

The hidden endoscopic burden of sleeve gastrectomy and its comparison with Roux-en-Y gastric bypass

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Abstract

Background This study aimed to assess the endoscopic burden of bariatric surgical procedures at our trust. This is an enhanced parallel study to “The Hidden Endoscopic burden of Roux-en-Y Gastric Bypass” published in *Frontline Gastroenterology* in 2013 incorporating the data for sleeve gastrectomy and comparison with Roux-en-Y gastric bypass (RYGB).

Methods This is a retrospective study that included 211 patients undergoing sleeve gastrectomy over a 34-month period. We utilized previously collected data for the RYGB patient cohort which included 553 patients over a 29-month period. We searched our hospital endoscopic database for patients who underwent post-operative endoscopy for indications related to their surgery.

Results 16.6% of the sleeve gastrectomy patients required post-operative endoscopy, of whom 11.4% underwent therapeutic procedures. This compares to 20.4% of the RYGB cohort of whom 50.4% needed therapeutic procedures ($P < 0.001$). 1.9% of sleeve gastrectomy patients encountered a post-operative staple line leak and collectively required 29 endoscopic procedures. One patient also developed stricturing (0.47%) requiring 18 pneumatic dilatations. 11.4% of the RYGB cohort developed an anastomotic stricture requiring 57 balloon dilatation procedures. To date, these procedures have accumulated an equivalent cost of €159,898 in endoscopy tariffs, or €177 per RYGB and €373 per sleeve gastrectomy performed.

Conclusions Bariatric surgery can have significant implications in terms of patient morbidity and financial cost. Having a local bariatric surgery service increases the demand for endoscopic procedures in our hospital, both in investigating for and dealing with post-operative complications. Provision of extra resources and expertise needs to be taken into account.

Keywords Endoscopy, obesity, bariatric surgery, gastrectomy

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Introduction

The UK is encountering an obesity crisis, with 61.9% of adults being classified as obese [1]. Obesity-related health problems are estimated to cost the NHS the equivalent of nearly €7 billion per year [2]. It is estimated that 50% of the world's population will be obese by the year 2030 [3]. In 2008,

the UK National Institute for Clinical Excellence (NICE) issued guidance on the management of obesity. It recommended bariatric surgery as an option to patients with a body mass index (BMI) of over 40, or between 35 and 40 if they have significant co-morbidities that could be improved by losing weight (such as type 2 diabetes mellitus). Non-surgical measures should be attempted first unless the patient has a BMI of over 50, when surgery can be considered as first line. All patients should receive intensive management in a specialist obesity center [4].

A number of bariatric surgical options are available, including laparoscopic gastric band insertion, Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy. The UK's Walsall Manor Hospital is one of the main centers for bariatric surgery in the West Midlands. Like all procedures, bariatric surgery has a risk of complications such as anastomotic leaks and stricture formation. Metanalysis suggests that the leak rate for sleeve gastrectomy is around 2.4% [5], whereas the incidence of anastomotic stricture formation in RYGB surgery varies widely between 0.8% [6] and 23% [7]. Sleeve gastrectomy has been

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shown to achieve comparable weight loss to RYGB surgery but is felt to be a simpler procedure with a lower long-term risk profile and so the number of these procedures in comparison to RYGB is increasing [8].

Complications of bariatric surgery are often investigated, diagnosed and managed by the use of endoscopic procedures, such as endoscopic stent insertion for an anastomotic leak, or balloon dilatation for a stricture. In 2012 Steed *et al* showed that RYGB surgery had a significant impact on local endoscopic services and this was associated with an added cost to the NHS [1].

The total number of bariatric surgeries performed in the UK is rising. From 2006 to 2012 there was a 530% rise in RYGB surgeries performed for obesity in the UK [9]. In November 2014, NICE issued new guidance which, for the first time, states that patients with a BMI of 30-35 with recent onset type 2 diabetes mellitus can be considered for bariatric surgery, in particular those of Asian family origin [10]. Given the increasing obesity rates and change to NICE guidance, it is likely that more bariatric surgery will be performed in the UK in the coming years.

The aim of this study was to assess the current endoscopic burden of bariatric surgery at our center, including RYGB and sleeve gastrectomy. This is intended to be a sister article to the aforementioned article on RYGB surgery and we thank the authors for endorsing the use of their data.

Patients and methods

Study design and patient selection

All 553 patients undergoing RYGB between 1st February 2008 and 31st July 2010 were included in the original study by Steed *et al* [1]. RYGB procedures were still being performed after July 2010, however with less frequency given the alternative option of sleeve gastrectomy, performed in our trust from January 2011. We included all 211 patients undergoing sleeve gastrectomy from this date until 2nd October 2013. For our study we utilized the previously collected RYGB data and added current sleeve gastrectomy data. The follow-up period was a minimum of 180 days in both groups. All patients were retrospectively investigated for post-operative endoscopic procedures and, if so, their electronic records were reviewed.

Bariatric surgery

The Bariatric Service at Walsall Manor Hospital receives referrals according to the NICE guidance criteria. If surgical management is decided upon, the type of surgery is a combination of surgeon recommendation and patient preference. If the patient is on a proton pump inhibitor (PPI) or histamine 2 (H₂) blocker then further questions are asked regarding symptoms of acid reflux or dyspepsia. If this is positive then a pre-operative Barium swallow and meal is performed to look for a hiatus hernia and other physical

abnormalities, which may preclude bariatric surgery or affect the surgical methods used.

During the sleeve gastrectomy procedures, Endo Gia Ultra staples were used and the length of these was graduated along the staple line based on the stomach wall thickness, with longer staples used towards the antrum in an attempt to reduce the risk of a staple-line leak. For the RYGB procedures, a 25 mm stapler was used and a 1.5 m Roux loop was made for open procedures, with a 45 mm stapler and 1 m Roux loop for laparoscopic procedures. All patients underwent gastrografin swallow 24-48 h post-operatively, before oral diet was allowed. This was to exclude any immediate leaking from the anastomosis/staple line which may need urgent return to theatre or endoscopic procedures. This was done routinely in a bid to prevent further complications if we waited until the patient's became symptomatic from any leak. All patients were discharged with PPI therapy for life.

Cost of endoscopy procedures

All procedures have an associated cost, or "tariff", to the NHS. In 2013, these were the equivalent of €481 for a diagnostic gastroscopy, €905 for endoscopic balloon dilatation and €4941 for an endoscopic stent insertion, including the consumables used. In the original Steed *et al* study, 2010 tariffs were used however, for the purposes of comparison in this study; we have used 2013 tariffs for both cohorts. These tariffs were gathered from the Hospital's finance department.

Statistical analysis

Comparisons between the RYGB and Sleeve Gastrectomy eras were made using Fisher's exact test for nominal factors, and Kendall's Tau for ordinal factors. All analyses were performed using IBM SPSS Statistics 22 (IBM Corp. Armonk, NY).

Results

Demographic data

211 patients underwent sleeve gastrectomy in this period, 35 of whom underwent post-operative upper GI endoscopy (16.6%). This compares to 20.4% for the Steed Roux-en-Y patient data where 113 of the 553 surgical patients required post-operative endoscopy (P=0.26).

Overview of endoscopic procedures performed

The aforementioned 35 post-sleeve gastrectomy patients had 66 upper gastrointestinal endoscopies between them. The 113 RYGB patients required 147 procedures. In both groups, 44% of the total number of endoscopic procedures were therapeutic

while 56% were diagnostic. In the sleeve gastrectomy cohort, 39.4% of procedures were done as an inpatient compared to only 3.4% in the RYGB cohort ($P<0.001$). There were no complications resulting from any of the endoscopic procedures.

Using 2013 endoscopy tariffs, the sleeve gastrectomy cohort has totalled the equivalent of €78,736 to date. This was €373 per surgery performed and included €17,781 in diagnostic endoscopy, and €60,955 in therapeutic endoscopy. Using the same tariffs for the RYGB patients (to aid in comparison), the total was €98,248. €39,407 went towards diagnostic gastroscopy, and €58,842 towards therapeutic gastroscopy, at a cost of €177 per RYGB operation performed (€147 if using 2010 tariffs).

Indications for endoscopic procedures

The indications for endoscopic procedures are shown in Table 1. The most common indication for endoscopy in the sleeve gastrectomy group was dysphagia (53%), with persistent vomiting also being a significant problem (15.2%) followed by persistent dyspepsia (13.6%). This differs from the RYGB data whereby dysphagia accounted for 31.3% ($P=0.004$), persistent vomiting for 63.3% ($P<0.001$) and dyspepsia 2.0% ($P=0.002$).

Dyspepsia, in particular, was seen more often in post-sleeve gastrectomy than in post-RYGB surgery. Of the 9 post-sleeve gastrectomy patients suffering with dyspeptic symptoms, 4 showed esophagitis, 2 gastritis, 2 hiatus hernia, and 1 was normal. An additional 11 patients suffering with other symptoms also showed signs of inflammation and 2 further hiatus hernias were found at endoscopy. This makes a total of 9% of the total sleeve gastrectomy group symptomatic from gastroesophageal reflux disease (GERD). Two post-sleeve gastrectomy patients were found to have symptomatic ulceration (0.95% for the whole sleeve gastrectomy group) but neither of these patients required endoscopic or surgical intervention. This compares to 4 of the Roux-en-Y patients (0.7%, $P=0.67$).

Therapeutic endoscopic procedures

The 29 post sleeve gastrectomy therapeutic procedures were performed on only 4 patients (1.9%), compared to 57 RYGB patients who required 63 procedures between them (10.3%,

$P<0.001$). The 4 sleeve gastrectomy patients who underwent therapeutic endoscopy had all suffered a staple line leak (1.9%). One of these patients then developed stricturing post-leak, 0.47% of the total sleeve gastrectomy group. These 4 patients totalled 14 pneumatic dilatations, 9 stent insertions and 5 naso-jejunal tube insertions. If a therapeutic endoscopy was required post sleeve gastrectomy, the numbers ranged from 2 to 18 procedures per patient.

One sleeve gastrectomy patient had a staple line leak followed by stricture formation and has required 18 endoscopic procedures to date, including 14 balloon dilatations, 3 stents and one nasojejunal tube insertion. Of the total endoscopic bill for the sleeve gastrectomy cohort of €78,736, this patient accounts for the equivalent of €35,693 (45%), with future procedures likely. The other 3 patients mentioned only required between 2 and 6 procedures before remaining asymptomatic for the rest of the follow-up period. The mean number of therapeutic endoscopy procedures needed in the sleeve gastrectomy group was 7.25 procedures, with a median of 4 procedures per patient.

This compares to 65 therapeutic procedures in the Roux-en-Y group on 57 patients, all of which were pneumatic dilatations due to stricture formation, with no leaks seen. An additional 5 patients returned to the operating theater due to severe stricturing, all diagnosed via endoscopy. This gives an overall stricture rate of 11.39% in the RYGB surgery group. Patients treated endoscopically required between 1 and 3 procedures, with a mean of 1.14. Both the rates of anastomotic leak and stricture formation were statistically significant between the two surgical groups ($P<0.05$).

All complications needing therapeutic endoscopy were seen within 44 days in the sleeve gastrectomy cohort. This differs from the RYGB cohort whereby new strictures were seen up to 506 days post-operatively, with 60% seen within the first 3 months, 95% within 6 months and 5 percent presenting between 6 and 17 months [1]. A full comparison of our results for the two surgical procedures can be found in Table 2.

Discussion

The data we have presented is only for our trust and patients may have attended other local endoscopy centers. We did not

Table 1 Indication for upper gastrointestinal endoscopic procedures (numbers in brackets indicate Roux-en-Y gastric bypass data)

Indication	Therapeutic N=29 (N=65)	Diagnostic N=37 (N=82)	Early (<31 days)	Late (>31 days)	Inpatient	Outpatient
Persistent vomiting	5 (48)	5 (45)	0 (10)	10 (83)	6 (2)	4 (91)
Dysphagia	14 (16)	21 (30)	1 (0)	34 (46)	9 (0)	26 (46)
Hematemesis/melena	0 (0)	2 (4)	0 (1)	2 (3)	0 (3)	2 (1)
Dyspepsia	0 (1)	9 (2)	0 (0)	9 (3)	1 (0)	8 (3)
Abdominal pain	0 (0)	0 (1)	0 (0)	0 (1)	0 (0)	0 (1)
Leak on GG swallow (for stent insertion)	7 (0)	0 (0)	3 (0)	4 (0)	7 (0)	0 (0)
Planned stent removal	3 (0)	0 (0)	0 (0)	3 (0)	3 (0)	0 (0)

GG, gastrografin

Table 2 Comparison of Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy data

Parameter	RYGB (%)	Sleeve gastrectomy (%)	P-value
Patients requiring gastroscopy	113/553 (20.4)	35/211 (16.6)	0.260
Type of gastroscopy			<0.001*
Therapeutic	57/113 (50.4)	4/35 (11.4)	
Diagnostic	56/113 (49.6)	31/35 (88.6)	
Therapeutic procedures per patient			<0.001**
1	50/57 (87.7)	0/4 (0.0)	
2	6/57 (10.5)	1/4 (25.0)	
3	1/57 (1.8)	1/4 (25.0)	
>3	0/57 (0.0)	2/4 (50.0)	
Location of endoscopic procedures			<0.001*
Inpatient	5/147 (3.4)	26/66 (39.4)	
Outpatient	142/147 (96.6)	40/66 (60.6)	
Complications of surgery			-
Leak	0/553 (0)	4/211 (1.9)	0.006*
Stricture	63/553 (11.4)	1/211 (0.5)	<0.001*
Indication for endoscopic procedures			<0.001*
Vomiting	93/147 (63.3)	10/66 (15.2)	<0.001*
Dysphagia	46/147 (31.3)	35/66 (53.0)	0.004*
Hematemesis/melena	4/147 (2.7)	2/66 (3.0)	1.000
Dyspepsia	3/147 (2.0)	9/66 (13.6)	0.002*
Abdominal pain	1/147 (0.7)	0/66 (0.0)	1.000
Leak on contrast study	0/147 (0.0)	7/66 (10.6)	<0.001*
Planned stent removal	0/147 (0.0)	3/66 (4.6)	0.029*

P-values from Fisher's exact test, unless stated otherwise. *Factor is ordinal, so P value comes from Kendall's Tau b. *Significant at P<0.05

contact patients directly to ask about symptoms or if they had attended services elsewhere. This may underestimate the total endoscopic cost. However, all bariatric patients are offered long-term follow up locally and we assume that most patients, especially those who encountered significant post-operative problems, will have attended our endoscopy unit due to our close links with the in-house bariatric service. In addition, it is possible that the follow-up period of 180 days will have missed some late endoscopic procedures for those patients who underwent surgery towards the end of the study period. However, all patients requiring therapeutic endoscopy post sleeve gastrectomy presented to our unit within 6 weeks of their surgery. In contrast, 95% of patients presenting with stricturing post-RYGB presented over the longer time scale of up to 6 months and so it is therefore possible that our follow-up period could have missed some late stricture formation in the RYGB cohort.

Overall, there were a large number of diagnostic procedures performed to our cohorts which did not lead to endoscopic therapy or any other change in management. The question must be asked whether all of these procedures were truly indicated or whether we are currently over-investigating some of these patients. Given that further increases in the popularity

of bariatric surgeries are likely to be seen in the coming years, it may benefit the endoscopy department to formalize a protocol as to when/if to perform endoscopy in these patients. Our data regarding the likely timing of therapeutic endoscopy, depending on the surgical procedures performed, may aid with this.

Much of the total endoscopic cost is via therapeutic endoscopy with its higher tariffs and increased endoscopist expertise required. More of the RYGB cohort required therapeutic endoscopy compared to the sleeve gastrectomy cohort (P<0.001). However, the RYGB group required fewer procedures per patient compared to the sleeve gastrectomy patients (P<0.001). All 4 sleeve gastrectomy patients who required post-operative therapeutic endoscopy had first suffered a suture line leak, and they required at least 1 stent insertion each. This procedure has a high tariff of €4941 and this procedure alone accounts for 56% of the endoscopy bill in this cohort. Endoscopic stent insertion was successful in all these patients, without the need for further surgery. No complications were seen, although more than one stent may have been required. This indicates that stent insertion for treatment of a staple line after sleeve gastrectomy is costly, but safe and effective. After the study period ended, changes were

made locally to reduce the leak rate post sleeve gastrectomy by biologically re-enforcing the staple line, as was suggested through international consensus [11]. This may have reduced the need for future patients requiring this surgery to undergo therapeutic endoscopy due to leakage, and thus significantly reduce the burden on our endoscopy units. However, the management of one sleeve gastrectomy patient is ongoing, with many more therapeutic endoscopic procedures likely for treatment of recurrent post-leak stricturing. No other sleeve gastrectomy patient presented with a stricture within the study period. This patient could be considered an anomaly, however, in a group of only 4 post-sleeve gastrectomy therapeutic endoscopy patients, more data is needed to ascertain this further. No complications were seen from the multiple balloon dilatation procedures, except recurrence of symptoms over time. This indicates that endoscopic treatment of anastomotic strictures post sleeve gastrectomy via balloon dilatation is safe and provides short-term relief. It can however require repeat procedures which come at a significant financial cost and patient morbidity.

Our calculations only include the endoscopic tariffs and do not take into account other hidden costs such as hospital admissions. 39.4% of procedures were done as an inpatient in the sleeve gastrectomy cohort compared to 3.4% in the RYGB group ($P < 0.001$). These were mostly therapeutic procedures after experiencing a leak. While this likely has a significant added cost in our data set, it may improve with the above-mentioned changes to surgical practise to reduce the leak rates.

Post-sleeve gastrectomy complications and dyspeptic symptoms are more common in patients with pre-operative reflux disease, therefore this is felt to be a relative contraindication to sleeve gastrectomy [12]. The question remains whether routine pre-operative testing of all patients for GERD via endoscopy and/or physiological studies should be recommended, instead of the barium swallow which our department currently utilizes in symptomatic patients. Studies so far have shown little benefit in asymptomatic patients but patients with relevant symptoms should be screened [13]. Furthermore, large-scale studies are needed but it must be remembered that there would be additional associated costs that need to be provided for if this were to be implemented.

Despite the limitations in our study, this data does show the current endoscopic burden of our bariatric service on our trust endoscopy unit. We have calculated these costs to be, at present, €373 per sleeve gastrectomy procedure and €177 per RYGB performed. This could be applied to other hospitals performing similar procedures and could be used for estimating future endoscopic workload that bariatric surgery poses to the NHS.

Given the recent changes to NICE guidance, more bariatric surgeries are likely to be done over the forthcoming years, which can only increase the associated endoscopic costs. There may be a case for more detailed pre-operative assessment for GERD in some patients, which could also add to the hidden costs of bariatric surgery. Data from our study could aid in the development of protocols by our endoscopy department for the appropriate selection of patients requiring endoscopy post-

Summary Box

What is already known:

- The numbers of bariatric surgical procedures are increasing in the UK due to a rise in obesity levels
- In 2014, NICE guidance reduced the recommended body mass index limits for consideration of surgery to as low as 30 in some cases and this will likely result in a further increase in bariatric surgery procedures
- Roux-en-Y gastric bypass (RYGB) carries a significant endoscopic burden in investigating for and dealing with complications

What the new findings are:

- Sleeve gastrectomy also carries a significant endoscopic and cost burden; in our study more so per procedure than RYGB
- Gastroesophageal reflux is a relative contraindication for sleeve gastrectomy due to significant related post-operative complications and persistent symptoms. There may be a case for detailed pre-operative assessment, which will, in itself, add to the hidden costs of bariatric surgery
- Most anastomotic leaks requiring intervention present within 6 weeks of sleeve gastrectomy surgery whereas stricturing from RYGB can present many months later
- Extraendoscopic resources need to be taken into account when commissioning a new bariatric service or when expanding an already established one

bariatric surgery. In addition, specific expertise is needed in the endoscopy department to accurately, effectively and safely diagnose and manage post-bariatric surgery complications. Overall, one should not forget that bariatric surgery and any resulting associated complications come at a price, both financial to the NHS but also in terms of quality of life for the patient. These hidden costs and need for additional resources need to be taken into account when commissioning a new bariatric surgery service and also when considering expanding an already established service. This must all be balanced against the risks (and costs) of long-term morbidity and mortality that obesity poses to a growing number of the population.

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