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Original article

A prospective longitudinal study of chronic abdominal pain and symptoms after sleeve gastrectomy

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Abstract

Background: Sleeve gastrectomy (SG) is widely applied. Few studies have evaluated patient-reported abdominal symptoms after SG.

Objective: To evaluate the prevalence of chronic abdominal pain (CAP) and symptom characteristics after SG.

Setting: Oslo University Hospital and Voss Hospital.

Methods: We performed a longitudinal prospective cohort study of patients operated on with SG at two tertiary referral centers. For broad assessments of abdominal pain and symptoms, consultations were performed and questionnaires retrieved before and 2 years after SG. The definition of CAP or recurrent abdominal pain lasting for more than 3 months was sustained. Preoperative predictors of CAP were explored.

Results: Of 249 patients at baseline, 207 (83.1%) had follow-up consultations. Mean preoperative body mass index was 43.9 (6.0) kg/m^2, and 181 patients (72.7%) were female. Total weight loss was 31.9% (10.4%). CAP was reported in 32 of 223 patients (14.3%) before and in 50 of 186 patients (26.9%) after SG (P =.002). All mean gastrointestinal symptoms rating scale questionnaire scores increased after SG, and they were higher in patients with CAP. Symptoms of depression decreased but were more prevalent in patients with CAP at follow-up. Most quality-of-life scores increased after SG. However, patients with CAP had lower scores (except for physical functioning). Preoperative bothersome Gastrointestinal Symptom Rating Scale reflux symptoms, study center, and younger age seemed to predict CAP after SG.

Conclusion: The prevalence of patient-reported CAP increased after SG. Patients reporting CAP had reduced quality-of-life scores. (Surg Obes Relat Dis 2021;■:1–11.)

Keywords: Chronic abdominal pain; Quality of life; Gastrointestinal symptoms; Sleeve gastrectomy; Bariatric surgery; Anxiety; Depression

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Sleeve gastrectomy (SG) is a widely applied surgical procedure enabling significant weight loss, resolution of obesity-related diseases, and improved quality of life [1]. However, bariatric surgery also has been associated with adverse effects including abdominal pain and symptoms that may influence long-term outcome [2].

High rates of abdominal pain after Roux-en-Y gastric bypass (RYGB) have been reported [3,4]. A recent study found an increase in the rate of self-experienced chronic abdominal pain (CAP) from 12% before to 29% 2 years after RYGB [5]. Following SG, gastroesophageal reflux disease (GERD) has been reported at high rates [6,7]. Less evidence is available regarding abdominal symptoms and pain [8].

Shedding light on such patient-reported outcome measures after SG is relevant for both preoperative and postoperative consultations and guidance. With this aim, we explored the prevalence of CAP before and 2 years after SG. Secondarily, we evaluated abdominal symptoms, psychological aspects, and quality of life.

Methods

Setting

We performed a prospective longitudinal cohort study at 2 institutions, both tertiary referral centers for bariatric surgery annually operating on 200–300 and 200 patients, respectively. At 1 of the study institutions, SG was the dominant procedure used in most patients, although not in those with severe GERD. At the other institution, SG was used only for patients with no reflux symptoms or verified GERD, with RYGB offered to those with reflux disease.

This study was approved by the Regional Committee for Medical and Health Research Ethics and registered at ClinicalTrials.gov. The STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for reporting observational studies were followed. All participants provided written informed consent for study participation.

Outcomes

The prevalence of patient-reported CAP 2 years after SG was the primary outcome. CAP was defined as sustained or recurrent abdominal pain lasting for more than 3 months [5]. Secondary outcomes included abdominal symptoms and characteristics in general, quality of life, and potential preoperative predictors of CAP after SG.

Early complications were defined as complications occurring within 30 days, and subsequent events were reported as late complications. Serious complications were classified according to the Clavien–Dindo algorithm (grade IIIb or higher) [9].

Participants

Patients scheduled for SG were invited to study participation at preoperative consultations from November 2015 to May 2017. Follow-up consultations were performed from November 2017 to August 2020. At inclusion and at follow-up, the participants responded to a set of questionnaires, followed by consultations with a physician. Study exclusion criteria were inability to understand the spoken language and previous and redo bariatric procedures.

Surgical procedure

SG was performed laparoscopically by mobilizing the greater curvature up to the left crus. Gastric resection was performed along a 30–32-Fr tube by using stapling devices. At 1 of the institutions, the staple line was inverted from the top to the angulus of the stomach by absorbable sutures (3-0 V-lock, Covidien, Inc., Mansfield, Massachusetts). Distally, the stapling started about 4 cm proximal to the pylorus. At the other institution, the stapling started about 2–3 cm from the pylorus. At this institution, no reinforcement was used, but gastropexy was performed in most patients [10].

Follow-up

Patients were discharged 1–2 days after surgery. Multivitamins, iron, vitamin D, calcium, and vitamin B_{12} were prescribed. Oral ursodeoxycholic acid (Ursofalk; Dr. Falk Pharma UK, Ltd., Buckinghamshire, England) was recommended at the first institution for 6 months. Patients were scheduled for routine follow-up at 6–8 weeks after surgery and then at 6 months and 1, 2, and 5 years.

Questionnaires

A primary questionnaire was used to evaluate CAP [5]. The inlet question was, “Are you experiencing long-term or recurrent abdominal pain lasting for more than three months?” If the participant answered “Yes,” he or she was instructed to respond to the rest of the items. Pain severity was graded along a numerical rating scale from 0 to 10 (0 = no pain; 10 = worst imaginable pain), with cutoff values of mild (0–5), moderate (6–7), and severe (8–10). Interference with sleep, daily activities, and work was graded on the same numerical rating scale (0 = not affected; 10 = completely affected) with the same cutoff values [11].

Abdominal symptoms were evaluated with the Gastrointestinal Symptom Rating Scale (GSRS; 1-week recall), which gives a total score and 5 syndrome scores (abdominal pain, GERD, diarrhea, indigestion, and constipation syndrome). We used the mean value of $\geq$3 as a cutoff value for bothersome symptoms [5,12]. The ROME III questionnaire was used to evaluate the prevalence of irritable bowel syndrome symptoms [13]. The GERD questionnaire

(GERDq) was used to predict GERD, with items resulting in total scores between 0 and 18 and with total scores ≥9 having the best sensitivity and specificity for predicting GERD [14,15]. Aspects of bodily pain were assessed with the Brief Pain Inventory (BPI) questionnaire, with 1 of the items requesting patients to specify all areas of pain on a body figure [16].

Psychosocial characteristics were evaluated by the Pain Catastrophizing Scale (PCS) and the Hospital Anxiety and Depression Scale (HADS). The PCS gives a total score and 3 subscale scores of catastrophizing (i.e., rumination, magnification, and helplessness). Cutoff values corresponding to the 75th percentile were used to indicate clinically relevant levels of catastrophizing [17]. Symptoms of anxiety and depression were evaluated by the HADS. A subscore of ≥8 was regarded as a symptom of anxiety and/or depression [18].

Quality of life was assessed by the Short Form 36, version 2 (SF-36v2, 4-week recall; National Center for Interprofessional Practice and Education, Minneapolis, Minnesota). Sums of all SF-36v2 items within each of the 8 domains were transformed into a 0–100 scale (0 = maximum disability; 100 = no disability). SF-36v2 was scored using PRO CoRE, version 1.5 (Optum Inc., Eden Prairie Minnesota) [19].

Statistical analysis

Student's *t* test, Wilcoxon signed-rank test, or Wilcoxon rank-sum test/Mann–Whitney *U* test was used when comparing continuous variables, and McNemar's test or the χ^2 test was used for categorical variables. Continuous variables were presented as means (with standard deviations) and categorical variables as numbers (portion in percent). Effect sizes (ESs) of the changes in scores between 2 means were estimated with Cohen's *d* (continuous variables) [20,21].

CAP at 2 years was the outcome variable in the logistic regression model. Variables were entered simultaneously and chosen by clinical relevance. The model was limited to 9 preoperative variables (i.e., institution, sex, age, body mass index, musculoskeletal pain, GERD [from GSRS, scores ≥3], symptoms of anxiety [from HADS], irritable bowel syndrome diagnosis [from ROME III], and preoperative CAP). Statistical analyses were performed using IBM SPSS Statistics, version 26 (IBM Corp., Armonk, New York)

Results

The baseline population consisted of 249 patients, and follow-up data were available for 207 of 249 patients (83.1%; Supplementary Fig. 1). Patient characteristics are given in Table 1. At 2-year follow-up, mean change

Table 1
Patient characteristics before and 2 years after sleeve gastrectomy at Oslo University Hospital and Voss Hospital

	Baseline Oslo n = 84	Baseline Voss n = 165	Baseline combined n = 249	Follow-up combined n = 207
Patient demographic characteristics and social status				
Female*	69 (82.1)	113 (68.1)	181 (72.7)	80 (64.0)
Age, yr	40.3 (10.3)	41.6 (11.3)	41.2 (11.0)	43.7 (10.7)
Weight, kg†	125.6 (24.9)	129.5 (23.3)	128.2 (23.9)	87.3 (20.1)
Body mass index, kg/m^2†	43.4 (6.6)	44.1 (5.7)	43.9 (6.0)	29.8 (6.0)
Civil status*†				
Living with someone	38 (46.9)	102 (66.7)	140 (59.8)	135 (71.4)
Living alone	43 (53.1)	51 (33.3)	94 (40.2)	54 (28.6)
Employment status				
Working full/part time/student	58 (73.4)	97 (63.4)	155 (66.8)	142 (74.3)
Unemployed/sick leave/disability pension	21 (26.6)	56 (36.6)	77 (33.2)	49 (25.7)
Diseases‡				
Type 2 diabetes†	6 (7.1)	21 (13.4)	27 (11.2)	5 (2.8)
Hypertension†	31 (36.9)	53 (33.3)	84 (34.6)	29 (16.3)
Gastroesophageal reflux*†	7 (8.3)	63 (42.0)	70 (29.9)	71 (39.9)
Hypothyroidism	10 (12.3)	22 (14.3)	32 (13.6)	15 (8.6)
Depression*	14 (17.1)	37 (31.9)	51 (25.8)	33 (18.4)
Anxiety	12 (14.8)	29 (25.0)	41 (20.8)	28 (15.6)
Musculoskeletal pain*†§	50 (60.2)	102 (75.0)	152 (69.4)	66 (36.9)
Gallstone*	4 (5.0)	15 (17.9)	19 (11.6)	12 (7.1)
Abdominal surgery prior to SG*¶	35 (42.7)	46 (29.5)	81 (34.0)	N.A.

Categorical variables are reported as n (%) and continuous variables as mean (SD). Patients with missing data are not included in the analyses.
* Baseline variables with significant difference ($P < .05$) between institutions.
† Significant changes ($P < .05$) from baseline combined to follow-up combined.
‡ Symptomatic patient-reported diseases.
§ Undefined/miscellaneous pain.
¶ Abdominal surgery for any cause.

in body mass index was 14.1 (6.3) kg/m^2, mean percentage of total weight loss was 31.9% (10.4%), and mean percentage of excess weight loss was 77.1% (25.6%).

Serious perioperative complications were reported in 1 patient with a stricture at the gastroesophageal junction handled by endoscopy. Late abdominal surgical procedures were reported in 3 patients, 1 with dysphagia and hiatal hernia treated with diaphragm crural repair and gastropexy, 1 with cholecystectomy, and 1 with diagnostic laparoscopy for abdominal pain. No patients with CAP at follow-up reported complications related to SG.

There were no significant differences in the rates of working full or part time among patients with and without CAP at follow-up, which were 68.8% and 77.2%, respectively (P = .329).

Symptoms of chronic abdominal pain

A total of 32 of 223 patients (14.3%) reported CAP at baseline compared with 50 of 186 patients (26.9%) at follow-up (P = .002). CAP was a new occurrence at follow-up in 33 of 43 patients (76.7%). At the first institution, 8 of 80 patients (10.0%) reported CAP at baseline

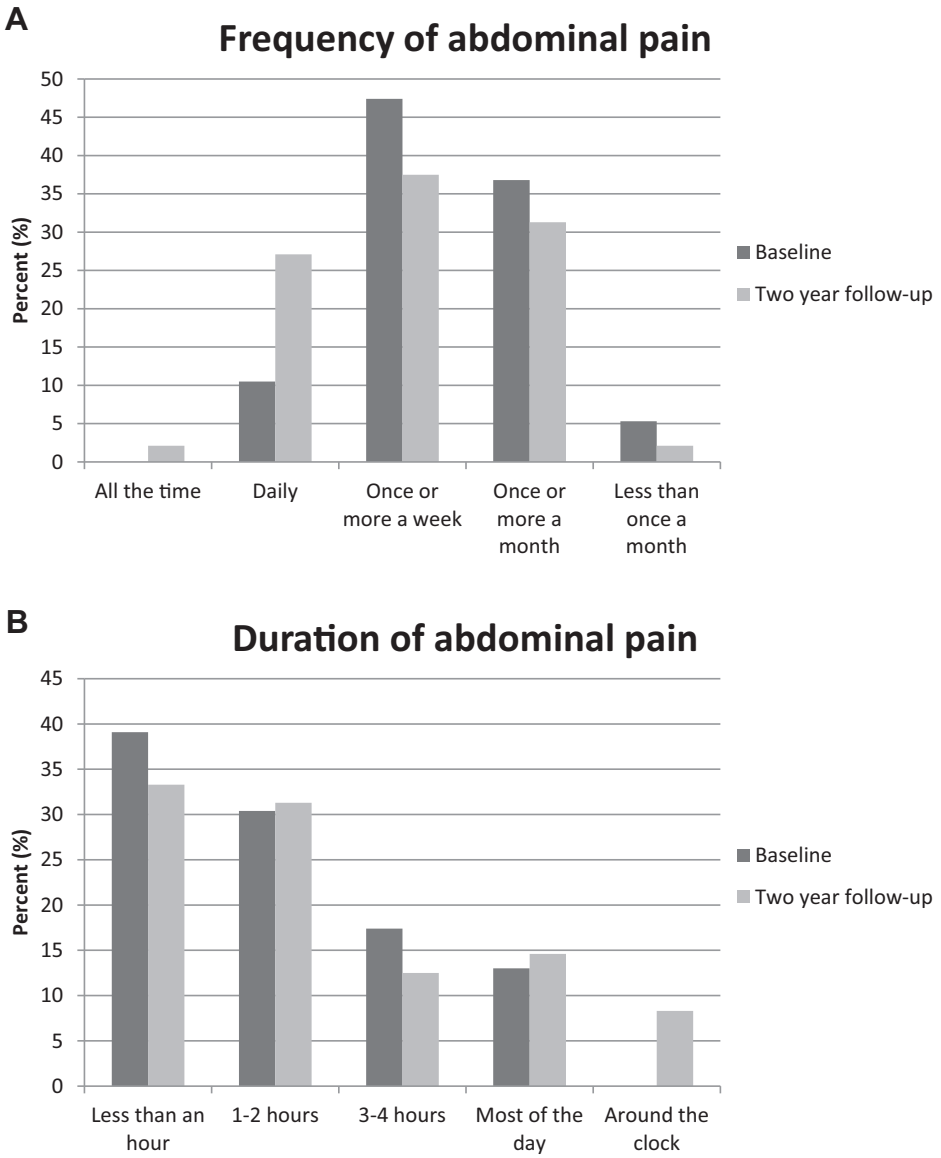


Fig. 1. (A, B) Frequency and duration of abdominal pain. (C) Multiple-response item. (D) At baseline, mild, moderate, and severe pain was seen in 18 of 23 patients (78.3%), 5 of 23 patients (21.7%), and no patients (0%), respectively. At follow-up, mild, moderate, and severe pain was seen in 25 of 49 patients (51.0%), 14 of 49 patients (28.6%), and 10 of 49 patients (20.4%), respectively. (E) At baseline, mild, moderate, and severe interference with sleep was seen in 17 of 23 patients (73.9%), no patients (0%), and 6 of 23 patients (26.1%), respectively. At follow-up, mild, moderate, and severe pain was seen in 36 of 48 patients (68.8%), 3 of 48 patients (6.3%), and 9 of 48 patients (18.8%), respectively. (F) At baseline, mild, moderate, and severe interference with work and daily activities was seen in 17 of 23 patients (73.9%), 1 of 23 patients (4.3%), and 5 of 23 patients (21.7%), respectively. At follow-up, mild, moderate, and severe interference was seen in 33 of 48 patients (68.8%), 9 of 48 patients (18.8%), and 6 of 48 patients (12.5%), respectively. Patients with missing data are not included in the analyses.

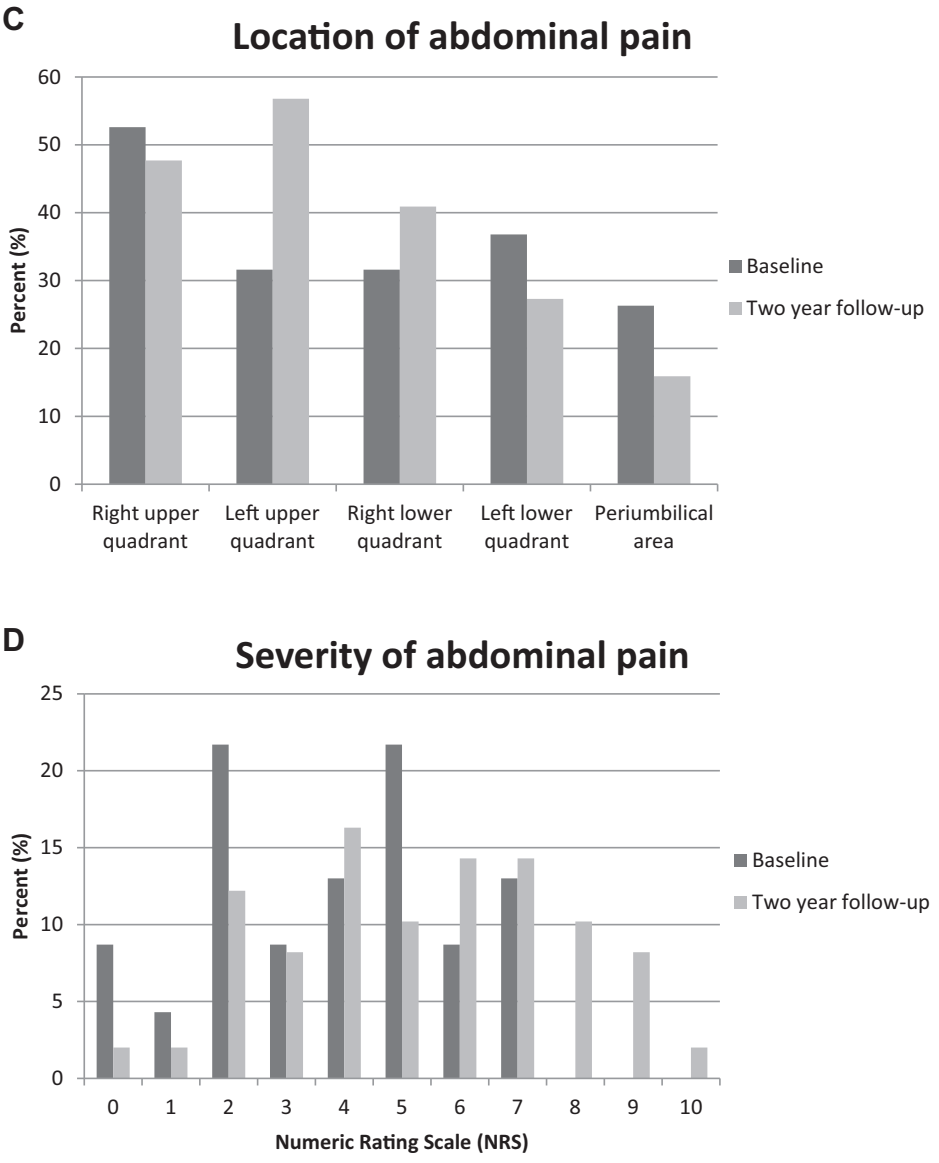


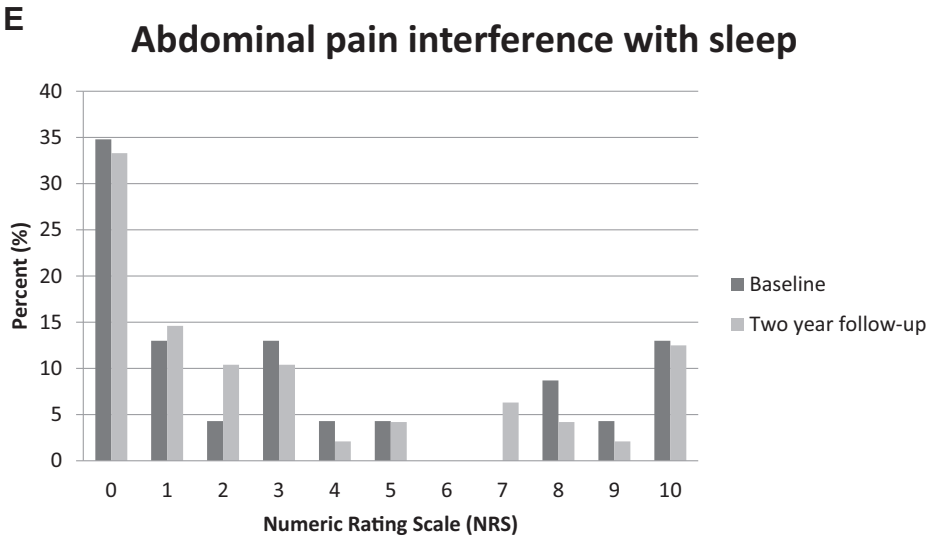
Fig. 1. Continued

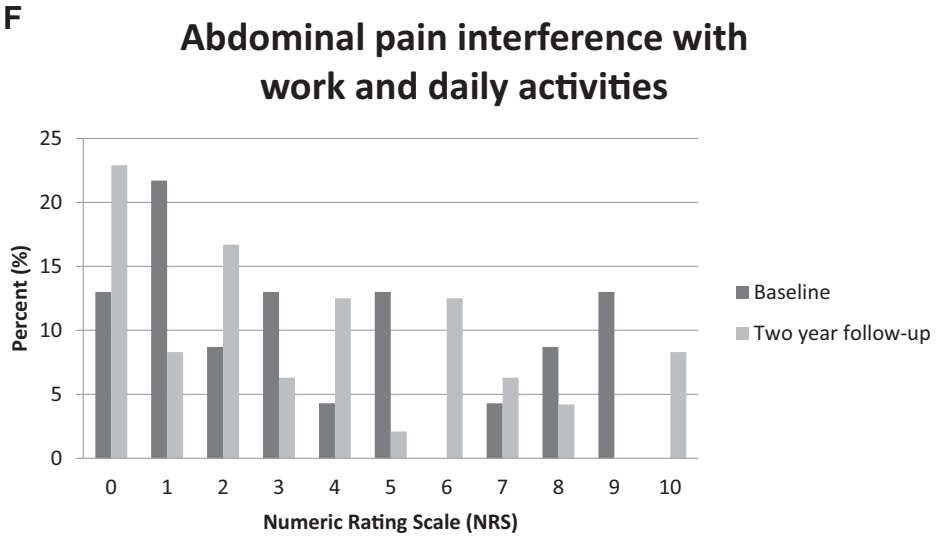
and 21 of 64 patients (32.8%) at follow-up ($P = .017$). The corresponding figures at the second institution were 24 of 143 patients (16.8%) at baseline and 29 of 122 patients (23.8%) at follow-up ($P = .093$). The pain characteristics are presented in Fig. 1. Use of any kind of analgesic for CAP was reported by 8 of 23 patients (34.8%) at baseline and 13 of 50 (26.0%) at follow-up ($P = .221$). No patients used opioids for CAP at baseline, and 1 patient used opioids at follow-up for CAP.

Abdominal symptoms

The GSRS scores increased significantly from baseline to follow-up for abdominal pain, GERD, and constipation syndrome and for total scores with small to medium ESs (Fig. 2A, and Table 2). The number of patients with bothersome symptoms (scores ≥ 3) increased for abdominal pain from 35 of 237 patients (14.8%) at baseline to 44 of 186 patients (23.7%) at follow-up ($P = .012$); for GERD, from 31 of 237 patients (17.0%) to 58 of 187 patients (31.0%; $P < .001$); and for constipation, from 32 of 234 patients (13.7%) to 47 of 185 patients (25.4%; $P < .001$), respectively.

At follow-up, patients with CAP had higher scores for all GSRS syndromes when compared with patients without CAP and with medium to large ESs (Fig. 2B and Table 3). Bothersome symptoms were more common in patients with CAP at follow-up: for abdominal pain





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symptoms (24 of 49 patients [49.0%] versus 20 of 134 patients [14.9%], $P < .001$), diarrhea symptoms (20 of 49 patients [41.7%] versus 16 of 134 patients [11.9%], $P < .001$), indigestion symptoms (23 of 47 patients [48.9%] versus 27 of 131 patients [20.6%], $P = .001$), and constipation symptoms (20 of 48 patients [41.7%] versus 27 of 34 patients [20.1%], $P = .006$).

At baseline and follow-up, 20 of 204 patients (9.8%) and 27 of 171 patients (15.8%) had a high likelihood of GERD (GERDq score ≥ 9; $P = .099$), respectively. At follow-up, the rate of likelihood of GERD did not differ statistically in patients with and without CAP.

According to the BPI questionnaire, the abdominal area was marked as the location of pain ($P = .017$) in 10 of 142 patients (7.0%) at baseline and 31 of 108 patients (28.7%) at follow-up.

Psychosocial characteristics

Clinically relevant levels of catastrophizing did not increase significantly after SG for the entire population. However, clinically relevant levels of catastrophizing at follow-up for all types except rumination were seen significantly more often in patients with CAP. All mean HADS scores decreased after SG and were lower in patients without CAP (see Table 2 and 3). No significant changes were seen in symptoms of anxiety. Symptoms of depression decreased from 53 of 223 patients (23.8%) at baseline to 19 of 177 patients (10.7%) at

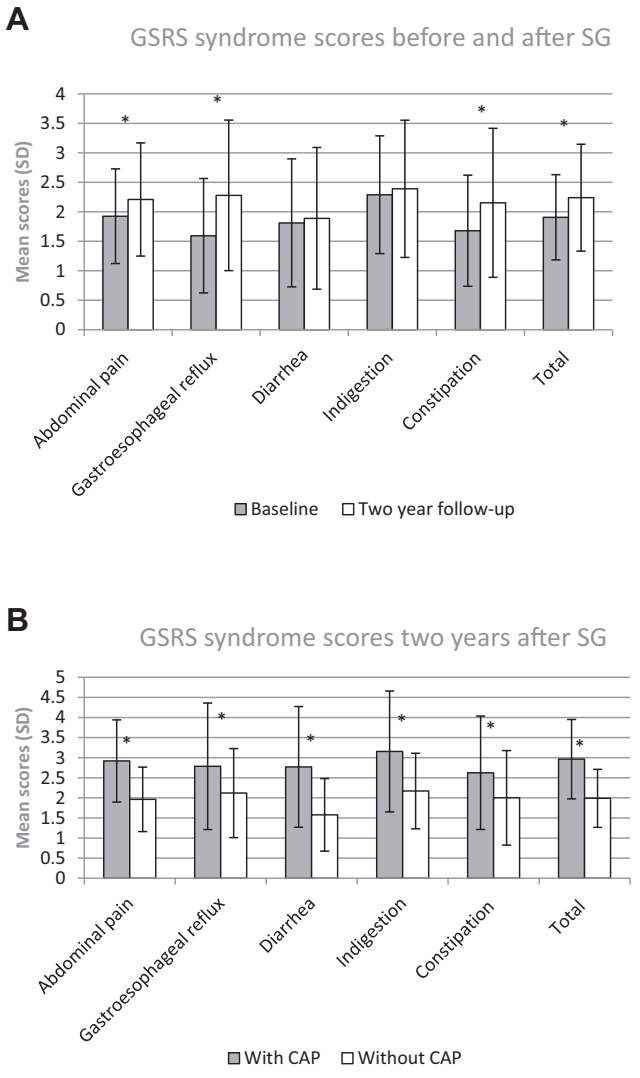

Fig. 2. (A) Mean GSRS scores with standard deviations (SDs). Significant increase in GSRS syndrome scores for the total population from baseline to 2 years after sleeve gastrectomy for total scores and all subscores except the diarrhea syndrome score and indigestion syndrome score. Significant changes are marked with an asterisk (*). Small effect sizes (ESs) for all subtypes and total scores (Wilcoxon signed-rank test). (B) Significantly higher GSRS syndrome scores in patients with CAP compared with patients without CAP for all syndrome scores. Significant changes are marked with an asterisk (*). Medium ESs for gastroesophageal reflux, indigestion, and constipation syndrome with large ESs for the remaining subtypes and total scores (Mann–Whitney test). (C) Mean scores with SDs. All scores increased significantly from baseline to 2-year follow-up. Significant changes are marked with an asterisk (*). Small ESs for all domains (except for general health [GH]) with medium ESs and physical summary scores (PCS) with large ESs (Wilcoxon signed-rank test). (D) Mean scores with SD. All scores were significantly lower in patients with CAP compared with patients without CAP, except for physical functioning (PF). Significant changes are marked with an asterisk (*). Small ESs for all domains, except for role physical (RP), bodily pain (BP), general health (GH), vitality (VT), and physical summary scores (PCS,) which have medium ESs (Mann–Whitney test). Patients with missing data are not included in the analyses. SF = social functioning; RE = role emotional; ME = mental health; MCS = mental component summary score.

follow-up ($P = .002$). At follow-up, 8 of 47 patients (17.0%) with CAP and 11 of 127 patients (8.7%) without CAP had symptoms of depression ($P < .001$).

Quality of life

For the entire cohort, all mean domain scores (except mental component summary scores) increased significantly after SG with small to large ESs (see Table 2). At follow-up, the scores (except for physical functioning) were significantly lower for patients with CAP compared with patients without CAP with small to medium ESs (Fig. 2C, D).

Predictors of chronic abdominal pain

Preoperative bothersome GERD symptoms as defined by the GSRS questionnaire and CAP increased the crude odds ratio of having CAP at follow-up in the univariate analyses. In the multivariate analyses, significant preoperative predictors were study center, younger age, and bothersome GERD symptoms as defined by the GSRS questionnaire (Supplementary Table 1).

Discussion

A main finding was an increased prevalence of patient-reported CAP 2 years after SG. This was an unexpected observation. After SG, patients seem to locate pain symptoms more frequently to the abdomen while reporting less use of analgesics for their CAP. A change in the extent and location of symptom burden may contribute to this finding. A discrepancy between the patient perception and interpretation of pain and the awareness of these symptoms by the physician may exist. The disparities observed in SF-36v2 scores between patients with and without CAP at follow-up underline a clinical relevance of our findings. Thus, improved awareness by healthcare providers and information to patients regarding such symptoms may be warranted.

None of the patients with CAP at follow-up had been on sick leave or disability pension due to abdominal symptoms. We think that patients may consider CAP as a postoperative state and that the benefits of weight reduction and increased ability to work seem to matter more to them than the CAP [22]. Our finding that patients with CAP at follow-up reported less use of analgesics compared with patients with CAP at baseline may support this.

According to the GSRS scores, bothersome abdominal pain symptoms were seen in 14.8% of patients at baseline and in 23.7% at follow-up, corresponding to the reporting of CAP by the patients. GSRS findings, however, are based on 1-week recall, whereas the definition of CAP is for 3 months or more. Consistency of this trend concerning

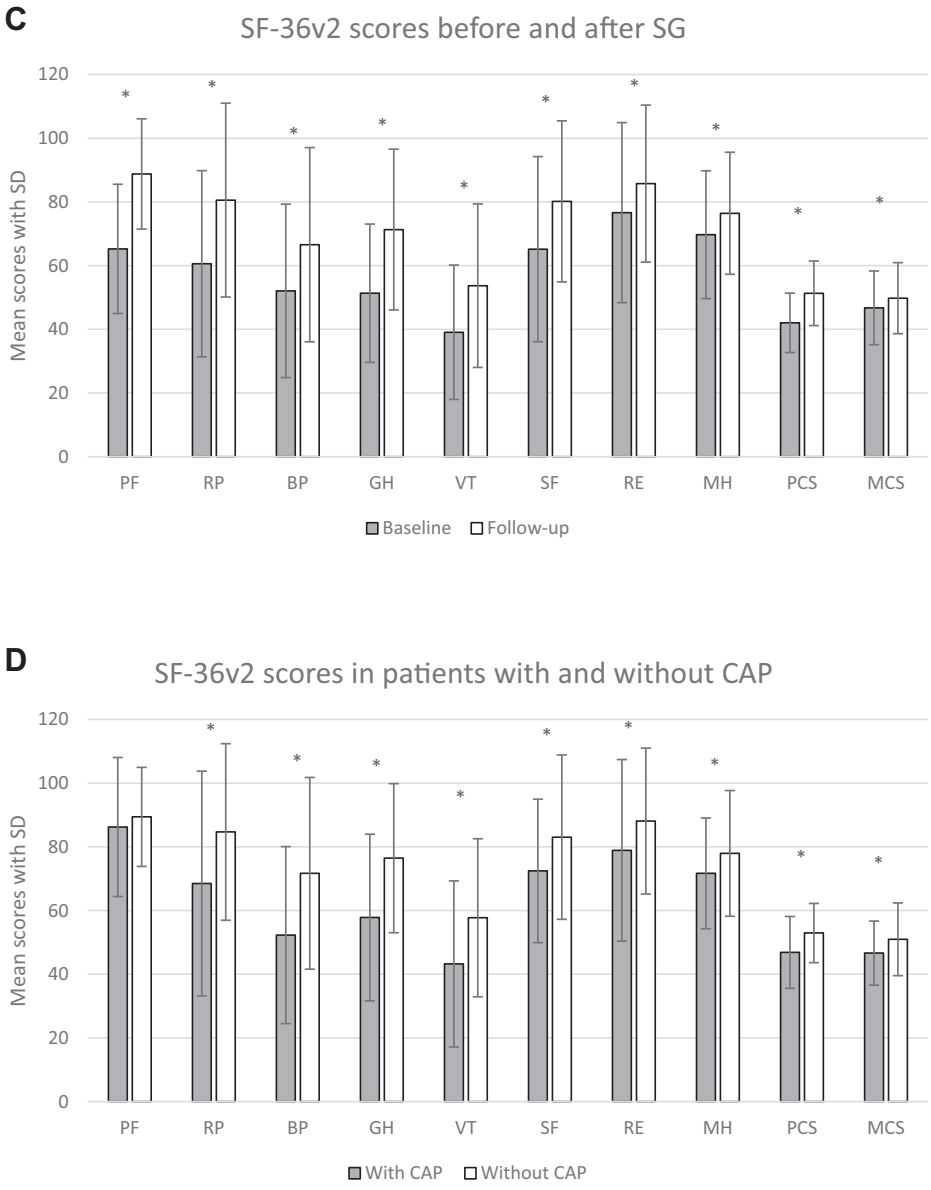

Fig. 2. Continued

increased abdominal symptoms is further underscored by the increase from 7% to 28.7% of patients depicting the abdominal region as the location of pain by the BPI questionnaire. After surgery and weight loss, musculoskeletal pain in weight-bearing joints may be reduced [23,24]. Our data suggest similar findings; thus patient awareness and focus on abdominal symptoms may emerge after surgery when the burden of pain from other locations is reduced.

We found that GSRS bothersome GERD symptoms (scores ≥ 3) increased after SG in line with previous reports [6,7,22]. This finding was supported by the data from the GERDq, indicating increased likelihood of having GERD after SG. However, at follow-up, patients with CAP did not have more bothersome GERD symptoms (GSRS scores), nor did they have a higher likelihood of having GERD (GERDq) compared with patients without CAP. This contradicts our clinical experience because patients with CAP after SG often seem to have GERD symptoms. This interesting finding should increase the awareness of other causes of CAP after SG and should be explored in future studies.

In our multivariate analyses, preoperative bothersome GERD symptoms (GSRS), young age, and study center predicted postoperative CAP. More awareness should be given to preoperative GERD symptoms that may be underreported

Table 2
Questionnaires scores before and 2 years after sleeve gastrectomy

Questionnaire	Baseline	Follow-up	*P* value*	Effect size†
Gastrointestinal Symptom Rating Scale scores				
Abdominal pain syndrome	1.92 (0.80)	2.21 (0.96)	<.001	0.30
Reflux syndrome	1.59 (0.97)	2.28 (1.28)	<.001	0.47
Diarrhea syndrome	1.81 (1.10)	1.89 (1.20)	.660	0.06
Indigestion syndrome	2.29 (0.99)	2.39 (1.16)	.121	0.11
Constipation syndrome	1.68 (0.94)	2.15 (1.26)	<.001	0.38
Total	1.90 (0.72)	2.24 (0.91)	<.001	0.39
Pain Catastrophizing Scale scores				
Rumination type	4.73 (4.04)	4.56 (4.21)	.249	0.04
Magnification type	2.31 (2.44)	2.08 (2.59)	.010	0.08
Helplessness type	5.36 (4.93)	4.67 (5.05)	.004	0.13
Total	12.47 (10.40)	11.17 (10.97)	.007	0.12
Hospital Anxiety and Depression Scale scores				
Anxiety symptoms	5.79 (3.99)	5.01 (4.23)	.033	0.20
Depression symptoms	4.62 (3.62)	2.56 (3.38)	<.001	0.54
Total	10.42 (6.93)	7.63 (6.80)	<.001	0.41
Short-Form version 2 scores				
Physical functioning	65.26 (20.29)	88.79 (17.31)	<.001	1.17
Role physical	60.60 (29.23)	80.57 (30.43)	<.001	0.57
Bodily pain	52.08 (27.22)	66.57 (30.50)	<.001	0.44
General health	51.34 (21.72)	71.33 (25.25)	<.001	0.73
Vitality	39.08 (21.09)	53.70 (25.68)	<.001	0.54
Social functioning	65.17 (29.07)	80.17 (25.29)	<.001	0.51
Role emotional	76.64 (28.28)	85.77 (24.65)	<.001	0.31
Mental health	69.71 (20.06)	76.44 (19.16)	<.001	0.32
Physical component summary score	42.03 (9.34)	51.32 (10.14)	<.001	0.86
Mental component summary score	46.74 (11.58)	49.78 (11.16)	.073	0.26

Mean scores with standard deviation (SD) and effect size of the changes between the two timepoints.
* Wilcoxon signed rank test.
† Cohen's d.

by patients. The study center association with CAP may have been influenced by variations in the selection criteria of patients to SG and in baseline patient characteristics (see Table 1). The first hospital did not offer SG to patients with GERD and preferred SG before RYGB for females of childbearing age or with the presence of abdominal pain symptoms. At the second hospital, most patients were offered SG, including those with GERD. Furthermore, gastropexy, an antireflux procedure, is routinely performed in most patients at the second hospital [10,25].

At follow-up, more patients with CAP had clinically relevant levels of catastrophizing compared with patients without CAP, although complex therapeutic interventions targeting catastrophizing may reduce symptoms of CAP in selected patients [5,26]. In line with others, we observed a decrease in symptoms of depression after SG [27,28]. However, at follow-up, patients with CAP experienced more symptoms of depression (HADS). Further studies are needed because few data exist on the correlation between depression and CAP. Quality of life was lower in patients with CAP compared with patients without CAP. This needs to be explored in studies with longer follow-up.

The importance of patient-reported CAP in the context of RYGB has been described previously, and surprisingly, such emphasis also may be relevant for patients opting for SG [5]. Severity, characteristics, and impact of symptoms may vary between RYGB and SG, as may also the pathophysiology of symptoms. Comparative analyses elaborating on this may contribute to a more individualized approach to bariatric surgery.

The strengths of our study include the comprehensive evaluation of abdominal symptoms with validated questionnaires in a large series with a low attrition rate. With several questionnaires included and the high response rate, we reduced issues related to measurement or misclassification biases. The 2-center approach may improve the external validity of our observations. One limitation includes some variations in surgical technique between the 2 centers. In addition, details regarding the diagnostic workup of abdominal symptoms are not provided. Gastroscopy was not performed for evaluation of GERD symptoms.

Table 3
Questionnaire scores at 2-year follow-up, in patients with and without CAP

Questionnaire	With CAP	Without CAP	*P* value*	Effect size†
Gastrointestinal Symptoms Rating Scale scores				
Abdominal pain syndrome	2.92 (1.02)	1.96 (0.80)	<.001	1.04
Reflux syndrome	2.79 (1.57)	2.12 (1.11)	.010	0.50
Diarrhea syndrome	2.77 (1.50)	1.58 (0.90)	<.001	0.96
Indigestion syndrome	3.15 (1.50)	2.17 (0.94)	<.001	0.78
Constipation syndrome	2.63 (1.41)	2.00 (1.18)	.004	0.48
Total	2.96 (0.99)	1.99 (0.72)	<.001	1.13
Pain Catastrophizing Scale scores				
Rumination type	6.49 (4.39)	3.84 (3.90)	<.001	0.64
Magnification type	3.50 (3.26)	1.59 (2.10)	<.001	0.70
Helplessness type	6.82 (6.08)	3.97 (4.46)	.002	0.53
Total	16.64 (12.84)	9.40 (9.64)	<.001	0.64
Hospital Anxiety and Depression Scale scores				
Anxiety symptoms	6.21 (4.39)	4.61 (4.14)	.018	0.38
Depression symptoms	3.60 (3.70)	2.18 (3.21)	.002	0.41
Total	9.76 (7.16)	6.89 (6.60)	.005	0.42
Short-Form 36 version 2 scores				
Physical functioning	86.24 (21.84)	89.42 (15.56)	.693	0.17
Role physical	68.50 (35.29)	84.69 (27.73)	.001	0.51
Bodily pain	52.30 (27.79)	71.70 (30.10)	<.001	0.67
General health	57.81 (26.17)	76.45 (23.41)	<.001	0.75
Vitality	43.24 (26.08)	57.74 (24.82)	.002	0.57
Social functioning	72.45 (22.53)	83.05 (25.80)	>.001	0.44
Role emotional	78.91 (28.52)	88.10 (22.90)	.027	0.36
Mental health	71.68 (17.39)	77.96 (19.74)	.006	0.34
Physical component summary scores	46.86 (11.28)	52.95 (9.29)	<.001	0.59
Mental component summary scores	46.64 (10.07)	50.98 (11.41)	.002	0.40

Mean scores with standard deviation (SD) and effect size of the changes between the groups.
CAP = chronic abdominal pain.
* Mann-Whitney test.
† Cohen's d.

Conclusion

Our findings suggest an increased prevalence of clinically relevant patient-reported CAP 2 years after SG. Further evaluations of these findings are necessary.

Disclosures

The authors have no commercial associations that might be a conflict of interest in relation to this article.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.1016/j.soard.2021.07.014.

References

[1] Poelemeijer YQM, Liem RSL, Vage V, et al. Gastric bypass versus sleeve gastrectomy: patient selection and short-term outcome of 47,101 primary operations from the Swedish, Norwegian, and Dutch National Quality Registries. Ann Surg 2020;272(2):326–33.

[2] Gribsholt SB, Pedersen AM, Svensson E, Thomsen RW, Richelsen B. Prevalence of self-reported symptoms after gastric bypass surgery for obesity. JAMA Surg 2016;151(6):504–11.

[3] Mala T, Hogestol I. Abdominal pain after Roux-En-Y gastric bypass for morbid obesity. Scand J Surg 2018;107(4):277–84.

[4] Gormsen J, Burcharth J, Gogenur I, Helgestrand F. Prevalence and risk factors for chronic abdominal pain after Roux-en-Y gastric bypass surgery: a cohort study. Ann Surg 2021;273(2):306–14.

[5] Chahal-Kummen M, Blom-Hogestol IK, Eribe I, Klungsøyr O, Kristinsson J, Mala T. Abdominal pain and symptoms before and after Roux-en-Y gastric bypass. Br J Surg Open 2019;3(3):317–26.

[6] Peterli R, Wolnerhanssen BK, Peters T, et al. Effect of laparoscopic sleeve gastrectomy vs laparoscopic Roux-en-Y gastric bypass on weight loss in patients with morbid obesity: the SM-BOSS randomized clinical trial. JAMA 2018;319(3):255–65.

[7] Yeung KTD, Penney N, Ashrafian L, Darzi A, Ashrafian H. Does sleeve gastrectomy expose the distal esophagus to severe reflux? A systematic review and meta-analysis. Ann Surg 2020;271(2):257–65.

[8] Pierik AS, Coblijn UK, de Raaff CAL, van Veen RN, van Tets WF, van Wagensveld BA. Unexplained abdominal pain in morbidly obese patients after bariatric surgery. Surg Obes Relat Dis 2017;13(10):1743–51.

[9] Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240(2):205–13.

[10] Vage V, Behme J, Jossart G, Andersen JR. Gastropexy predicts lower use of acid-reducing medication after laparoscopic sleeve gastrectomy: a prospective cohort study. Int J Surg 2020;74:113–7.

[11] Boonstra AM, Stewart RE, Koke AJ, et al. Cut-off points for mild, moderate, and severe pain on the numeric rating scale for pain in

patients with chronic musculoskeletal pain: variability and influence of sex and catastrophizing. Front Psychol 2016;7:1466.
[12] Kulich KR, Madisch A, Pacini F, et al. Reliability and validity of the gastrointestinal symptom rating scale (GSRS) and quality of life in reflux and dyspepsia (QOLRAD) questionnaire in dyspepsia: a six-country study. Health Qual Life Outcomes 2008;6:12.
[13] Drossman DA, Dumitrascu DL. Rome III: new standard for functional gastrointestinal disorders. J Gastrointestin Liver Dis 2006;15(3):237–41.
[14] Jonasson C, Wernersson B, Hoff DA, Hatlebakk JG. Validation of the GERDq questionnaire for the diagnosis of gastro-oesophageal reflux disease. Aliment Pharmacol Ther 2013;37(5):564–72.
[15] Jones R, Junghard O, Dent J, et al. Development of the GERDq, a tool for the diagnosis and management of gastro-oesophageal reflux disease in primary care. Aliment Pharmacol Ther 2009;30(10):1030–8.
[16] Tan G, Jensen MP, Thornby JI, Shanti BF. Validation of the brief pain inventory for chronic nonmalignant pain. J Pain 2004;5(2):133–7.
[17] Sullivan MJL, Bishop SR, Pivik J. The pain catastrophizing scale: development and validation. Psychol Assess 1995;7(4):524–32.
[18] Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand 1983;67(6):361–70.
[19] Lins L, Carvalho FM. SF-36 total score as a single measure of health-related quality of life: scoping review. SAGE Open Med 2016;4:2050312116671725.
[20] Ialongo C. Understanding the effect size and its measures. Biochem Med (Zagreb) 2016;26(2):150–63.
[21] Durlak JA. How to select, calculate, and interpret effect sizes. J Pediatr Psychol 2009;34(9):917–28.
[22] Carabotti M, Silecchia G, Greco F, et al. Impact of laparoscopic sleeve gastrectomy on upper gastrointestinal symptoms. Obes Surg 2013;23(10):1551–7.
[23] Wright LJ, Schur E, Noonan C, Ahumada S, Buchwald D, Afari N. Chronic pain, overweight, and obesity: findings from a community-based twin registry. J Pain 2010;11(7):628–35.
[24] Bout-Tabaku S, Gupta R, Jenkins TM, et al. Musculoskeletal pain, physical function, and quality of life after bariatric surgery. Pediatrics 2019;144(6):e20191399.
[25] Sanchez-Pernaute A, Talavera P, Perez-Aguirre E, Dominguez-Serrano I, Rubio MA, Torres A. Technique of Hill's gastropexy combined with sleeve gastrectomy for patients with morbid obesity and gastroesophageal reflux disease or hiatal hernia. Obes Surg 2016;26(4):910–2.
[26] Kvalem IL, Bergh I, Sogg S, Mala T. Psychosocial characteristics associated with symptom perception 1 year after gastric bypass surgery: a prospective study. Surg Obes Relat Dis 2017;13(11):1908–13.
[27] de Zwaan M, Enderle J, Wagner S, et al. Anxiety and depression in bariatric surgery patients: a prospective, follow-up study using structured clinical interviews. J Affect Disord 2011;133(1–2):61–8.
[28] Gill H, Kang S, Lee Y, et al. The long-term effect of bariatric surgery on depression and anxiety. J Affect Disord 2019;246:886–94.