

Original Article

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Partial remission of Type 2 diabetes and changes in quality of life after gastric bypass

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ABSTRACT

INTRODUCTION: The prevalence of severe obesity is increasing and highly associated with co-morbidities such as Type 2 diabetes (T2D). Furthermore, quality of life (QoL) is negatively affected among patients with severe obesity and T2D. Studies have found that gastric bypass surgery may lead to remission of T2D and improved QoL.

The aim of this study was to investigate the association between partial remission of T2D and change in QoL from baseline to a one-year follow-up in severely obese patients undergoing laparoscopic Roux-en-Y gastric bypass (LRYGB).

METHODS: This cohort study was based on data from patients with T2D undergoing LRYGB at a private hospital in Denmark and included 704 patients among whom 337 (48%) patients with T2D contributed with data in the analysis. Data were collected preoperatively and at a one-year follow-up. Preoperative T2D status was patient-reported and validated through the patient's medical record. At the one-year follow-up, partial remission was defined as an HbA_{1c} concentration < 7.3% with no use of antidiabetics. Continued T2D was defined as intake of diabetic medication or an HbA_{1c} concentration > 7.3%. QoL was measured by the Moorehead-Ardelt QoL Questionnaire. Multiple linear regression was applied.

RESULTS: At the one-year follow-up, the prevalence of partial remission of T2D was 72.7%. No significant association was seen between partial remission of T2D after LRYGB and change in QoL one year later. Loss to follow-up was 35.8%.

CONCLUSIONS: The majority of patients with T2D experienced partial remission one year after undergoing LRYGB surgery. However, partial remission of T2D was not associated with an improved QoL.

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Worldwide, obesity is an increasing health problem with a prevalence of 13% in 2016 [1]. Severe obesity is associated with a decreased quality of life (QoL) and an increased risk of developing Type 2 diabetes (T2D) [2]. Surgery is the only treatment with an established long-lasting effect on weight loss in severe obesity [3]. In Denmark, the primary bariatric surgery procedure is laparoscopic Roux-en-Y gastric bypass (LRYGB), which is used in 98% of all cases [4]. Besides weight loss, LRYGB is associated with remission of T2D and improved QoL [5, 6]. The risk of developing T2D increases exponentially with increasing BMI [7]. Moreover, T2D is associated with negative health effects such as cardiovascular disease, neuropathy and decreased QoL [8, 9]. A study found that LRYGB led to remission of T2D in 60% of the cases at a one-year follow-up [10] and Murphy et al [11] along with Schauer et al [12] concluded that LRYGB is an effective treatment to achieve remission of T2D in severely obese patients. Several studies have demonstrated a significant improvement of QoL after LRYGB [2, 6, 13, 14].

Improvement of obesity-related co-morbidities is often mentioned as an important factor in improving QoL after LRYGB [2, 3, 15]. Only few studies have investigated how changes in glycaemic status after LRYGB affect QoL among patients with T2D [6, 8].

Thus, we found it relevant to investigate the association between partial remission of T2D and change in QoL from baseline to a one-year follow-up in a Danish cohort of severely obese patients undergoing LRYGB.

METHODS

Study population

The study population consisted of patients with T2D undergoing LRYGB at the private hospital Mølholm in Denmark. Data were collected prospectively from 1 September 2007 to 31 December 2013. To be a candidate for surgery, patients had to be 18 years or older, have a BMI > 40 kg/m² or a BMI between 35 and 40 kg/m² and obesity-related co-morbidity. In Denmark, as of January 2011, the age criterion for receiving LRYGB was changed from 18 to 25 years, and the BMI criterion for patients without obesity-related co-morbidity was changed to > 50 kg/m².

Data collection

Data were collected from a clinical patient database based on patient-reported questionnaires and data completed by a nurse specialised in LRYGB. The questionnaire contains information on variables such as demographics and T2D. To obtain information about QoL, patients completed the disease-specific Moorehead-Ardelt Quality of Life Questionnaire II (M-A QoLQII). Preoperatively and at the one-year follow-up, the patients received the same questionnaire

Exposure

In the present study, exposure was partial remission of T2D. At baseline, data about T2D status were patient-reported by yes/no and validated by researchers through matching the patient-reported data with the endocrinologist's medical record. At the one-year follow-up, diabetic status was defined by intake of diabetic medication and HbA_{1c} level. Partial remission was defined as an HbA_{1c} concentration < 7.3% with no use of antidiabetics. Continued T2D was defined as intake of diabetic medication and/or an HbA_{1c} concentration > 7.3%. Subsequently, the study cohort was divided retrospectively into two exposure groups; partial remission and continued T2D using the above-mentioned definitions. In the statistical analysis, the exposure was considered a dichotomous variable.

Outcome

The Danish translation of the M-A QoLQII was used to measure QoL. The Danish translation has not been validated, but it is used by the Danish Health Authority [16] and the National Database for Bariatric Surgery in Denmark [17]. The questionnaire defined QoL using six categories: self-esteem, level of physical activity, social life, work ability, sexual life and eating habits. Patients were asked to complete the questionnaire according to their current emotional state. The six categories are ranked on a scale from -0.5 to 0.5 divided into ten steps. The total score is calculated by adding the scores from each of the six categories. The total scores range from -3.0 (poor QoL) to 3.0 (good QoL) [18]. In the statistical analysis, the outcome was considered a continuous variable.

Confounding

Potential confounders for the association between partial remission of T2D and changes in QoL were identified by a literature search. The five following potential confounders were identified: weight loss, age, joint

symptoms, working status and gender. Weight loss defined as % excess weight loss (%EWL) and age defined as number of years were considered continuous variables in the analysis. Joint symptoms were divided into two categories: “No to mild symptoms” and “Moderate to intense symptoms”. Working status was divided into two categories: “Full-time work, Part-time work and Student” and “Unemployed, Sick leave, Retired and Stay-at-home”. Gender was defined as male/female.

Statistical analysis

Demographics were described. Demographics were presented for the total cohort and the two groups of exposure: Partial remission of T2D and Continued T2D. The average change in QoL and standard deviation (SD) was calculated for the two exposure groups. The two exposure groups were compared using the unpaired t-test and Wilcoxon's rank-sum test for continuous variables and by the chi-squared test for categorical variables.

The association between partial remission of T2D and changes in QoL from baseline to the one-year follow-up was investigated by multiple linear regression including adjustment for the identified potential confounders. QQ plots and histograms were performed ahead of the multiple linear regression analysis to check if model assumptions were met.

A drop-out analysis was performed to investigate if patients lost to follow up were significantly different according to baseline demographics from patients participating in the one-year follow-up. The analysis included use of the unpaired t-test and Wilcoxon's rank-sum test for continuous variables and the chi-squared test for categorical variables.

All analyses were performed in STATA 14, and all hypotheses were tested at a 5% significance level.

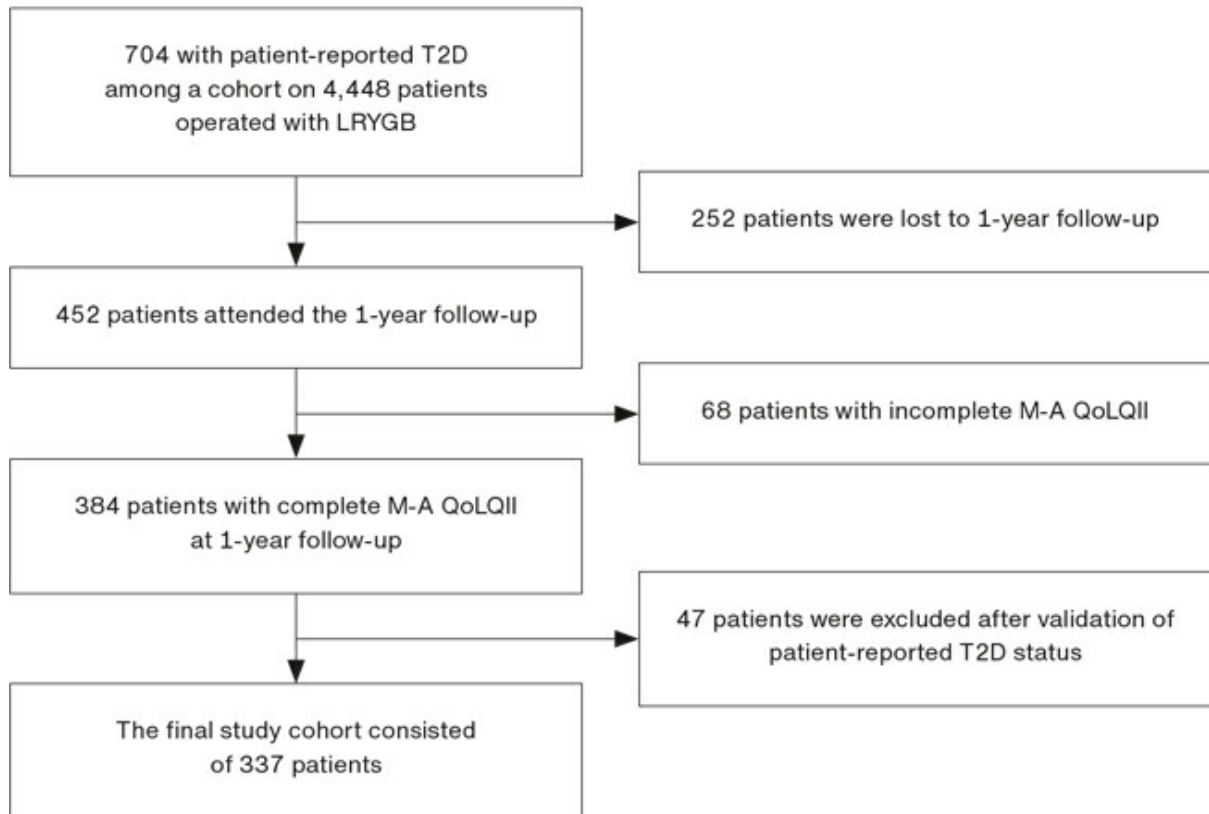
Trial registration: not relevant.

RESULTS

Study population

In the study period, 4,448 patients were treated with LRYGB at the private hospital Mølholm, Denmark. Of these patients, 704 had self-reported T2D at baseline and were included in the present study. A total of 452 patients attended the one-year follow-up health check, and 252 (35.8%) were lost to follow-up. Among the 452 participating patients, 68 had an incomplete M-A QoLQII, and an additional 47 patients were excluded after validation of the patient-reported baseline T2D status because their patient-reported answer did not match the response from the endocrinologist. After inclusion and exclusion, the final study cohort thus consisted of 337 patients (48%) (Figure 1).

FIGURE 1 Flow chart of patients included in the study.



LRYGB = laparoscopic Roux-en-Y gastric bypass; M-A QoLQII = Moorehead-Ardelt Quality of Life Questionnaire II; T2D = Type 2 diabetes.

Baseline characteristics

The majority of the patients in the study cohort were female (Table 1). The mean age was 47 years (\pm SD: 9.2), median weight was 129 kg and median BMI was 44.05 kg/m². A total of 26.6% of the patients experienced no to mild joint symptoms and 76.4% experienced moderate to intense joint symptoms. A total of 56.7% of the patients were on the labour market and 43.3% were outside the labour market. At baseline, the mean QoL score was -0.34 (\pm SD: 1.1). The two exposure groups varied significantly on the variables of age ($p = 0.02$), working status ($p = 0.02$) and QoL ($p = 0.02$). The group with partial remission of T2D had a mean QoL score at baseline of -0.26, and those who still had T2D reported a mean QoL at baseline of -0.57.

TABLE 1 Baseline characteristics. The groups of exposure were defined according to Type 2 diabetes status at one-year follow-up.

	Total cohort		Partial remission of T2D		Continued T2D		p-value ^a
	parameter	n (%)	parameter	n (%)	parameter	n (%)	
<i>Gender, n (%)</i>							
Men		124 (36.8)		88 (35.9)		36 (39.1)	0.59 ^b
Women		213 (63.2)		157 (64.1)		56 (60.9)	
Total		337		245		92	
Weight, median (IQR), kg	129 (11-145)	336	130.5 (115-146)	244	126.5 (114-140)	92	0.25 ^c
BMI, median (IQR), kg/m ²	44.05 (40.40-48.63)	333	44.19 (40.16-48.91)	241	43.25 (40.73-47.74)	92	0.91 ^c
<i>Joint symptoms, n (%)</i>							
No/mild		87 (26.6)		64 (27.1)		23 (25.3)	0.74 ^b
Moderate/intense		240 (73.4)		172 (72.9)		68 (74.7)	
Total		327		236		91	
Age, mean (± SD), yrs	47 (± 9.2)	337	46 (± 8.8)	245	49 (± 9.9)	92	0.02 ^d
<i>Working status n (%)</i>							
Full-time, part-time or student		190 (56.7)		147 (60.5)		43 (46.7)	0.02 ^b
Unemployed, sick leave, retired or stay-at-home		145 (43.3)		96 (39.5)		49 (53.3)	
Total		335		245		92	
M-A QoLQII, mean (± SD)	-0.34 (± 1.1)	337	-0.26 (± 1.1)	245	-0.57 (± 1.1)	92	0.02 ^d

IQR = interquartile range; M-A QoLQII = Moorehead-Ardelt Quality of Life Questionnaire II; SD = standard deviation; T2D = Type 2 diabetes.

a) Estimated from the baseline characteristics of the 2 groups.

b) χ^2 -test.

c) Wilcoxon rank-sum test.

d) Unpaired t-test.

Lost to follow-up

Patients lost to follow-up were significantly younger than participating patients. On the variables QoL, gender, weight, BMI and working status, patients lost to follow-up did not differ significantly from participants.

Partial remission of Type 2 diabetes and changes in quality of life

At the one-year follow-up, 245 patients (72.7%) experienced partial remission of T2D, whereas 92 patients (27.3%) still had T2D. The group with partial remission of T2D had a mean change in QoL of 1.98 (± SD: 1.17) from baseline to the one-year follow-up; those who still had T2D reported a mean change in QoL of 2.01 (± SD: 1.26) measured by the M-A QoLQII.

Association between partial remission of Type 2 diabetes and changes in quality of life

The difference in change in QoL from baseline to the one-year follow-up was -0.02 on M-A QoLQII in patients with partial remission of T2D relative to patients who still had T2D (Table 2). After adjustment for age, gender, joint symptoms, working status and %EWL, the difference in change in QoL was -0.04 on the M-A QoLQII in patients with partial remission of T2D relative to patients who still had T2D. The difference in change in QoL was insignificant in both the unadjusted and the adjusted analysis. In the adjusted analysis, a significant association between age and change in QoL was found.

TABLE 2 Linear association between partial remission of Type 2 diabetes and change in quality of life with continued Type 2 diabetes as reference group.

	Unadjusted			Adjusted ^a		
	n	partial remission of T2D	p-value	n	partial remission of T2D	p-value
Change in M-A QoLQII (95% CI)	337	-0.02 (-0.31-0.27)	0.89	322	-0.04 (-0.34-0.25)	0.77

CI = confidence interval; M-A QoLQII = Moorehead-Ardelt Quality of Life Questionnaire II; T2D = Type 2 diabetes.

a) The adjusted estimate was corrected for gender, age, baseline joint symptoms, baseline working status and weight loss in % excess weight loss.

DISCUSSION

The aim of the present study was to investigate the association between partial remission of T2D and change in QoL from baseline to a one-year follow-up after LRYGB. Both exposure groups experienced a major improvement in QoL one year after LRYGB. Additionally, 72.7% of the patients experienced partial remission of T2D. A high remission rate was also found by Cummings et al [10] reporting complete remission of T2D in 60% of patients after LRYGB. They defined remission as HbA_{1c} concentration < 6.0% (< 42.1 mmol/mol), off all diabetes medicines. Aftab et al [14] defined T2D as either a fasting plasma glucose ≥ 7 mmol/l, a HbA_{1c} concentration $\geq 6.5\%$ or use of antidiabetic medication, and found that 67% of patients experience remission of T2D after gastric bypass.

Literature is sparse on the relationship between remission of T2D and change in QoL after LRYGB [8]. In the present study, no significant difference in change in QoL between patients who experienced partial remission of T2D and patients who still had T2D was found either in the unadjusted or the adjusted analysis; this is in line with the work by Weiner et al [8]. However, Weiner et al discuss a tendency in their data material that patients with complete remission of T2D on average experienced larger improvement in QoL after LRYGB than patients who continued to have T2D [8]. This tendency was not found in the present study. Another study found that preoperative T2D was neither a positive nor a negative predictor for change in QoL after LRYGB [6]; this is in line with the results of the present study.

Internal validity

The strengths of this study are the prospective design, the large sample size and the statistical analyses with adjustment for potential confounders. The use of disease-specific QoL measurement is considered a strength of the study despite the absence of language validation of the questionnaire.

However, several limitations should be considered. We recorded a 35.8% dropout at the one-year follow-up. This patient group is known to have a high dropout rate, which was also seen in a study by Julia et al where loss to follow-up was 43% [2]. Patients lost to follow-up had a non-significantly lower baseline QoL than participating patients had. If patients with minor changes in QoL who continued to have T2D were especially prone not to participate at the one-year follow-up, this may lead to an underestimation of the association. The short one-year follow-up period is considered a limitation of the study. The difference in collecting information on T2D status at baseline and follow-up may cause uncertainty in measurement, but we consider that the same level of uncertainty will likely have been present at baseline and follow-up.

The difference in estimates in the unadjusted and adjusted analysis is considered minor, and the present study is thus largely unaffected by the chosen confounders. The baseline age difference between the two exposure groups was significant and, in the adjusted analysis, age was significantly associated with change in QoL. Age may be considered a significant confounder for the association between partial remission of T2D and change in QoL. Both groups of exposure improved QoL, and no difference was found between the groups. In the present study, the group with partial remission of T2D had a significantly higher baseline QoL than the group with continued T2D. The difference in QoL between the baseline and the one-year follow-up may be affected by the level of QoL at baseline. Patients with a low baseline QoL may have had the potential for achieving a higher change in QoL than patients with a high baseline QoL. The statistical analysis does not address this problem or the possible consequences, which is a limitation to the present study. Working status at baseline was significantly different between the groups, and it cannot be excluded that working status is associated with QoL. In the adjusted analysis, working status was taken into consideration but working status turned out not to be a significant factor of influence in the multiple regression analysis. Future research should investigate the impact of the severity of T2D in relation to remission and improvement in QoL after LRYGB.

External validity

With caution, the results of the present study could be generalised to comparable patient populations referred for LRYGB under the same conditions as in the present study. However, the limitations in internal validity, especially the large loss to follow-up, should be considered. Furthermore, the generalisation is affected by the difference in data collection about T2D at baseline and follow-up. The reader should be aware of different definitions of remission in T2D between countries, hospital sites and in different time periods.

CONCLUSIONS

A total of 72.7% of severely obese patients experienced partial remission of T2D at the one-year follow-up after LRYGB. Both exposure groups experienced major improvements in QoL one year after LRYGB. However, no significant association was found between partial remission of T2D and change in QoL before and after adjustment for potential confounders.

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Conflicts of interest none. Disclosure forms provided by the authors are available with the article at Ugeskriftet.dk/dmj

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