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Original article

Effects of statin therapy on weight loss and diabetes in bariatric patients

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Abstract

Background: Bariatric surgeries are considered effective treatments for weight loss and improved diabetes control. Statins increase diabetes onset in prospective clinical trials and many bariatric patients with metabolic disease are concurrently on statins.

Objectives: We retrospectively examined the relationship of statin therapy to weight loss, diabetes mellitus onset and remission, and metabolic outcomes after bariatric surgery.

Setting: xxx

Methods: A total of 1575 patients (1231 women) underwent laparoscopic adjustable gastric banding (n = 1035), Roux-en-Y gastric bypass (n = 468), or sleeve gastrectomy (n = 72) and were categorized as to statin use (n = 671 statin users) and diabetes status (n = 557 patients with diabetes) preoperatively and at one year follow-up.

Results: New onset cases of diabetes did not differ between patients on and not on preoperative statins (3 versus 4 new diabetes cases, respectively), but diabetes resolved after surgery in 159 (23.7%) patients on preoperative statins and in only 124 (13.7%) patients not on preoperative statins ($\chi^2 = 26.1$; $P < .01$). Patients ceasing statin therapy experienced more diabetes remission (n = 85 or 35.7%) than patients consistently using statin therapy at both time points (n = 57 or 17.0%; $\chi^2 = 27.3$; $P < .01$).

Conclusion: In contrast to expectations, our results suggest that diabetes resolves with bariatric surgery more often in patients maintained on statin therapy than in those never on statin therapy whereas cessation of statin therapy is associated with the greatest reductions in diabetes prevalence. These results indicate an impact of statin use on metabolic outcomes following bariatric surgery; a randomized control trial is needed to examine carefully this relationship. (Surg Obes Relat Dis 2016;▮:00–00.)

Keywords: Roux-en-Y gastric bypass; Laparoscopic adjustable gastric band; statins

Statins are among the most commonly prescribed pharmaceuticals in the United States, but produce a small but significant increased risk of new-onset diabetes [1,2]. This risk could be attributable to lifestyle factors, since a review of the National Health and Nutrition Examination Survey (NHANES) database found that patients on statin therapy eat more and gain more weight than nonstatin users [3]. Alternatively, smaller trials have found a possible mechanistic link between statin therapy and alterations in skeletal muscle oxidative metabolism [4–6] that could exacerbate diabetes risk.

The development of diabetes during statin therapy is greater in patients with prestatin diabetes risk factors such

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as the metabolic syndrome, a fasting glucose >100 mg/dL, a body mass index >30 kg/m^2, a glycosylated hemoglobin (HbA1C) >6%, a sedentary lifestyle, family history of diabetes, and abdominal obesity [7,8].

Bariatric surgeries improve glucose control and reduce the prevalence of diabetes [9]. Many bariatric surgical patients are concurrently treated with statin therapy, raising the question as to how concurrent statin therapy affects the metabolic changes associated with bariatric surgery. To our knowledge, the only published study of 440 adults reported no difference in weight loss or diabetes remission between preoperative statin users and nonstatin users undergoing Roux-en-Y gastric bypass (RYGB) surgery [10].

Consequently, we aimed to assess the effect of pre- and postoperative statin therapy on weight loss, diabetes prevalence, and metabolic health variables in a large database of bariatric surgery patients.

Methods

Participants

We reviewed data from our prospectively maintained database of patients who underwent bariatric surgery at our center. A total of 2878 patients underwent bariatric surgery with 1 of 2 surgeons. Procedures included laparoscopic adjustable gastric banding (LAGB; n = 1776), RYGB (n = 939), and sleeve gastrectomy (SG; n = 163). We included only patients who had statin use and diabetes status data before surgery and completed 1-year follow-up visits for a final sample size of 1575 patients (1035 LAGB, 468 RYGB, and 72 SG).

Patients were categorized based on preoperative statin use (yes or no) and the diagnosis of diabetes status (yes or no). Diabetes status determinations were made by the physician using available bloodwork and medication information at each time point. Statin dose and type were not analyzed since they were not consistently recorded in the database. Patients at 1-year follow-up were considered in diabetes remission if they were no longer using diabetes medications and had fasting glucose <126 mg/dL and HbA1C <6.0%. Body mass index (BMI), weight, HbA1C, fasting glucose, insulin, and blood lipids (total, high density lipoprotein [HDL-C], LDL-C, and triglycerides) were measured at both time points. Percent excess weight loss (%EWL) was calculated utilizing as ideal weight the patient's weight corresponding to a BMI of 25 kg/m^2.

Statistical Analyses

Baseline differences between statin-users and nonstatin users were calculated with a one-way analysis of variance (ANOVA) for continuous variables or chi-square for dichotomous variables. Changes in continuous outcomes such as weight, BMI and serologic measures were assessed using ANOVA, modeling the dependent factor as a change score (post-to-pre), including statin use, surgery type, and diabetes status as fixed factors, and controlling for age and baseline characteristic as covariates. Tukey's method was used to adjust pairwise differences between factor level means to control the family error rate during multiple comparisons. Chi-square analyses were used to investigate the relationships between statin use or surgery type and changes in diabetes status (no change, going into remission, or receiving a new diabetes diagnosis). Multinomial logistic regression was used to investigate the interaction between statin use, surgery type and changes in diabetes status. Results were considered significant at $P < .05$ and all analyses were conducted with IBM SPSS Statistics 22. Q5

Results

Baseline characteristics

Patients using statins preoperatively were more likely to have diagnosed hypertension and hyperlipidemia; higher triglycerides, fasting glucose, insulin and HbA1C values; and lower total and LDL cholesterol (Table 1). Women comprised 481 statin users (71.7%) versus 750 nonstatin users (83.0%; $\chi^2 = 28.7$; $P < .01$). In addition, more patients ($\chi^2 = 162.8$; $P < .01$) on statins had type 2 diabetes (T2D) (Fig. 1). There were no differences in statin use among surgery types ($\chi^2 = .17$; $P = .92$) with 597 (66%), 265 (29.3%) and 42 (4.6%) of 904 nonstatin using patients undergoing LAGB, RYGB, and SG, and 437 (65.1%), 203 (30.3%), and 31 (4.6%) of 671 statin-using patients undergoing these 3 surgeries, respectively.

Table 1
Preoperative subject characteristics (mean ± standard deviation)

	Nonstatin Use (n = 904)	Statin Use (n = 671)
Women, n (%)	750 (83.0)	481 (71.7)*
T2D, n (%)	200 (22.1)	357 (53.2)*
HTN, n (%)	468 (51.8)	501 (74.7)*
DYSLIP, n (%)	439 (48.6)	550 (82.0)*
GERD, n (%)	536 (59.3)	401 (59.8)
OBSSYN, n (%)	596 (65.9)	461 (80.7)
Age, yr	42.8 ± 10.1	50.4 ± 10.7*
Weight, kg	129.0 ± 24.3	129.3 ± 25.3
BMI, kg/m^2	45.9 ± 6.9	45.7 ± 7.3
Glucose, mg/dL	107.3 ± 33.4	129.3 ± 49.2*
Insulin, mIU/L	24.7 ± 22.5	30.3 ± 50.8*
HbA1C, %	6.2 ± 1.2	7.0 ± 2.0*
Triglycerides, mg/dL	140.1 ± 84.3	168.1 ± 91.9*
Total cholesterol, mg/dL	189.3 ± 32.8	178.4 ± 43.1*
HDL-C, mg/dL	48.0 ± 17.6	46.5 ± 12.8
LDL-C, mg/dL	113.3 ± 27.4	98.9 ± 34.9*

BMI = body mass index; DYSLIP = diagnosed hyperlipidemia; GERD = diagnosed gastrointestinal reflux disease; HbA1C = hemoglobin A1C or glycated hemoglobin; HDL-C = high density lipoprotein cholesterol; HTN = diagnosed hypertension; n = number of sample; LDL-C = low density lipoprotein cholesterol; OBSSYN = obstructive sleep apnea syndrome; T2D = type 2 diabetes.

*Indicates significant difference between patients using versus not using statins at $P < .05$.