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ORIGINAL CONTRIBUTIONS

Laparoscopic Roux-En-Y Gastric Bypass Versus Sleeve Gastrectomy on Pelvic Floor Disorders in Morbidly Obese Women: a Prospective Monocentric Pilot Study

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Abstract

Background Obesity is a well-known risk factor for female pelvic floor disorders (PFD). This study assessed the effects of bariatric surgery (BS) on pelvic organ prolapse symptoms (POPs) and urinary (UI) and anal incontinence (AI) in morbidly obese women undergoing either sleeve gastrectomy (SG) or Roux-en-Y gastric bypass (RYGB).

Methods Morbidly obese women undergoing BS from June 2016 to May 2017 were prospectively included. POPs, UI, and AI were compared at baseline and at 1 year after surgery using validated questionnaires.

Results Seventy-two consecutive women were enrolled, 54 (75%) (30 (56%) RYBP and 24 (44%) SG) completed the study at 1 year and were considered for the final analysis. The mean age and mean preoperative BMI were 43 ± 11.8 years (range, 20–65) and 41 ± 5.4 kg/m^2 (range, 35–56), respectively. At baseline, 30 (56%), 32 (59%), and 27 (50%) patients, respectively, had AI (flatus only 72%), UI, and POPs. The mean TBWL% at 1 year was 33%. In the whole study population, weight loss was associated with a significant improvement in UI ($p < 0.001$) but there was no significant difference in terms of AI and POPs. In the subgroups analysis, AI increased significantly 1 year after the RYGB ($p = 0.02$) due to an increase in flatus incontinence ($p = 0.04$). No significant difference in AI was found 1 year after the SG.

Conclusion BS is associated with a significant improvement in UI but not in POPs. RYBP seems to increase AI, mainly flatus incontinence, compared to SG.

Keywords Bariatric surgery · Obesity · Pelvic floor disorders · Anal incontinence · Urinary incontinence · Pelvic organ prolapse · Roux-en-Y gastric bypass · Sleeve gastrectomy

Introduction

Pelvic floor disorders (PFD) include different symptoms related to urinary incontinence (UI), pelvic organ prolapse symptoms (POPs), anal incontinence (AI), and other dysfunctions of the lower urinary and gastrointestinal tracts. PFD concerns 23–44% of adult women in the general population [1, 2], and obesity is a known risk factor for PFD with 75–90% of women with a BMI more than 35 kg/m^2 reporting symptoms related to PFD [3–5]. PFD seriously impact patients' quality of life with significant social consequences [6]. The main mechanism claimed as responsible for the increased rate of PFD in obese individuals is the increased intra-abdominal pressure that is a direct consequence of the increased amount of intra-abdominal fat resulting in the stretching of pelvic muscles and nerves [7, 8].

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Bariatric surgery (BS) developed enormously in recent years in concomitance with the recent epidemic of obesity [9] and surgery-induced weight loss has been shown to improve patients' quality of life and expectancy [10]. While there is a large body of literature proving the positive effect of BS on obesity-related comorbidities, few data exist on its effects on PFD [11–14]. Indeed, while there is sufficient evidence on the beneficial effects of weight loss induced by BS on urinary symptoms, literature on POPs and AI is scanty and data are contradictory [15, 16]. Indeed, an increased rate of AI, although mainly to flatus, has been reported after BS [17–19]. The modification of bowel habits and gastrointestinal disorders induced by BS have been both claimed as responsible for these symptoms [20–22]. Some bariatric procedures include a malabsorption component, as the Roux-en-Y gastric bypass (RYGB) and can therefore have different effects on bowel habits in addition to the effects of weight loss on bowel function. Indeed, the RYGB is associated with intestinal disorders including abdominal pain, abdominal distension, increased flatus, diarrhea, and fecal urgency that may impact PFD [18, 23]. However, to date, results of BS on colorectal symptoms and AI have not been fully investigated. Furthermore, the few studies on the topic have not compared the two most common procedures performed nowadays that are the RYBP and the sleeve gastrectomy (SG) [14].

The aim of the present study was to investigate the effects of the two most common bariatric procedures, the RYGB and the SG on PFD.

Methods

Study Design

All consecutive morbidly women undergoing BS during the study period between June 2016 and May 2017 were asked to participate in the present study after being informed through a written information notice on the principles of the study (CNIL Number 6009701). As data were completely anonymized, no written informed consent was required. Seventy-two consecutive patients accepted to take part to the study and were prospectively enrolled. All patients fulfilled the criteria for BS according the NIH consensus conference [24]: BMI of ≥ 40 or of 35 with at least one comorbid condition, including type 2 diabetes (T2D), blood hypertension (HT), obstructive sleep apnea syndrome (OSAS), or joint arthritis. The choice of the surgical procedure was left to the discretion of the operating surgeon.

Patients were asked to pill the following questionnaires the day before surgery (baseline) and at 1 year. The questionnaires were collected and analyzed at the end of the study by a single researcher.

The following data were also collected: demographics (age, BMI), comorbidities (T2D, HT, OSAS, joint arthritis), number of vaginal deliveries, type of BS (SG or RYGB), postoperative complications, and mortality.

Definition of comorbidities, their improvement, and resolution have been detailed elsewhere [25].

Two validated French version questionnaires were used to assess PFD:

1. The USP (urinary symptoms profile) [26] is a self-administered questionnaire developed and validated by the French Urological Association (AFU). It comprises 13 items covering all types of symptoms of the lower urinary tract: stress UI, overactive bladder (OB), and lower stream symptoms (dysuria).
2. The pelvic floor distress inventory (PFDI20) [27, 28] includes 20 questions in 3 domains: pelvic organ prolapse distress inventory (POPDI), colorectal-anal distress inventory (CRADI), and urogenital distress inventory (UDI). Possible scores for each domain range from 1 to 100, with higher scores indicating more severe symptoms. CRADI includes 3 questions about AI, allowing individualizing 3 scores: AI, fecal incontinence (FI), and flatus incontinence. A symptomatic PFD was defined as having one or more of the three disorders (UDI, POPDI, and CRADI).

Surgical Procedures

The laparoscopic RYGB procedure included a Roux-en-Y loop done with a 150-cm long alimentary limb and a 50-cm biliopancreatic limb, a vertical gastric pouch of 20 to 30 ml, and a 10 to 12 mm gastrojejunostomy. The SG procedure included a longitudinal gastrectomy over a 36 endoluminal French boogie.

Statistical Analysis

Quantitative variables are presented as mean ± standard deviation (SD) associated with the interquartile range (IQR). Qualitative variables are presented as percentage and frequency of the entire study population. Mann Whitney test for continuous variables and Fisher's test for categorical variables were used to compare groups (SG and RYGB). We investigated pairwise comparisons using Wilcoxon test with Holm correction for continuous variables. Non-parametric tests were used for non-normally distributed continuous variables as indicated by Shapiro-Wilk test.

The results with $p < 0.05$ were considered as statistically significant. Statistical analysis was performed using the online BiostaTGV software.

Results

A total of 72 consecutive women entered the study at baseline while complete information was available in 54 (75%) of them at 1 year after surgery, and data on these were analyzed in the present paper. Baseline clinical characteristics of the women are presented in Table 1. The mean age was 42 ± 11.8 years (range, 20–65), and the mean preoperative BMI was 41 ± 5.4 kg/m^2 (range, 35–56). Twenty-nine patients (54%) had at least one comorbidity with 11 patients (20%) having two or more comorbidities. Twenty-four (44%) patients had a SG and 30 (56%) had a RYGB. There was no difference between patients undergoing SG and RYGB.

There was no postoperative mortality. The rate of postoperative complications was 4%, and no patients required reoperation. One patient presented with an intra-abdominal collection that required antibiotics, and one other patient presented a splenic ischemia treated by analgesics. As expected, both surgical procedures were effective in inducing a significant weight loss with a mean total body weight loss (%TWL) of 33% (range, 9–51). Interestingly, the SG and RYGB resulted in comparable TWL%: 31 (15–46) for the SG vs 34 (9–51) for the RYGB (Table 2).

Urinary Symptoms: USP (Fig. 1)

At baseline, 49 patients (90%) had urinary symptoms: 32 patients (59%) had UI, 48 (89%) had OB, and 18 (33%) had low stream symptoms. The mean USP total score decreased from 6.9 ± 4.5 to 2.9 ± 3.9 ($p < 0.001$) 1 year after surgery. The mean UI score decreased from 1.7 ± 2.09 to 0.57 ± 1.4 ($p < 0.001$), and the mean OB score decreased from 4.9 ± 3.5 to 1.9 ± 2.7 ($p < 0.001$). There was no significant difference between mean low stream score before and after surgery ($p = 0.2$).

The subgroup analysis between SG and RYGB reached the same results as in the global population.

Pelvic Floor Disorders Symptoms: PFDI 20 (Fig. 2)

At baseline, 88% of the patients presented various degrees of PFD. The PFDI 20 score decreased from 42.4 ± 36.6 to 29.2 ± 31.5 after surgery ($p = 0.03$). The decrease in the prevalence of PFD symptoms was mainly attributed to a significant reduction in the prevalence of urinary symptoms: UDI mean score decreased from 21.8 ± 19.9 before surgery to 6.5 ± 9.2 after surgery ($p < 0.001$). The mean CRADI score and POPDI score did not differ significantly before and after surgery ($p = 0.3$ and $p = 0.3$). The subgroup analysis between SG and RYGB yielded the same results as in the whole population.

Anal Incontinence: (Fig. 3a, b)

The rate of AI at baseline was 56%, while flatus incontinence and FI were present in 50% and 19% of patients, respectively. While there was no significant difference in the whole study population in AI, FI, and flatus incontinence scores before and 1 year after surgery ($p = 0.26$, $p = 0.79$, and $p = 0.1$, respectively), subgroup analysis yielded interesting results. Indeed, in the SG group, there was no significant difference between the three scores of AI, with the FI score decreasing to 0 after surgery ($p = 0.09$) (Fig. 3a), and in the RYBG group, there was an increase in the score of AI from 2 ± 2.2 to 3.1 ± 2.7 after surgery ($p = 0.02$) (Fig. 3b). This increase was mainly related to an increase of flatus incontinence score from 1.5 ± 1.57 to 2.23 ± 1.65 ($p = 0.04$) while there was no significant difference concerning FI in this subgroup ($p = 0.3$).

Discussion

In this study, we were able to demonstrate a significant increase in the AI to flatus in morbidly obese women undergoing the RYGB, while patients undergoing the SG showed an

Table 1 Baseline patients' characteristics

	Total	SG	RYGBP	*p*
Patient (*N*)	54	24	30	
Age, mean ± SD (IQR)	42 ± 11.8 (20–65)	40 ± 12.3 (20–65)	44 ± 11.1 (25–65)	0.15
BMI kg/m^2, mean ± SD (IQR)	41 ± 5.4 (35–56)	43 ± 5.9 (35–56)	40 ± 4.6 (35–51)	0.8
HT, *n* (%)	11 (20)	3 (12)	8 (27)	0.24
T2D, *n* (%)	4 (7)	3 (12)	1 (3)	0.3
OSAS, *n* (%)	15 (28)	6 (25)	9 (30)	0.8
Arthritis, *n* (%)	11 (20)	2 (8)	9 (30)	0.08
Vaginal deliveries, *n* (%)	24 (44)	8 (33)	16 (53)	0.3

IQR interquartile range, *SD* standard deviation, *BMI* body mass index, *HT* blood hypertension, *T2D* type 2 diabetes, *OSAS* obstructive sleep apnea syndrome, *SG* sleeve gastrectomy, *RYGB* Roux-en-Y gastric bypass

Table 2 Postoperative complications and evolution of body weight 1 year after bariatric surgery

	Total	SG	RYGB	*p*
TWL % (IQR)	33 (9–51)	31 (15–46)	34 (9–51)	0.3
EWL % (IQR)	79 (31–100)	75 (37–100)	83 (31–100)	0.2
POC (*n*)	2	2	0	0.2

TWL total weight loss, *EWL* excess weight loss, *POC* postoperative complications, *SG* sleeve gastrectomy, *RYGB* Roux-en-Y gastric bypass

improvement in these symptoms that however did not reach statistical significance.

In the present study, the evaluation of AI was performed by isolating the questions related to signs of fecal and flatus incontinence in the PFDI20. As the CRADI score explores the colorectal symptoms in general (constipation, AI), which were not clinically relevant to the aims of our study, we isolated the questions concerning AI in this score. Although the fact that a questionnaire targeting specifically AI was not used may be claimed as a limitation of the present study, we wanted to have an overview on the different symptoms related to PFD. Furthermore, we were not expected to find such differences between the SG and the RYGB on flatus incontinence when the study was designed.

Before BS, 56% of patients had AI and more than half of them reported that the latter had an impact on their quality of life. Interestingly, AI was mainly represented by flatus incontinence. The increased AI in obese women is probably multifactorial, due to the increased intra-abdominal pressure stretching the sphincter apparatus and the pudendal nerves, the diabetes, nerve conduction abnormalities, and intervertebral disc herniation [7, 8, 29]. In the present study, while the analysis of the results after the BS showed a non-significant increase in the whole population, the subgroups analysis showed an increase in AI in the RYGB subgroup of patients related to an increase in flatus incontinence ($p = 0.02$ and $p = 0.04$, respectively), whereas in the SG subgroup no significant difference was found. As these findings have never been reported before, we hypothesized that the RYGB-related gastrointestinal disorders were involved in the mechanisms responsible for the increased incontinence to flatus [21]. Indeed, the bariatric procedures including a malabsorption component such as RYGB may cause gastrointestinal disorders including diarrhea [18] that, in turn, may be at the origin of a decompensation of the AI. Another major point involves the alteration of the intestinal microbiota which occurs in bariatric procedure including an intestinal bypass but not in the case of SG [30, 31]. The impact of this modification of the intestinal microbiota has been studied, with respect to stabilization of weight loss after surgery, while the link between this modification and gastrointestinal disorders has not been elucidated so far [32]. One potential explanation might be found in the bacterial overgrowth syndrome that is rather common in the setting of the RYGB and that is responsible for ballooning, increased flatus, and diarrhea [33, 34]. This, in turn, may favor flatus incontinence. However, bacteroides, normally increased after SG and decreased after RYGB, was found to be substantially decreased in patients with idiopathic chronic diarrhea [22].

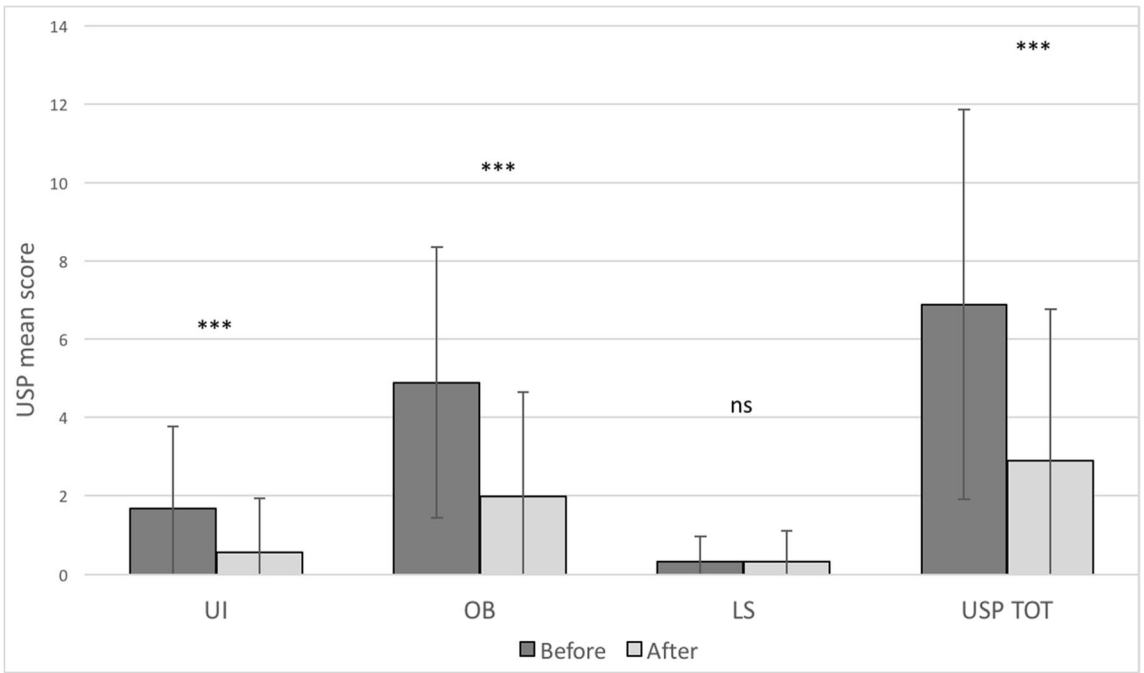


Fig. 1 Evaluation of USP score before and after bariatric surgery. *UI* urinary incontinence, *OB* overactive bladder, *LS* low stream, *USP TOT* urinary symptom profile total score, *** indicates *p* value < 0.001, *ns* not significant

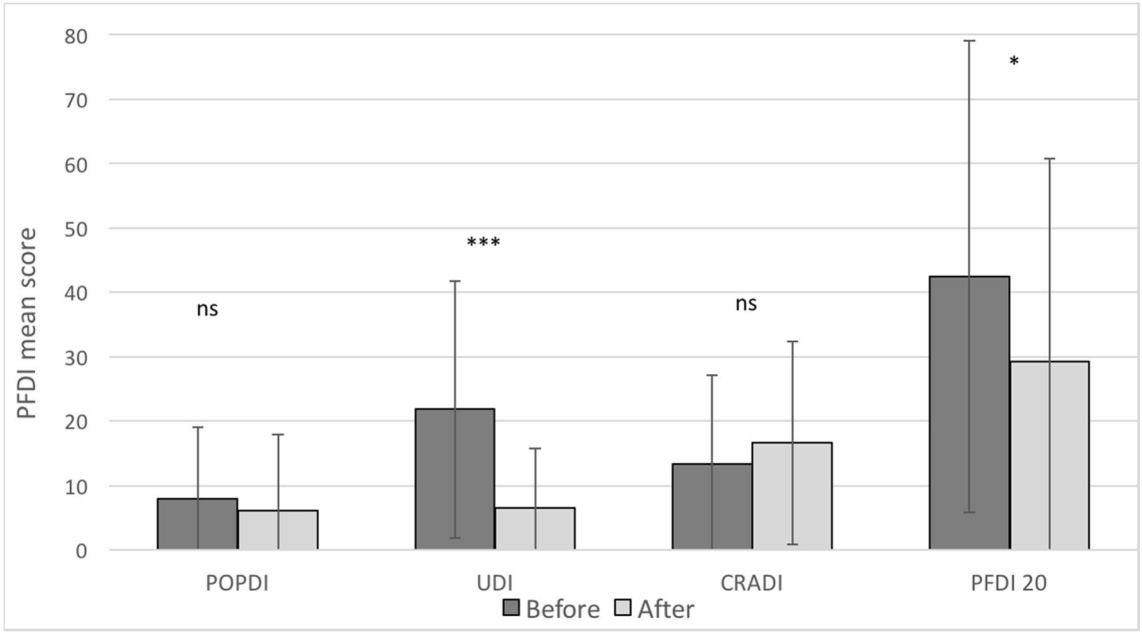


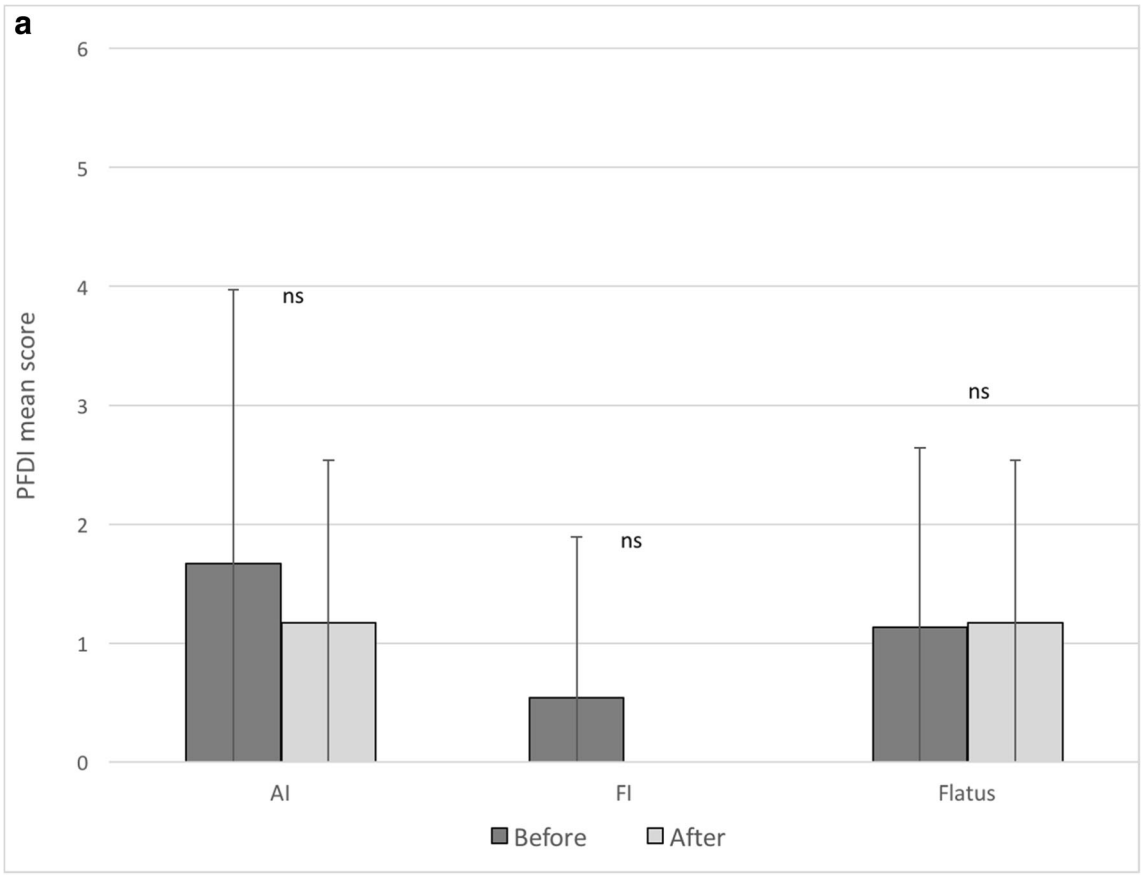
Fig. 2 Evaluation of PFDI 20 score before and after bariatric surgery. *POPDI* pelvic organ distress inventory, *UDI* urinary distress inventory, *CRADI* ColoRectal-Anal Distress Inventory, *PFDI 20* Pelvic Floor Disability Index total score, *** indicates p value < 0.001, * indicates 0.05 > p value > 0.01, *ns* non specific

The wide variation in the prevalence of AI in the general population going from 0.5 to 24% [2] is mainly related to the definition of AI that includes or not flatus incontinence. Indeed, most studies evaluating the effect of BS on AI, do not consider flatus incontinence. However, as it is well known that the latter may significantly impact the quality of life of women in young age as in those included in the present study, we aimed to analyze the impact of BS-induced weight loss also on flatus incontinence. The literature investigating the relationship between obesity and AI is very scanty, the results are discordant, and none has compared the SG and the RYBG. Scozzari et al. found an increase in the rate of AI from 28.1 to 40.6%, which did not reach statistical significance [16]. Interestingly, the authors conducted in their study anorectal manometric pressure measurements in 32 women before and after BS and found that the anorectal manometric pressure did not differ after BS implying that AI is not related to a dysfunction in the sphincter apparatus itself. On the other hand, Foster et al., investigating the effects of RYGB on intestinal symptoms, found that the AI rate decreased after BS [20], but they analyzed 37 patients with a follow-up of 6 months.

Although, the improvement of AI did not reach statistical significance in the SG group, a tendency to decrease the FI with absence of FI signs in the SG group at 1 year after surgery was found ($p = 0.09$). This was probably due to the small size of the sample analyzed, especially in the SG group that should be acknowledged as a limitation of the present study. However, in light of the results we obtained on the effects of the RYGP, colorectal functional disorders and incontinence symptoms should be sought before proposing a RYGB, especially since flatus incontinence affected more than 50% of the obese women in this study.

While, we were not able to find any difference on POPs after BS in the present study, current literature is divergent on the subject. Leshem et al. found an improvement on POPs after BS [35], and a meta-analysis of 11 studies [14] concluded that BS is associated with improvement in both UI and POPs. Interestingly, in this meta-analysis, no significant effect was found on AI and the type of surgical procedure was not reported. However, Romero-Talamas et al. performed gynecologic examination (pelvic organ prolapse quantification test) and urodynamic testing to evaluate the effect of BS on PFD, and there was no significant change in the prevalence and severity of POPs [36]. A limitation of the present study relies in the absence of clinical and morphological examination for the diagnosis of POPs. Indeed, questionnaires underestimate the true prevalence of POPs diagnosed by physical examination, because some women deny or ignore symptoms. However, it may be argued that as appropriate treatment for POPs is selectively offered in presence of symptoms, symptom-based diagnosis is an appropriate tool to select women who may need specialized care.

The decrease in the prevalence of PFD symptoms after BS that we found in the present study was mainly due to a significant reduction in the prevalence of urinary symptoms as previously reported in the literature [14, 37, 38]. The favorable results of BS-induced weight loss were mainly due to a decrease in symptoms related to UI and OB but not in storage symptoms [39]. We also found a decrease in the impact of urinary symptoms on the quality of life. Indeed, with a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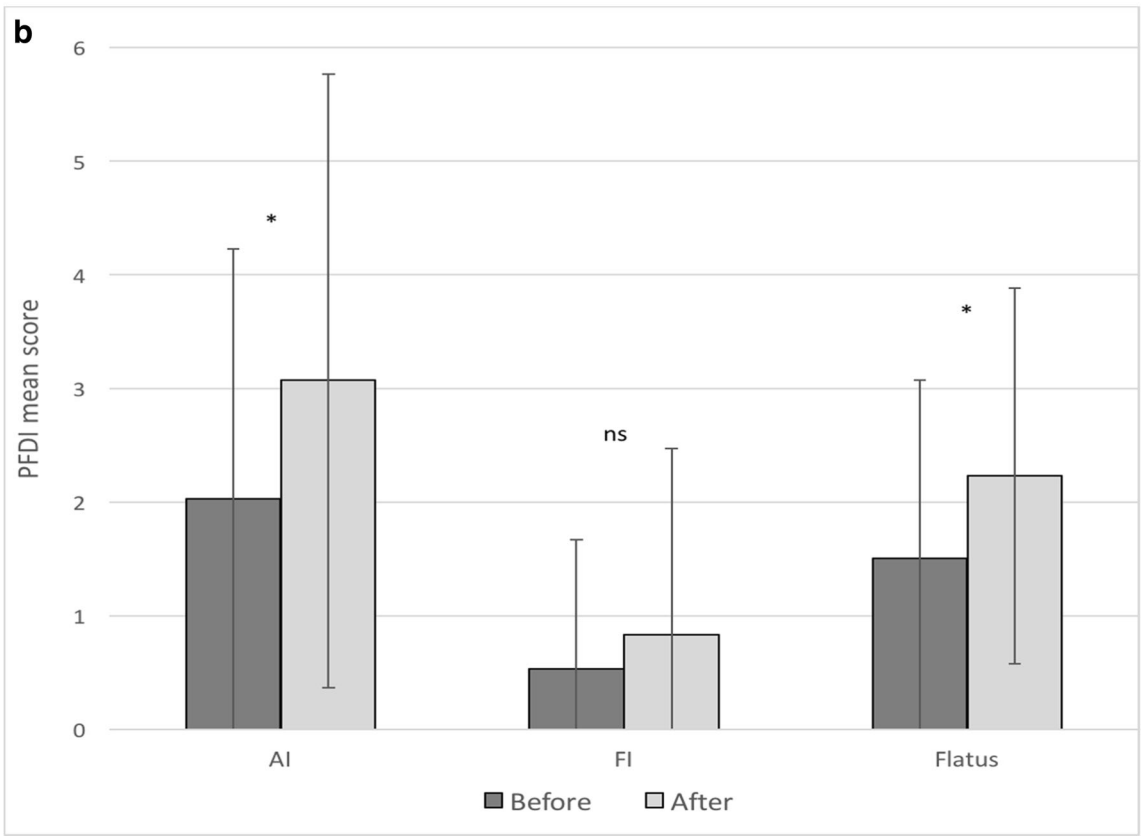
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◀ **Fig. 3** **a** Evaluation of anal incontinence before and after SG. *AI* anal incontinence, *FI* fecal incontinence, *Flatus* flatus incontinence. * indicates $0.05 > p$ value > 0.01, *ns* not significant. **b** Evaluation of anal incontinence before and after Roux-en-Y gastric bypass. *AI* anal incontinence, *FI* fecal incontinence, *Flatus* flatus incontinence. * indicates $0.05 > p$ value > 0.01, *ns* not significant

reduction of more than 50% in the UI rate and concordant results in the literature, BS should be probably considered as first line therapy for UI among morbidly obese women wishing to enter a bariatric program.

Conclusion

The present study confirms those previously reported on urinary symptoms in the setting of morbid obese women undergoing BS but, must importantly, indicates that the RYGB may decompensate flatus incontinence while this effect is not found in patients undergoing the SG. While these data should be confirmed in a larger study focused on colorectal disorders and AI, the effect of the RYGB should kept in mind in the process leading to the choice of the most appropriate bariatric procedure.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Informed Consent Patients were informed through a written notice on the purpose of the study.

Ethical Approval All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments.

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