High Frequency of Computer Tomography and Surgery

For Abdominal Pain After Roux-en-Y Gastric Bypass

Short title: CT and surgery after RYGB

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The authors declare no conflicts of interest and have completed ICMJE conflict of interest forms.

Abstract

Introduction: Acute, intermittent and chronic abdominal pain is a common complaint after Roux-en-Y gastric bypass (RYGB).

Objectives: The aim of the study was to evaluate the use of medical imaging and the need for surgery treating abdominal pain after RYGB in a cohort with long-term follow-up.

Methods: Data from 569 patients who underwent RYGB as primary bariatric procedure at a public hospital in Norway between April 2004 and June 2011 were prospectively registered in a local quality registry for bariatric surgery. All abdominal imaging and abdominal surgical procedures were registered until August 2017.

Results: Mean follow-up was 100 months (61-159). During the observation period 22% had one CT, 9% had two CTs, 4% had three CTs and 5% had ≥ four CTs for abdominal pain. Twenty-two per cent underwent abdominal surgery, as 16% had 1 and 6% had ≥ 2 operations, gynecological procedures excluded. The purpose of operation was postoperative complications (1.4%), suspected internal herniation (9.3%), cholecystectomy (9.3%), appendectomy (2.3%), hernias (3.2%), and perforated ulcer in the gastrojejunal anastomosis (0.7%). Mean time interval was 42 ± 27 months from RYGB to cholecystectomy and 51 ± 26 months for suspected IH.

Conclusion: With a mean follow-up period of more than eight years after RYGB, 40% of the patients suffered from abdominal pain, needing one or more CT scans. The need for surgery treating suspected internal hernia and cholecystectomy was equal, at 9.3% for both procedures, but the mean time from RYGB to operation was shorter for cholecystectomies.

Introduction

Roux-en-Y-gastric bypass (RYGB) is a common bariatric procedure. Its effect on weight loss and resolution of comorbidity is well documented [1]. According to a global survey 229.455 RYGB-procedures were performed in 2014, which were 40% of all bariatric/metabolic surgical procedures performed that year [2]. Based on reports from the last twenty years, it may be suggested that the post-RYGB-population represents somewhere between one and three million persons [3].

Acute, intermittent and chronic abdominal pain after RYGB are frequent reasons for unplanned hospital visits [4]. The cause of pain ranges from eating habits not suitable after RYGB to small bowel obstruction due to internal herniation (IH).

Physical examination alone is often inconclusive for patients with high BMI, as common signs like abdominal tenderness may be absent even in a situation with bowel obstruction. Thus, it is essential to maintain a low threshold for using medical imaging to detect surgical complications following RYGB. Plain X-rays seldom provides sufficient information for excluding a serious condition, and Computer Tomography (CT) of abdomen and pelvis is the superior method for detection of IH and small bowel obstruction after RYGB [5-8]. However, a negative CT at one point of time does not exclude a serious condition at a later point, and the resulting repeated CTs and radiation exposure may imply increased risk of malignancies [9].

IH with small bowel obstruction needs emergency surgery with reposition of the herniated bowel and closure of the mesenteric defects. IH without small bowel obstruction can cause intermittent or chronic pain, which also needs surgery, but more often allows for a planned setting [10].

Gallbladder stones are another common cause of abdominal pain in bariatric patients, and the rate of cholecystectomy in bariatric patients is high before as well as after the bariatric operation [11, 12].

Abdominal magnetic resonance imaging (MRI) may provide similar information as CT, but is more time consuming, less available in emergency situations, and does not add additional information compared to abdominal CT. Magnetic resonance cholangiopancreatography (MRCP) is however valuable if stones in the bile duct are suspected [13].

The aim of this study was to investigate the frequency of medical imaging for abdominal pain in a RYGB cohort with long-term follow-up, and to assess rates and timelines of the most frequent surgeries for abdominal pain after the RYGB procedure.

Materials and Methods

Data on 569 patients who underwent RYGB at Alesund hospital between April 2004 and June 2012 was collected prospectively in a local quality registry. This registry has been updated with information from the common electronic medical record system for Central Norway Regional Health Authority through August 2017. The electronic medical record contains information on all treatments at public hospitals in the region, including all medical imaging and surgical procedures. The use of private hospitals is minimal in this area, and no bariatric surgery or surgical emergency consultations were performed outside of public hospitals in the region in this period of time.

The RYGB operations were performed with laparoscopic antecolic, antegastric technique, known as the Lönroth technique. The gastrojejunostomy was constructed with a linear stapler and hand-sewn closure [14]. The jejunojejunostomy was made with a triple-stapling technique as described by Madan for the first 438 patients (77%), while for the last 131 patients (23%) the jejunojejunostomy was made with one stapling magazine and hand-sewn closure [15]. The mesenteric defects were not closed at the primary operation in this period. The rate of conversion to open technique was 0.2%.

Ursodiol to reduce gallstone formation in the weight loss period was not used. All patients had a preoperative upper endoscopy with test for H pylori. Preoperative eradication was given if HP test was positive. There was no routine use of PPI postoperatively, but PPI was used if indicated.

Outcomes

The total number of abdominal CTs, ultrasound examinations (US) and abdominal surgeries for acute, intermittent or chronic abdominal pain were analyzed. Gynecological surgeries and abdominal US/CT for follow-up on other conditions were excluded. We used a wide definition of suspected IH, and included all surgeries where IH was suspected, diagnosed under operation for other reasons, or when the mesenteric defects were closed during other procedures. The time intervals from RYGB to US, CT and surgery were calculated.

Statistical analysis

Categorical variables are presented as proportions, and continuous variables are presented as means ± SD or by median and range. For comparison of categorical variables, the Pearson χ^2 was performed. Kaplan-Meier estimates were used for continuous variables. $P < 0.05$ was considered statistically significant for all analyses. Statistical analyses were performed using IBM SPSS version 23 (SPSS Inc., Chicago, IL, USA) software.

Results

The 569 patients were between 18 and 65 years. Mean age was 40 ± 9.5 years at surgery and 75% were females. The mean preoperative BMI was 44.0 ± 5.1 kg/m², and there were no differences in age or BMI between men and women. Mean follow-up period was 100 ± 26 (range 61-159) months (Table 1). Fifteen (2.6%) of the patients moved out of the region during the first five years after the RYGB operation and might have had CT-scanning or surgery at other hospitals, and 10 (1.7%) patients have died, two of them (0.35%) early after RYGB (on day 7 and 28). The patients underwent 597 CTs and 245 US for abdominal pain after RYGB, and 181 abdominal operations were performed. Some patients had both CT and US, and in total 284 patients (50%) had some sort of medical imaging for abdominal pain in the observation period (Table 2).

CT scans

There were 227 (40%) patients who had one or more CTs for acute, intermittent or chronic abdominal pain, of whom 123 (22%) had one CT, 53 (9%) had two CTs, 24 (4%) had three CTs and 27 (5%) had ≥ four CTs. More women than men needed CTs, 43% of women and 31% of men had one or more CTs (p =0.016) (Table 2).

Mean time interval from RYGB to the first CT was 37 ± 32 months, and the mean interval from RYGB to the second and third CT was 51 ± 36 months and 55 ± 33months, respectively (Figure 1). Among the first CTs, 6.3% were performed within the first postoperative month for suspected postoperative complication. The postoperative reoperation rate was 1.4%.

Ultrasound scans

The main reason for doing an abdominal US was suspicion of gallbladder stones. There were 161 patients (28%) having one or more US, as 112 patients (20%) had one examination, 31 (5.4%) had two and 18 (3.3%) had three or more. The mean time from RYGB-operation to the first US was 38 ± 33 months, and for the second 56 ± 34 months. MR-CP for suspected bile duct stones was performed for 28 (5%) patients.

Abdominal surgery

There were 127 (22%) patients undergoing abdominal surgery after RYGB, as 93 (16%) had one and 34 (6%) had two or more surgical procedures, gynecological procedures excluded. Mean time from RYGB to the first and second operation was 38 ± 28 months and 60 ± 27 months, respectively. The need of abdominal surgery for women was 25.6% compared to 12.5% for men (p<0.001).

The most common indications for surgery were cholecystectomy and suspected internal herniation, which together affected 91 patients (16%) (Figure 2). Fifteen patients (2.6%) underwent both operations, 38 patients (6.7%) only had operation for IH and 38 (6.7%) only had cholecystectomy. All who underwent both operations were females.

Internal herniation

Suspected IH was the reason for surgery in 53 (9.3 %) patients (Table 2). The mean time from RYGB to IH operation was 51 ± 26 months, and half of the surgeries for IH were acute. Out of 49 patients who had their first CT-scan before operation for IH, 29 had their first CT 0-10 days before the operation. As shown in Figure 3, operations for IH occurred throughout the whole observation period and there were no gender differences.

According to the surgery reports from first-time operations for suspected internal herniation, there were bowel through the mesenteric defect at the time of surgery in 42 (79%) of the patients. In six patients (11%) there were no herniated bowel, but open mesenteric defects were closed. In five patients (9%) no hernia was found and no defects were closed. Out of the 42 patients (7.3% of 569) with internal herniation 36 had small bowel in the mesenteric defect behind the jejunojejunostomy, one in Petersen's space and one behind the alimentary limb. In 4 cases, type of herniation is not described in the surgery report.

Nine patients (1.6%) had more than one operation for suspected IH.

Thirty-seven out of 438 (8.5%) patients who had a triple-stapled jejunojejunostomy (mean observation 109 months) had an operation for IH, compared to 15 out of 131 (11.5%) who had a single-stapled jejunojejunostomy (mean observation 70 months) ($p<0.05$).

Cholecystectomies

Seven percent of the study population had their gallbladder removed before RYGB, and 26 patients (4.6%) knew before RYGB that they had gallbladder stones, but were without symptoms. Ultrasound for detection of asymptomatic gallbladder stones was not a part of the preoperative work-up, and no cholecystectomies were done simultaneously at the time of RYGB.

Fifty-three patients (9.3 %) had a cholecystectomy in the mean follow-up of 100 months after RYGB. Mean time from RYGB to cholecystectomy was 42 ± 27 months. Only one of those who had known gallbladder stones before RYGB had a cholecystectomy in the observation period. Cholecystectomy was more common among women, as 11.5% of females (49/425) and 2.8% of males (4/144) had a cholecystectomy ($p<0.001$) (Figure 4).

Three patients had biliary tract disease 5-11 years after RYGB.

Other procedures

Among the other reasons for abdominal surgery after RYGB were appendicitis (n=12) (2.1%), abdominal wall hernias (n=18) (3.2%), and perforated ulcer in the gastrojejunostomy (n=4) (0.7%).

Nearly half of the patients (n=262) (46%) who had a CT also had an operation, and most of those operated (n=478) (84%) had a CT.

Discussion

In the present population, 40% of the patients had one or more CTs, 28% had one or more US examinations, and that 22% of the patients needed a surgical procedure due to abdominal pain during a mean follow-up of eight years after RYGB. In a similar study on medical imaging in a post-bariatric population (n = 578) with a shorter follow-up (mean 3.5 years) Haddad found that 70% of the patients had at least one unplanned postoperative imaging, and that incidental findings often led to further investigation [16]. Differences in local organization, routines and resources may explain the higher level of imaging compared to the present study with longer observation time.

The mean time interval from RYGB to the first medical imaging and cholecystectomy was three to four years in the present cohort, and the mean interval from RYGB to the second medical imaging and surgery for suspected IH was between four and five years. All patients were offered clinical follow-up at a bariatric surgery out-patient clinic for five years. They were thereafter advised to contact their general practitioner for further yearly follow-up with blood tests and body weight. If surgical complications to RYGB were suspected they were referred back to the bariatric clinic or a surgical department in the region. Planned postoperative follow-up for RYGB patients in bariatric outpatient units differs among hospitals, and several units end their follow-up at two years. This may delay diagnosis and treatment of surgical complications after RYGB because of less awareness of these conditions in primary care.

Suspected IH after RYGB

By using a wide definition of operation for suspected IH, including all surgeries where IH was found or suspected, or the mesenteric defects have been closed during surgeries for other reasons, we found that this condition led to surgery in 9.3% of the cohort. Half of the cases were emergency procedures, and some had more than one surgery. In many studies on IH after RYGB, the definition of IH is based on intraoperative findings, and the reported frequency of IH after RYGB varies depending on definitions and length of follow-up [17].

In a study by Obeid on 328 RYGB patients where 46% were followed for 10 years, 12.8% had an operation for IH at a mean of 3.7 years after RYGB, and 6.1% were operated for small bowel obstruction at a mean of 4.2 years after RYGB [18]. In a Swedish study randomizing between closure and no closure of the mesenteric defects they found that IH was the cause of small bowel obstruction in 68% of cases [19].

Gallstone disease after RYGB

Before laparoscopic technique replaced open bariatric operations, concomitant prophylactic cholecystectomy was common. This is no longer advised as the extra risk for complications and extra costs cannot be justified [20].

In the present study 7% of the patients had their gallbladder removed before and 9.3% after the RYGB operation. There was no systematic US-screening after RYGB to identify gallbladder stones, but there was a low threshold for recommending cholecystectomy with moderate symptoms, especially for small stones, due to the technical challenge of doing ERCP following RYGB.

The frequency of cholecystectomy in a bariatric population has been analyzed in a Swedish study linking the national registries for obesity surgery and for cholecystectomy [12]. This study found a standardized incidence ratio for cholecystectomy of 3.42 before RYGB compared with the general population. The ratio peaked at 11.4 at 6-12 months after RYGB and gradually declined to preoperative levels at 36 months following RYGB.

Marginal ulcer

Ulcer in the gastrojejunostomy may induce acute or chronic localized pain in the epigastrium and is treated with PPI or other medication with or without diagnostic endoscopy, and in this study only four patients (0.7%) were in need of operation for perforated ulcer.

Limitations and strengths

This is a single center study with carefully nested data which may imply that the present results may differ from larger multicenter studies and national cohorts. Local organization, resources and clinical tradition may influence the use of medical imaging and rate of surgery. This study is based on information in a regional electronic medical record manually transferred to the database for the local quality registry. We cannot exclude the possibility that some patients may have had surgery and medical imaging outside this health region, which is not registered in our database, or human error in the transfer of information to the registry.

The strengths of this study are that the data were collected prospectively, and that they were cross-checked between different data sources. Compared with most other studies on the need for imaging and surgery after RYGB, the present cohort has a high rate of follow-up and a long observation time.

Conclusions

In the present RYGB-cohort, with a mean follow-up of more than eight years, 40% of the patients had one or more CTs. One in four patients who had a CT was operated for suspected internal herniation, half of them as an emergency procedure. Even if the frequency of CTs were high, it might be justified as the higher frequency may have reduced the number of diagnostic laparoscopies.

Cholecystectomies were equally common as suspected IH, and we therefore support the recommendation to rule out both diagnoses by relevant preoperative imaging before any abdominal surgery after RYGB is initiated [21]. It is also worth noting that through the follow-up period of 5-13 years, 50% of the cohort was not in need for medical imaging or surgery for abdominal pain.

Based on this and other studies, the mesenteric defects are now routinely closed when performing RYGB. Only one of those who had known gallbladder stones before RYGB had a cholecystectomy within eight years, and thus, this study does not support simultaneous cholecystectomy.

The authors declare no conflicts of interest.

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Ethical approval

The study was evaluated by the Regional Ethics Committee (REK 2016/331) as a Quality improvement project and approved by the local Data Protection Officer. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Statement

Does not apply.

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Table 1 Patient characteristics

	All	Female	Male
	n=569	n=425	n=144
Age at RYGB (years, mean, SD)	39.8 ±9.7	39.6±9.5	40.4 ±10.1
BMI at RYGB (kg/m², mean, SD)	44.0 ±5.1	43.9±4.9	44.0±5.7
BMI at 5 years (kg/m², mean, SD) *	31.6 ±5.3	31.3 ±5.5	32.6 ±4.7

* 14% missing BMI-values at 5 years.

Table 2 Medical imaging and surgery by gender

	N (%)	Female (425)	Male (144)	p
Medical imaging	285 (50%)	225 (53%)	59 (41%)	0.013
CT ≥1	227 (40%)	182 (43%)	45 (31%)	0.014
CT =1	123 (22%)	98 (23%)	25 (17%)	ns
CT =2	53 (9%)	44 (10%)	9 (6%)	ns
CT =3	24 (4%)	17 (4%)	7 (5%)	ns
CT ≥4	27 (5%)	25 (6%)	2 (1%)	0.028
US*≥1	159 (28%)	131 (31%)	28 (19%)	0.009
US=1	112 (20%)	88 (21%)	24 (24%)	ns
US=2	31 (5%)	27 (6%)	4 (3%)	ns
US ≥ 3	18 (3%)	18 (4%)	0	<0.05
MRCP**	28 (5%)	24 (6%)	4 (3%)	ns
Plain X-ray	100 (18%)	79 (19%)	21 (16%)	ns
Abdominal operation	127 (22%)	109 (26%)	18 (13%)	0.001
Operation =1	93 (16%)	82 (19%)	11 (8%)	0.011
Operation ≥2	34 (6%)	27 (6%)	7 (5%)	ns
Suspected IH	53 (9%)	43 (10%)	10 (7%)	ns
Cholecystectomy	53 (9%)	49 12%)	4 (3%)	0.001

*US = Ultrasound **MRCP= Magnetic Resonance Cholangiopancreatography

Figures

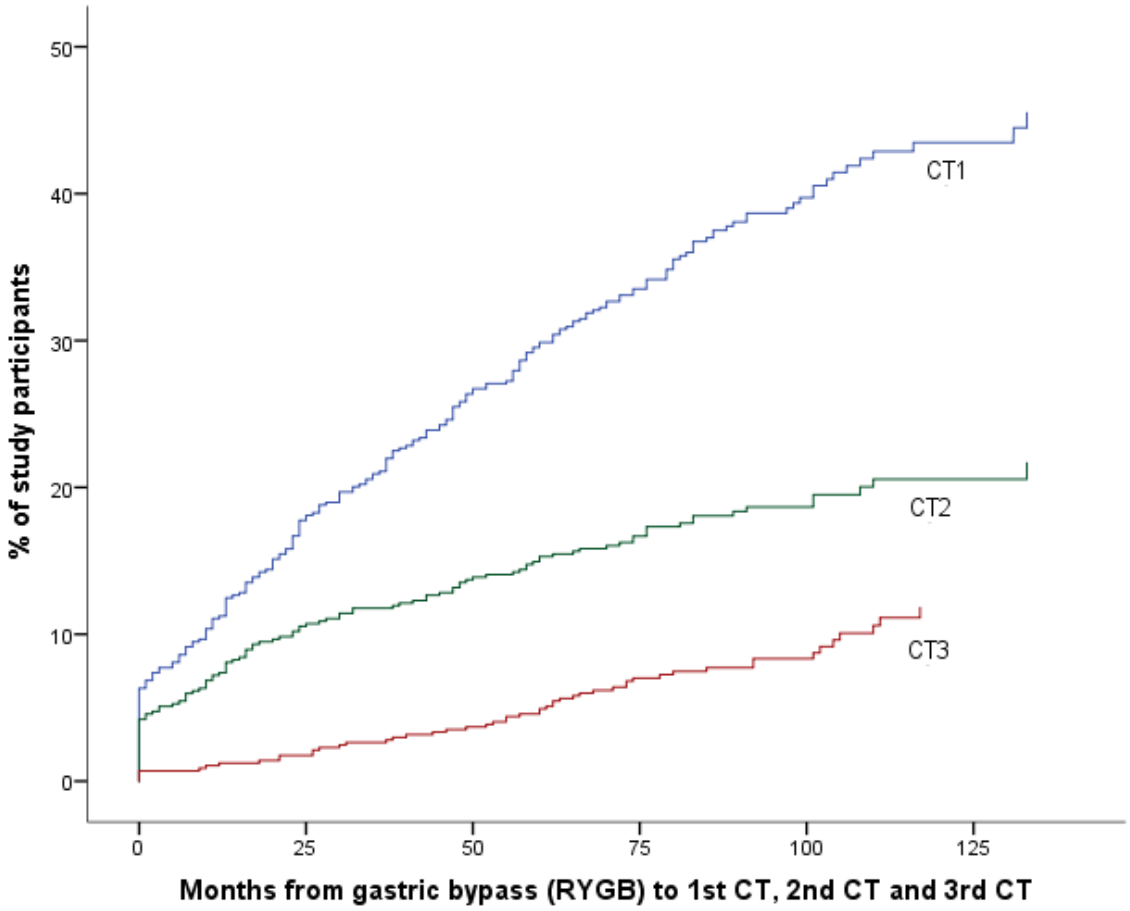

Fig. 1
Patients in need of one or more CTs due to abdominal pain after Royx-en-Y gastric bypass. 6.3% of the study population had CTs during the first month after operation.

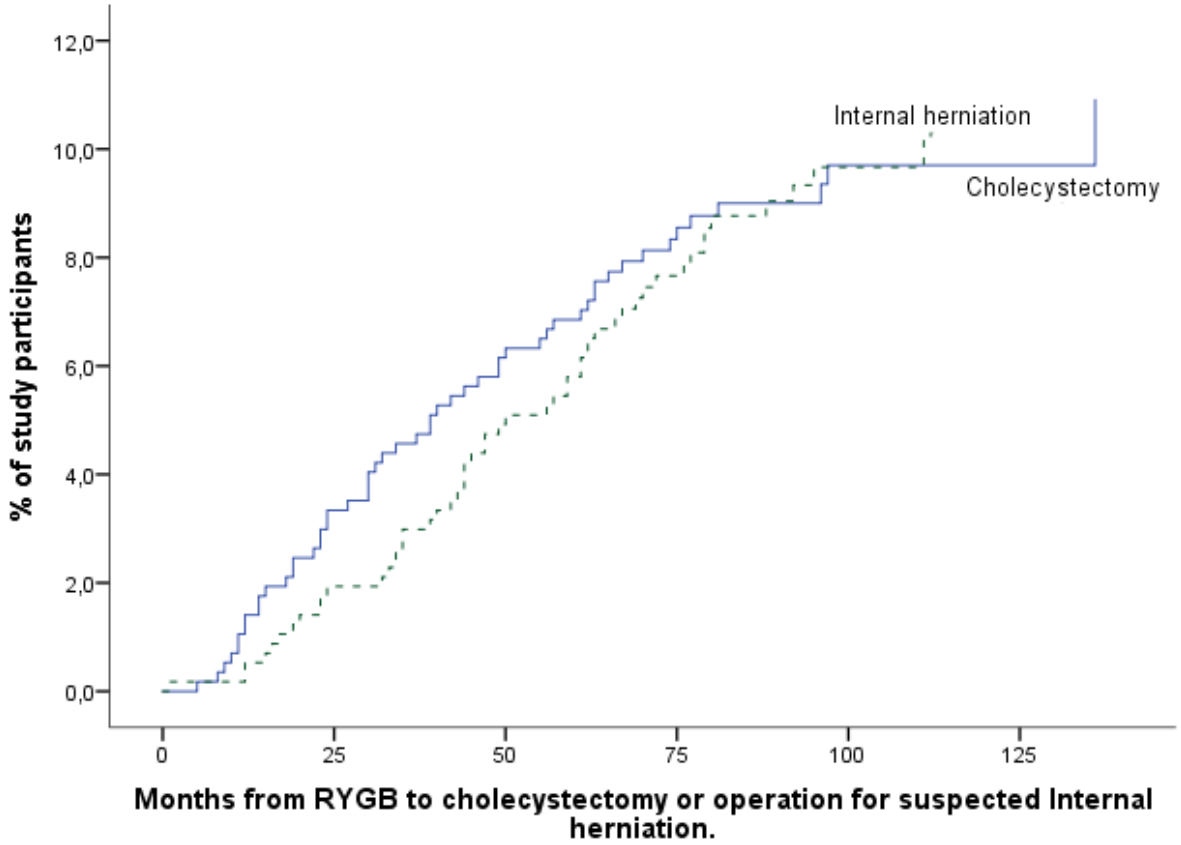

Fig. 2
Cholecystectomies (continuous line) and operations for suspected internal herniation (dotted line) in months after RYGB, (n=569).

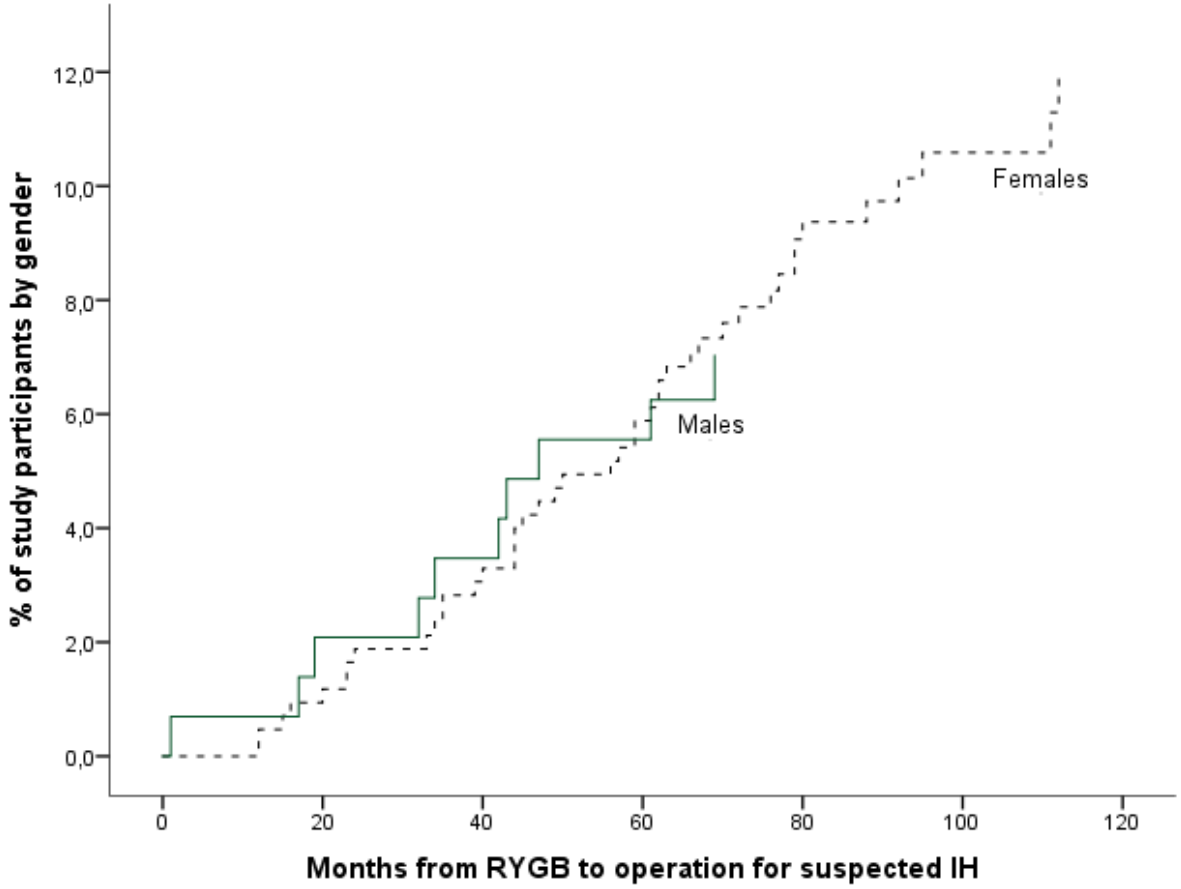

Fig.3
Surgery for suspected internal herniation after gastric bypass for males (continuous line, n=144) and females (dotted line, n=425).

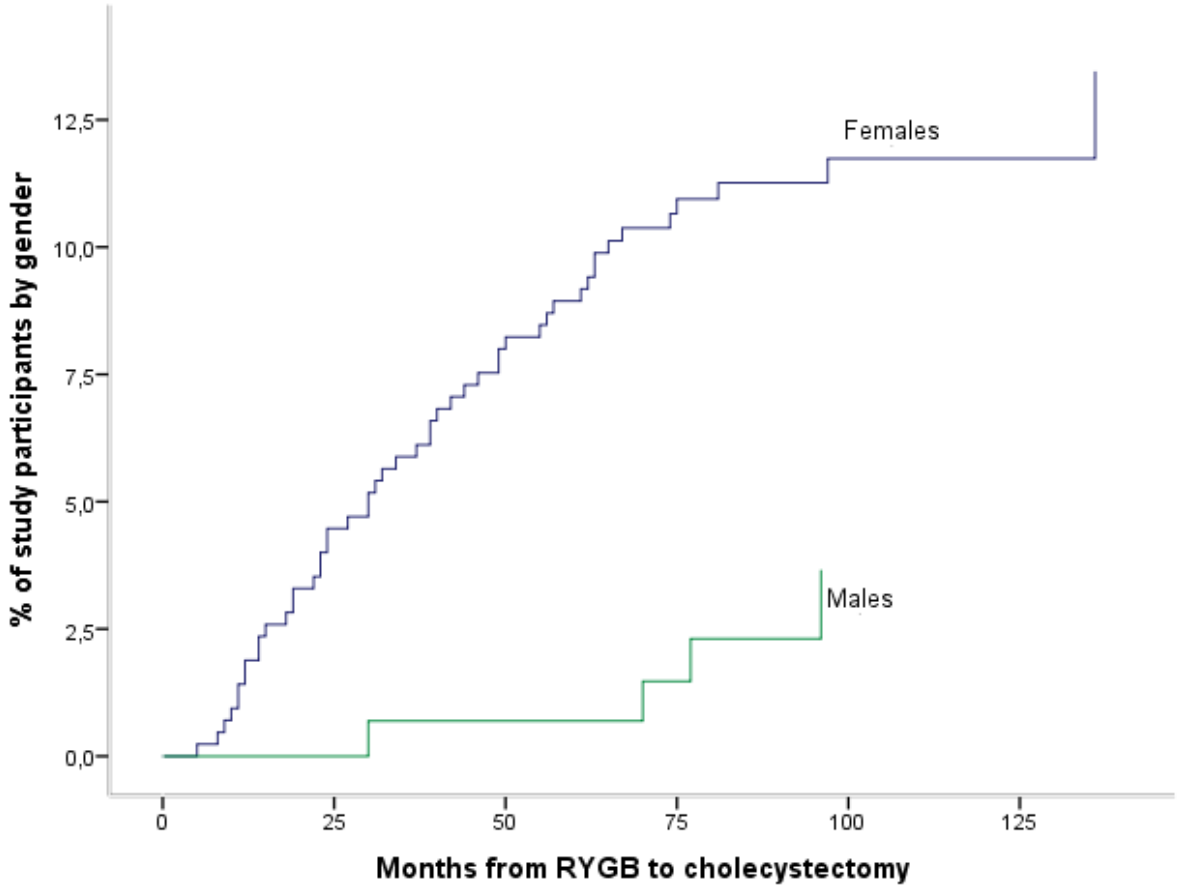

Fig. 4

Cholecystectomies in males (n=144) and females (n=425) after RYGB.