no competing interests.

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