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## Utility of routine versus selective upper gastrointestinal series to detect anastomotic leaks after laparoscopic gastric bypass

Schiesser, M ; Guber, J ; Wildi, S ; Guber, I ; Weber, M ; Muller, M K

**Abstract:** **BACKGROUND:** In up to 4% of laparoscopic Roux-en-Y gastric bypass (LRYGB) procedures, anastomotic leaks occur. Early detection of gastrointestinal leakage is important for successful treatment. Consequently, many centers advocate routine postoperative upper gastrointestinal (UGI) series. The aim of this study was to determine the utility of this practice after LRYGB. **METHODS:** Eight hundred four consecutive patients undergoing LRYGB from June 2000 to April 2010 were analyzed prospectively. The first 382 patients received routine UGI series between the third and fifth postoperative days (group A). Thereafter, the test was only performed when clinical findings (tachycardia, fever, and drainage content) were suspicious for a leak of the gastrointestinal anastomosis (group B; n = 422). **RESULTS:** Overall, nine of 804 (1.1%) patients suffered from leaks at the gastroenterostomy. In group A, four of 382 (1%) patients had a leak, but only two were detected by the routine UGI series. This corresponds to a sensitivity of 50%. In group B, the sensitivity was higher with 80%. Specificities were comparable with 97% and 91%, respectively. Routine UGI series cost only 1.6% of the overall costs of a non-complicated gastric bypass procedure. With this leak rate and sensitivity, US 86,800 would have to be spent on 200 routine UGI series to find one leak which is not justified. **CONCLUSIONS :** *This study shows that routine UGI series have a low sensitivity for the detection of anastomotic leaks after LRYGB. In most cases,*

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# Utility of Routine Versus Selective Upper Gastrointestinal Series to Detect Anastomotic Leaks After Laparoscopic Gastric Bypass

Marc Schiesser · Josef Guber · Stefan Wildi ·  
Ivo Guber · Markus Weber · Markus K. Muller

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## Abstract

**Background** In up to 4% of laparoscopic Roux-en-Y gastric bypass (LRYGB) procedures, anastomotic leaks occur. Early detection of gastrointestinal leakage is important for successful treatment. Consequently, many centers advocate routine postoperative upper gastrointestinal (UGI) series. The aim of this study was to determine the utility of this practice after LRYGB.

**Methods** Eight hundred four consecutive patients undergoing LRYGB from June 2000 to April 2010 were analyzed prospectively. The first 382 patients received routine UGI series between the third and fifth postoperative days (group A). Thereafter, the test was only performed when clinical findings (tachycardia, fever, and drainage content) were suspicious for a leak of the gastrointestinal anastomosis (group B;  $n=422$ ).

**Results** Overall, nine of 804 (1.1%) patients suffered from leaks at the gastroenterostomy. In group A, four of 382 (1%) patients had a leak, but only two were detected by the routine UGI series. This corresponds to a sensitivity of 50%. In group B, the sensitivity was higher with 80%. Specificities were comparable with 97% and 91%, respectively. Routine UGI series cost only 1.6% of the overall costs of a non-complicated gastric bypass procedure. With this leak rate and sensitivity, US \$86,800 would have to be spent on 200 routine UGI series to find one leak which is not justified.

**Conclusions** This study shows that routine UGI series have a low sensitivity for the detection of anastomotic leaks after LRYGB. In most cases, the diagnosis is initiated by clinical findings. Therefore, routine upper gastrointestinal series are of limited value for the diagnosis of a leak.

**Keywords** Morbid obesity · Bariatric surgery · Laparoscopic Roux-en-Y gastric bypass · Upper gastrointestinal series · Anastomotic leaks

## Introduction

Morbid obesity has reached a high prevalence in the western world and is associated with a number of concomitant health risks such as type II diabetes, hypertension, hyperlipidemia, coronary artery disease, and obstructive sleep apnea [1, 2]. Conservative treatment of morbid obesity has failed to show good results regarding long-term weight loss and reduction of co-morbidities [3–5]. Today, the most efficient treatment with proven long-term results is gastric bypass surgery [5].

Laparoscopic Roux-en-Y gastric bypass (LRYGB) was introduced by Wittgrove and Clark in 1994 [6] and is presently the most widely used procedure besides laparoscopic gastric banding worldwide. Several prospective, randomized clinical trials have demonstrated that LRYGB results in less blood loss, less pain medication requirements, shorter length of hospitalization, shorter return to daily activities, and fewer complications compared with an open approach [7–10]. However, LRYGB is associated with a number of complications [11]. One of the most serious complications is a leakage at the gastrojejunostomy, which occurs in approximately 2–4.4% of LRYGB procedures [12, 13]. It has been shown that early detection and

Marc Schiesser and Josef Guber equally contributed to the paper.

M. Schiesser · J. Guber · S. Wildi · I. Guber · M. Weber ·  
M. K. Muller (✉)  
Department of Visceral and Transplantation Surgery,  
University Hospital Zürich,  
Rämistrasse 100,  
8091 Zürich, Switzerland  
e-mail: markus.k.mueller@bluewin.ch

treatment is of paramount importance in order to reduce morbidity and mortality in the further course [14]. Unfortunately, detection of such leaks is a challenge in obese patients [15]. Therefore, some surgeons have suggested the use of a routine postoperative upper gastrointestinal (UGI) series to detect a potential leakage [11, 12, 14, 16]. Medicolegal issues further support the use of a routine UGI series. However, the usefulness of routinely performed tests after LRYGB is discussed controversial because of additional costs and lack of sensitivity [15, 17]. Moreover, the timing of the routine UGI series and occurrence of leaks is undetermined.

The evidence in the literature from large single institutional series is sparse as only small series have been reported using UGI contrast studies following LRYGB [16, 17]. In fact, as new bariatric programs emerge in face of the growing epidemic of obesity, many surgeons might think that routine UGI series increase the patient's safety.

Therefore, we evaluated the utility of routine upper gastrointestinal series after LRYGB using a prospective database of 804 consecutive patients operated at our institution. In addition, this study provides a cost analysis on the use of routine postoperative UGI series.

## Patients and Methods

Eight hundred four consecutive patients undergoing a LRYGB from June 2000 to April 2010 were analyzed using a prospectively collected database. In the first 382 patients routine, UGI series was performed between the third and fifth postoperative days (group A,  $n=382$ ). From May 2005 onwards, we stopped the performance of routine UGI series and used an intraoperative methylene blue test to assess the gastrojejunostomy in every patient instead (group B,  $n=422$ ). UGI series were only performed when clinical findings (tachycardia, fever, drainage content, and reduced general condition) were suspicious for a leakage of the gastrojejunostomy in this group. In group B, 16 upper gastrointestinal series (and additionally six computed tomography (CT) scans) were performed upon clinical findings suggesting a leakage. All radiology reports were reviewed and evaluated for effectiveness for detection of postoperative complications and anastomotic leaks. Reports, which raised a high suspicion for a leakage, were defined as test positive. Operative findings clearly showing a leak at the gastrojejunostomy, or clinical findings—including fever, tachycardia, and pain—and amylase-rich drainage fluid (amylase  $>200$  U/l for more than 3 days) or obvious aspect of intestinal contents within the drain over days served as a gold standard for the definition of a leakage. The interval between the operation and time of diagnosis was calculated. Sensitivity, specificity, positive

predictive value, and negative predictive value were calculated.

## Cost Analysis

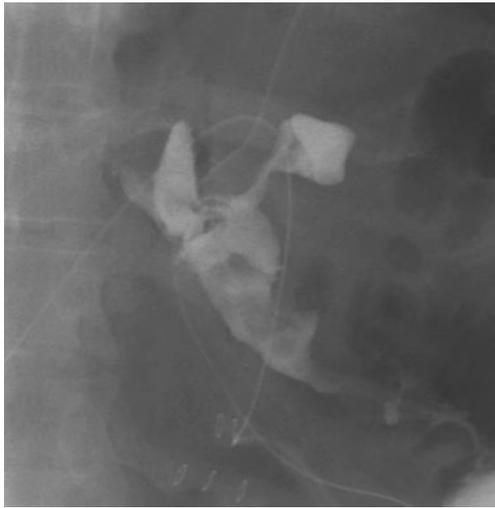
We calculated the overall cost of LRYGB in patients without complications and compared it to those of LRYGB in patients with a leak at the gastrojejunostomy. Costs of routine UGI series were also calculated.

## Surgical Technique

All gastric bypass procedures were performed laparoscopically as described by Wittgrove in 1994. Briefly, a small gastric pouch of 15–25 ml is created. Next, the jejunum is divided 50 ml distally to the duodenojejunal flexure, and the jejunojunctionostomy is performed using a linear stapler. The mesenteric window at the jejunojunctionostomy is closed with a non-absorbable suture (Ethibond™). Either an alimentary limb length of 150 cm in the proximal bypass or a common channel of 150 cm in the distal bypass is chosen, depending on the preoperative body mass index (BMI). The alimentary limb is then brought up to the gastric pouch. The gastrojejunal anastomosis is performed with a circular stapling device (CEEA 25-mm, Tyco, Mansfield, MA), which is inserted transabdominally. In group B, intraoperatively, methylene blue is injected via a nasogastric tube into the proximal stomach pouch. Simultaneously, the distal jejunum is occluded to create pressure on the gastric staple line and the gastrojejunal anastomosis. Leaks may be identified visually with extrusion of methylene blue.



**Fig. 1** Normal postoperative contrast study



**Fig. 2** Leak with extravasation of contrast

### Upper Gastrointestinal Series

An UGI contrast study was routinely performed between the third and fifth postoperative days in group A. For this imaging study the patient was placed in a semi-upright position. Approximately 60 ml of water soluble Gastrografin (diatrizoate meglumine and diatrizoate sodium; Bracco Diagnostics, Princeton, NJ, USA) was administered orally. Videofluoroscopy is performed as the contrast is administered, and fluoroscopic spot films are obtained. Overhead films are made in the anteroposterior (AP) and right and left posterior oblique positions to evaluate passage of contrast through the esophagus and gastric pouch (Figs. 1 and 2). Then 15 min later, an additional AP film is taken to assess emptying of the pouch, passage of contrast through the jejunum, reflux into the duodenum, and possible delayed leak. All films were assessed by one of the staff radiologists. In group B, the upper GI series were performed

upon a clinical suspicion for a leakage; in six cases, an additional CT scan was performed when the upper gastrointestinal series findings were unclear.

### Results

Patient's characteristics are presented in (Table 1). There was no significant difference between the two patient groups regarding, age, gender, BMI, or operative procedure.

In nine of 804 (1.1%) patients a leak was diagnosed upon operative results and clinical findings. In group A, leaks occurred in four out of 382 (1.0%) patients. In group B, five out of 422 (1.2%) patients presented with a leakage. There was no difference in the prevalence of leakages between the two groups (Fisher's exact test,  $p=1.000$ ). The leakages of the gastrojejunostomy were confirmed during surgery in seven patients and via analysis of the drainage content in two patients, who were treated conservatively with antibiotics and drainage. Among the seven patients who needed surgery for the leakage, two were operated laparoscopically and five underwent a laparotomy. One patient had a leak confirmed at surgery although the upper gastrointestinal series were negative, but deteriorated clinically. The interval between the operation and the time of diagnosis was between 2 and 9 days. The difference between the time intervals to diagnosis was not different in the two groups. In group A, the mean time interval was 5 days, and in group B it was 4.25 days (median 4.5 in both groups,  $p=0.743$ ). Therefore, omitting routine UGI series did not delay the diagnosis of a leakage. Three leakages occurred on the fifth postoperative day, three on the second, the remaining on the third, fourth, and ninth postoperative days. All patients with a leakage suffered either from fever, severe pain, or tachycardia.

Of the four patients who developed a leakage in group A, two were detected by the UGI series (Table 2). However,

**Table 1** Patients' characteristics

	Total	Group A	Group B	<i>p</i>
<i>n</i>	804	382	422	
Age (years)	41.0 (10.6)	41.3 (10.4)	40.7 (10.7)	0.425
Female	485 (74.2%)	275 (72%)	325 (77%)	0.105
Male	169 (25.8%)	107 (28%)	97 (23%)	
Weight (kg)	128.3 (24.6)	128.5 (24.0)	128.2 (25.5)	0.784
Mean BMI (kg/m <sup>2</sup> )	45.9 (7.3)	46.0 (7.2)	45.7 (7.4)	0.523
OP type ( <i>n</i> )				
Primary LRYGB	632 (79%)	304 (80%)	328 (78%)	0.135
Conversion from Gastric Banding	155 (19%)	74 (19%)	81 (19%)	
Primary ORYGB	17 (2%)	4 (1%)	13 (3%)	
Leak	9 (1.1%)	4 (1%)	5 (1.2%)	1.000
Time to diagnosis of leak (days)	4.5	5	4.25	0.743

Values are given in mean±SD. Chi-square test was used to compare sex and type of operation, independent *t* test for comparing means for age, weight, and BMI.

LRYGB laparoscopic Roux-en-Y Gastric Bypass, ORYGB Open Roux-en-Y Gastric Bypass

**Table 2** UGI series

	Leak	Confirmed	None
Group A: patients with routinely performed postoperative UGI series following LRYGB			
Test positive		2	9
Test negative		2	361
Group B: patients with a postoperative UGI series only when clinical findings were found			
Test positive		4 <sup>a</sup>	1
Test negative		1	10 <sup>b</sup>

<sup>a</sup> One case was additionally confirmed on CT scan

<sup>b</sup> Five cases were additionally confirmed on CT scan

both tests have been performed earlier than scheduled due to clinical symptoms. The other two leakages were missed on the contrast study, and in nine patients in group A the contrast study was false positive. This results in a sensitivity and specificity of 50% and 97% for routine upper gastrointestinal series, compared with 80% and 91% in group B (Table 3). In group B, 16 upper gastrointestinal series and additionally six CT scans with oral contrast have been performed upon clinical suspicion for a leakage. These tests correctly identified five leaks and missed one. Sensitivity and specificity are given in Table 3.

### Cost Analysis

The mean (SD) overall costs for UGI in patients without leakage at the gastrojejunostomy was US \$26,426 (5,927;  $n=795$ ). In the presence of a leakage at the gastrojejunostomy, expenses increased dramatically with a mean costs of US \$80,980 (56,543;  $n=9$ ). The cost of a routine UGI series was US \$434 (which corresponds to approximately 334 euros), only 1.6% of the overall costs of a non-complicated gastric bypass procedure.

With a leak rate of 1% and a sensitivity of 50%, one would have to do 200 tests and to spend US \$86,800 on routine upper gastrointestinal series to pick one leak and could still not assume that the cost would be diminished in this case, not to mention the missed case with a false-negative test. Of note, the difference between a standard uncomplicated gastric bypass procedure and a case with a leak at this hospital is US \$54,554.

**Table 3** Sensitivity, specificity, positive predictive value, and negative predictive value

	Sens (%)	Spec (%)	PPV (%)	NPV (%)
Group A	50	97	18	99
Group B	80	91	80	91

*Sens* sensitivity, *Spec* specificity, *PPV* positive predictive value, *NPV* negative predictive value

### Discussion

Patients undergoing LRYGB develop early postoperative complications in up to 15% [18]. Most common complications include port site infections, intra-abdominal abscess formation, and less frequent leakage of the gastrojejunostomy. Early detection and treatment of these complications has been reported to have a positive impact on the patients' outcome [19]. The incidence of gastrojejunal leakages occurs in up to 4.4% [12, 13]. Usually, the leakage is located at the gastrojejunostomy and can result in significant morbidity with prolonged hospital stay. Early detection of gastrointestinal leakage is of paramount importance in order to treat this severe complication adequately [14]. Upper gastrointestinal series are widely used on a routine basis in the postoperative period. It allows visualization of the gastric proximal pouch and provides information about size and position and potential leakage. Consequently, many centers, initially also our center, have suggested using a postoperative UGI contrast study on a routine basis [20]. However, the use of such tests on a routine basis after LRYGB is controversially discussed because of the additional costs and technical/methodological limitations, e.g., difficulties in monitoring contrast in obese patients [15, 17, 21–23]. In this study, we have shown that routine upper gastrointestinal series have a very low sensitivity to detect a leakage at the gastrojejunostomy and did not result in an earlier detection of the leakage. In fact in some patients where the leakages have been diagnosed correctly with routine UGI series, the tests have been performed earlier than scheduled due to clinical symptoms. The other two leakages were missed by the UGI series and in addition there were nine false-positive tests. The sensitivity of the upper gastrointestinal series was higher when performed under clinical suspicion for a leakage.

Omitting routine upper gastrointestinal series did not delay the time to diagnosis, and therefore did not have any negative impact on the patients' management and outcome. Furthermore, the incidence of detected leakages was the same with or without routine upper gastrointestinal series. Therefore, we suggest that routine UGI series can be omitted in high-volume institutions and be replaced by

tests, which are performed selectively upon clinical suspicion for a leakage, as has also been shown by Lee et al. in a smaller series [24]. In units with an evolving bariatric program, routine UGI series might still be valuable at least for medicolegal issues. In the recent period, we have performed contrast-enhanced CT scan with oral contrast upon clinical findings, which provides further information such as the presence of intra-abdominal abscesses.

The presence of a leakage results in considerable higher costs compared with costs in patients with an uneventful postoperative course. The costs for the UGI series is only a small part of the whole cost for a bypass procedure. However, since this procedure did not result in a faster recognition of the complication, economically spoken, the routine UGI series does not make sense and increases the costs for a bypass procedure without any further benefit. Even if one assumes that an early detection of a leak with an upper gastrointestinal series would defer the course to a comparable one without a leak, with a test sensitivity of only 50% it would not be economical as shown in our cost analysis. Therefore, we omit the routine test and perform tests upon postoperative clinical findings in our daily practice.

This study shows that routine upper gastrointestinal series have a low sensitivity for the detection of anastomotic leakages after laparoscopic gastric bypass surgery and is also economically not justified. Omitting routine UGI series did not result in a delay of the diagnosis of anastomotic leakage. Therefore, in our opinion UGI series on a routine basis is no longer recommended in high-volume institutions.

**Conflicts of interest** All authors declare that they have no conflict of interest.

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