Factors predicting the occurrence of a gastrojejunal anastomosis leak following gastric bypass

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Abstract

Introduction: *Occurrence of anastomotic leaks following Roux-en-Y gastric bypass (RYGB), arising principally from the gastro-jejunal anastomosis, is associated with significant morbidity and mortality. Their early detection and treatment is essential. However, a significant number of postoperative oral contrast studies fail to identify leaks, and a negative study providing false reassurance can lead to a delay in diagnosis and treatment. Physiological features including tachycardia, increased respiratory rate and pyrexia or elevations in C-reactive protein and white cell count are seen in patients with leaks. In this study we examine physiological and laboratory parameters in patients with and without anastomotic leaks following RYGB to try and improve the detection of leaks.*

Aim: *To evaluate clinical signs and laboratory tests in determination of the development of gastrojejunal leaks after gastric bypass surgery.*

Material and methods: *The study examined 116 consecutive patients undergoing laparoscopic RYGB. Clinical signs and laboratory results were reviewed retrospectively.*

Results: *Four gastrojejunostomy leaks in our series were identified after RYGB surgery. All these patients were treated successfully. Leak patients' in-hospital stay was longer. Tachycardia among leak patients occurs from day 1 with 100% sensitivity and 87% specificity at a cut-off point of 90 bpm. A temperature difference appears on day 2 in leak patients. The CRP was higher on day 2 and 3 in leak patients. Higher intravenous fluid requirements were observed in patients with leaks.*

Conclusions: *Gastrojejunal anastomosis leak is associated with longer in-hospital treatment. The earliest significant indicators of a leak are tachycardia and positive fluid balance. A temperature spike and CRP rise occur on day 2. Leak patients matched SIRS WBC count criteria on day 3.*

Key words: *obesity, Roux-en-Y gastric bypass (RYGB), anastomosis leak.*

Introduction

Anastomotic leaks are reported to occur following Roux-en-Y gastric bypass (RYGB) with a frequency of between 0 and 5% [1–5], arising principally from the gastro-jejunal anastomosis. Their occurrence is associated with significant morbidity and mortality [1, 6] and therefore their early detection and treatment is essential. However, this can be extremely difficult since a significant number of patients do not display the typical features of peritonitis and routine postoperative oral contrast studies [7] fail to identify a significant proportion of leaks, a negative contrast study providing false reassurance which can lead to a delay in diagnosis and treatment [6, 8, 9]. Physiological features such as the presence of tachycardia,

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increased respiratory rate and pyrexia or elevations in C-reactive protein (CRP) and white cell count are seen in patients with leaks [10, 11].

Aim

To evaluate clinical signs and laboratory tests in determination of the development of gastrojejunal leaks after gastric bypass surgery.

Material and methods

This retrospective study examined 116 consecutive patients undergoing RYGB for the treatment of morbid obesity between March 2009 and February 2010.

The indications for bariatric surgery conformed with NICE guidelines [12]. All the patients followed the approved North London Obesity Surgery Service perioperative protocol. The RYGB procedures were performed by two surgeons. Basic demographic data were collected from the patient medical records and an electronic database kept within the department. Laboratory results were retrieved from the hospital information system (data available on 105 patients) and the medical records reviewed retrospectively (records available on 86 patients). Presence of a gastrojejunal anastomosis leak was proven by contrast extravasation in a radiological study or at the time of reoperation. Demographic data of all the patients are displayed in Table I. There were no significant differences between patients with and without leaks in terms of age, sex, body mass index (BMI) or co-morbidities. Hospital stay was significantly longer in patients with leaks (Table I).

Surgical technique

The RYGB was performed through five ports, the gastric pouch being formed over a 32 Fr gauge (FG) bougie and extending to between the second and third vessel on the lesser curve side of the stomach. A side-to-side, antecolic gastrojejunostomy was formed using 25 mm of an Ethicon Echelon Endocutter 45-mm linear Gold cartridge. The anterior aspect of anastomosis was closed over a 32 FG bougie with a single layer of 2-0 Vicryl or 2-0 polydioxanone (PDS). The jejunojejunostomy was a side-to-side anastomosis formed with one firing of a 60-mm linear stapler (White cartridge) with enterotomy being closed in one layer with a continuous 2-0 PDS suture. The anastomoses were checked for integrity using a combination of methylene blue (120 ml) and air insufflations through a nasogastric (NG) tube. Drain placement was at the discretion of the surgeon. All procedures were completed laparoscopically.

Postoperative assessment

After surgery, pulse rate, blood pressure, body temperature, postoperative pain and fluid balance over a period of 24 h were measured from day 1 to 3. Data were collected as the average and range of pulse rate, systolic blood pressure, maximum temperature (in degrees Celsius), pain scores (1 is none, 2 mild, 3 moderate and 4 severe) and balance of fluid input and output in ml. A normal white cell count was between 4 and 12 × 10^9 cells/ml and the serum CRP normal value range was 0–5 mg/l. A postoperative Gastrografin study was not performed routinely.

Statistical analysis

The statistical analysis was performed using SPSS for Windows, release 17.0 (SPSS, Chicago, Ill., USA). Comparison between patient groups with and without leaks was performed using the χ^2 test and Mann-Whitney test as appropriate. Significance was defined as a p value < 0.05.

Table I. Demographic data

	Gender		Age, mean (SD) [years]	BMI, mean (SD) [kg/m^2]	Comorbidities [%]		Length of stay, mean (SD) [days]
	Male	Female			None	Present	
Leak	0	4	50.7 (10.0)	48.8 (12.0)	0	100	76 (53)*
No leak	16	96	44.6 (10.9)	48.1 (7.4)	30.4	69.6	3.78 (3.88)*
Total	16	100	44.8 (10.9)	48.1 (7.5)	29.3	70.7	5.7 (14.3)

**Significant differences between group*

Table II. Clinical data

	Pulse rate (SD)			T°(SD)			Systolic blood pressure (SD)			Pain Score (SD)		
	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3
Leak	106.5 (12.9)	112.7 (17.8)	116.5 (16.6)	37.8 (1.7)	39.1 (1.0)	39.2 (1.6)	118 (17.3)	124 (23.8)	140 (10.1)	3 (0)	3 (0)	4 (0)
No leak	76.7 (12.4)	81.3 (13.4)	80.4 (12.3)	36.9 (0.5)	37.0 (0.5)	37.0 (0.5)	127 (14.0)	131 (14.7)	133 (13.2)	2.04 (0.8)	2.09 (0.8)	2.09 (0.9)
Value of *p*	0.002	0.002	0.001	NS	0.001	0.001	NS	NS	NS	NS	NS	0.03

Results

There were 4 patients (3.8%) who developed leaks from the suture line of the gastrojejunal anastomosis which were identified within 72 h of the original procedure. All leaks were treated by the placement of a covered oesophageal stent and, in 2 cases, reoperation to perform peritoneal lavage and insert a drain. There were no deaths.

Pulse rate, temperature, blood pressure and pain score over the first three postoperative days are shown in Table II. Significant differences in pulse rate were evident from day 1 and persisted over all 3 days. A pulse rate of > 90 on day 1 distinguished between patients with and without a leak with a sensitivity of 100% and specificity of 87% (Table III). Significant differences in temperature appeared on day 2 and higher pain scores were recorded on day 3 amongst patients with leaks. Systolic blood pressure values did not differ significantly.

Serum CRP concentrations were significantly higher on day 2 and 3 in patients with leaks (Table IV). There were no significant differences in white blood cell count between the groups, but great variability in white blood count (WBC) count, from high concentrations to leucopenia, was seen amongst patients with leaks. There was a negative association between WBC and CRP concentrations in particular patients. Intravenous fluid requirements and positive fluid balance were greater in patients with leaks. These differences were statistically significant on all 3 days.

Table III. Sensitivity and specificity of tachycardia (pulse rate > 90 bpm)

	Leak positive	Leak negative	Total
Tachycardia positive	4	10	14
Tachycardia negative	0	72	72
Total	4	82	86

Discussion

Anastomotic leaks following RYGB can be caused by a number of factors including those compromising healing such as mechanical tension and ischaemia [9] but are also associated with other factors such as BMI, age and the postoperative course [1]. Our anastomotic leak rate of 3.8% is comparable to that of previously published series [1–3].

The current series supports the previously described sensitivity of tachycardia as the earliest indicator of a leak [2, 7, 10] and is one of the most important factors that we consider when deciding whether a leak has occurred. Because of the lack of sensitivity of radiological investigations we rarely

Table IV. Laboratory tests and fluid balance

	WBC (SD)			CRP (SD)			Fluid balance (SD)		
	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3
Leak	13.1 (2.7)	13.0 (1.9)	8 (10.5)	38.5 (49.8)	116.7 (82.4)	293 (80.0)	2917 (2382)	2641 (315)	3173 (908)
No leak	12.7 (3.6)	11.3 (3.0)	10.5 (7.2)	17.4 (25.6)	57.4 (47.8)	126 (82.6)	606 (1002)	927 (1157)	237 (1042)
Value of *p*	NS	NS	NS	NS	0.04	0.04	0.036	0.037	0.028

perform upper gastrointestinal studies in order to detect whether a leak is present, preferring to proceed straight to laparoscopy [13].

Following an anastomotic leak, bacteria released from the anastomosis into the peritoneal cavity are transported to the lacunas of the diaphragm, where they enter the lymphatic system [14]. The proximity of the leak to this area and elevated intra-abdominal pressure in obese patient accelerate the process. Peritonitis leads to the production of an inflammatory exudate within the peritoneal cavity, as well as fluid sequestration in the bowel as ileus develops and the loss of fluid into the interstitial spaces. Fluid sequestration in these patients decreases the circulating blood volume and may, in combination with the other effects of sepsis, lead to tachycardia, hypotension and a reduced urinary output [15]. The result of this is that patients need significantly more intravenous fluids and electrolytes to compensate for third-space losses and to ensure adequate urine output. This significantly increased requirement was seen as a positive fluid balance on the first postoperative day and remained throughout the 3 days of the study. An abnormally increased fluid requirement may develop very soon after a patient starts to leak from gastrojejunostomy as the result of developing sepsis. Patients in an intensive treatment unit after surgery where observations are undertaken continuously and fluid resuscitation is more aggressive are most likely to have this abnormality detected at an early stage. As far as we are aware, this is the first occasion on which increased fluid requirements have been observed as an early feature of an anastomotic leak in patients undergoing RYGB.

A significant increase in temperature was evident on the second postoperative day in patients with leaks. It is likely that the failure for significant differences to be apparent on the first postoperative day is as a result of a combination of factors. Firstly, the number of patients with leaks in the current study is small. Secondly, many patients will have minor increases in temperature on the first postoperative day as a result of other conditions such as pulmonary atelectasis which settle on the second postoperative day. And thirdly, the temperature arising as a result of the leak may be modest during the early period following the onset of sepsis.

We did not detect significant hypotension among patients with leaks.

We have relied upon an abnormal degree of pain as an important indicator of a leak. We routinely ask patients to drink as soon as possible after surgery in order to assess whether they have pain as the fluid passes through the gastric pouch and gastrojejunal anastomosis. If they do then we consider this an indicator of a leak. We were therefore surprised to note that the pain score was not a factor that discriminated between patients with and without leaks. This failure may be due to the small number of leaks in our series but also reflects the great variability in the degrees of pain experienced by patients postoperatively with some patients without a leak reporting severe postoperative pain. The provision of adequate and effective postoperative analgesia may also be a factor. Nonetheless, we still maintain close observation of all patients with severe pain in case it is associated with a leak.

Systemic inflammatory response syndrome (SIRS) is defined as temperature < 36°C or > 38°C, heart rate > 90 beats/min, respiratory rate > 20 breaths/min, pCO_2 < 32 mm Hg, WBC count < 4×10^9 or > 12×10^9, or the presence of > 0.10 immature neutrophils [16]. With respect to these criteria, we found that WBC count corresponded with these criteria in 2 patients on day 1 and day 2, then on day 3 all 4 patients with leaks had a WBC count range consistent with SIRS (23.8; 3.4; 2.8; 2.2 values). The CRP concentrations were significantly greater on the second postoperative day in patients with leaks and continued to rise on postoperative day 3, reaching a level > 200 mg/l in all patients with leaks. Significantly elevated CRP levels were observed even in patients without a leak. However, values were significantly lower. These data correspond with the findings from other publication series [17].

Whilst a number of papers have described factors associated with an anastomotic leak, it is not always an easy matter to apply these findings directly to clinical practice. In our practice we are concerned by the presence of severe abdominal pain especially when combined with a pulse rate greater than 90 bpm or the features of peritonitis and would offer relaparoscopy if associated with either. On the first postoperative day it is unlikely that the white cell count or CRP will be sufficiently abnormal to aid the decision making process. However, a CRP value > 200 mg/dl on day 2 or 3 would raise concern and prompt close examination of the patient. A CRP of less than 100 mg/dl and white cell count within the

normal range on day 3 are reassuring. An isolated indicator of a large fluid requirement would not in itself prompt relaparoscopy but if combined with other features indicating sepsis it would prompt a thorough search for the cause and, if one was not identified, relaparoscopy.

This early relaparoscopy view is in line with the ASMBS guidelines [13], which indicate that the most sensitive means of identifying a leak is laparoscopy. As the frequency of re-operation is recorded as a variance from normal and is used as an indicator of quality of care, there may be reluctance on the part of surgeons to offer relaparoscopy as a diagnostic test. However, the importance of early relaparoscopy has recently been appreciated by colorectal surgeons following laparoscopic colorectal resections [18] and laparoscopy is also being increasingly used as a diagnostic test in patients admitted as an emergency with unexplained abdominal pain. This appreciation of the importance of early diagnostic testing and the potentially serious consequences of missing a leak or delaying its diagnosis and the treatment of peritonitis should encourage the early use of relaparoscopy.

Conclusions

Anastomotic leak is one of the most dangerous complications in gastric bypass surgery, associated with significantly longer inpatient treatment, long-term morbidity or even death. The early postoperative detection of a leak and appropriate intervention is crucial to achieve better results and avoid mortality. The earliest significant indicators of a leak in our series are pulse rate > 90 bpm (sensitivity 100%, specificity 87%) and positive fluid balance due to increased intravenous fluid requirement. A significant temperature spike and CRP rise among leak patients occur on day 2. The white cell count in patients with leaks was variable, including leucocytosis and relative leucopenia; however, all leak patients matched SIRS WBC count criteria on day 3.

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