

# Laparoscopic Partial Sleeve Gastrectomy with Fundoplication for Gastroesophageal Reflux and Delayed Gastric Emptying

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## Abstract

**Background** A difficult management problem for the upper gastrointestinal surgeon exists when a patient presents with symptomatic and refractory severe delayed gastric emptying. Surgical treatment is further complicated by coexisting gastro-oesophageal reflux. No universal surgical strategy exists for this problem.

**Methods** A novel surgical strategy combines partial sleeve gastrectomy (SG) and hiatus hernia (HH) repair with fundoplication. A review of treating four such patients is described with objective outcome data.

**Results** Overall, solid gastric emptying improved in all, from median 350 (163–488) min pre-operatively to 108 (84–135) at 10 months (3–24) post-operatively, corresponding to 67 % improvement. Primary symptoms resolved in all; however, one patient had recurrent symptoms. GERD-HRQL also improved in all, from median 23 (3–25) to 4 (0–8) at 21 months (6–30, 83 % improvement). Gas bloat improved in three. All had post-operative gastroscopies showing intact repair and absent oesophagitis, with no patient requiring post-operative PPI. Patient weight reduced by median 11 % (7–20) post-operatively. There was no significant peri-operative morbidity.

**Conclusions** With careful patient selection and work-up, SG and HH repair with fundoplication may improve quality of life by coupling adequate reflux control with improved gastric emptying.

## Introduction

A difficult management problem for the upper gastrointestinal surgeon exists when a patient presents with symptomatic and refractory severe delayed gastric emptying (DGE). No universal surgical technique exists, with

descriptions of pyloroplasty, reconstructive gastrectomy and insertion of gastric pacemaker [1] being reported. Patients have non-specific symptoms and usually only diagnosed after many investigations. It is critical to ascertain the predominant symptoms to make sound judgments for treatment. We have treated four patients initially

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referred for symptomatic gastro-oesophageal reflux (GORD) and hiatus hernia (HH) but through further investigation were diagnosed with severe DGE. Both are known to co-exist through an incompletely understood interaction [2].

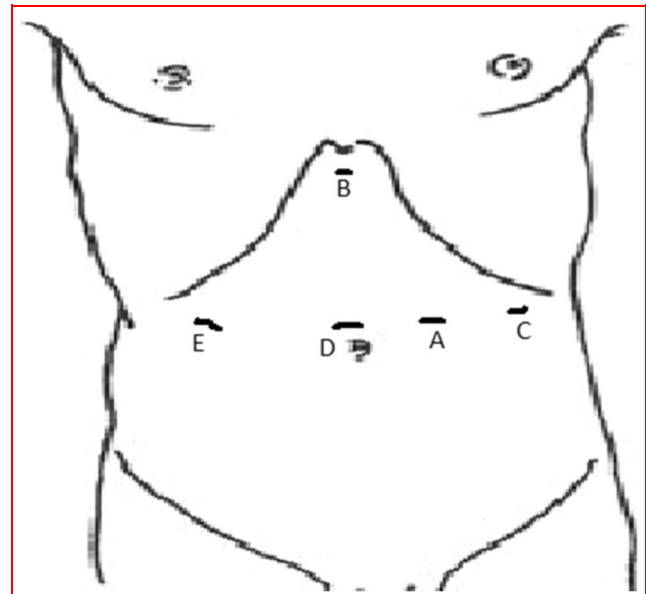
For these patients, the DGE was the predominant problem requiring treatment. Sleeve gastrectomy (SG) has been increasingly used to treat obesity in our unit and worldwide, and recent publications suggest consequent improvement in gastric emptying [3]. Given this knowledge, the severity of the patients symptoms and that no standard technique exists, we counselled our patients on the option of partial SG to target the DGE and the uncertain outcome, in accordance with local ethics approval. Additionally, given each had reflux and HH, a necessary adjunct was concomitant HH repair and fundoplication, which we have found necessary to improve reflux following SG for obesity [4].

### Surgical technique

Pre-operative investigations included endoscopy, nuclear medicine gastric emptying studies [GES, standardised protocol of solid meal ingestion labelled with  $^{99m}\text{Tc}$  (normal  $94.2 \pm 7.5$  min), region of interest determined by site of nuclear activity], barium swallow/meal, and oesophageal manometry/pH studies or other investigations as directed by symptoms.

Under general anaesthetic, the patient was supine in reverse Trendelenburg position with surgeon and assistant on the patient's right and left, respectively. Optical entry was achieved in the left midclavicular line a handsbreadth below the costal margin then gas insufflation to 15 mm Hg was commenced. Ports placement is seen in Fig. 1. A Nathanson liver retractor (Cook Medical Inc., Brisbane, QLD, Australia) we believe is critical to allow clear vision of the hiatus. Dissection commenced at the hiatus to restore the whole stomach into the abdomen and enable accurate SG. The hernia sac was fully reduced and excised. The oesophagus was circumferentially mobilised in the mediastinum to allow the cardio-oesophageal junction to lie tension-free 2 cm below the crura.

Attention then turned to the SG. At the antrum/body junction, the Ligasure (Covidien, CT, USA) commenced sealing branches of the gastroepiploic arcade to the greater curve. This continued onto the short gastric vessels and ceased at the upper fundus leaving the proximal 1–2 short gastric vessels. This contrasts to our bariatric SG whereby dissection starts just proximal to the pylorus and continues to fully expose the left crus (to ensure full fundal excision). A 56–60 French rubber bougie was passed to the pre-pyloric stomach by the anaesthetist (29F for our bariatric SG). The

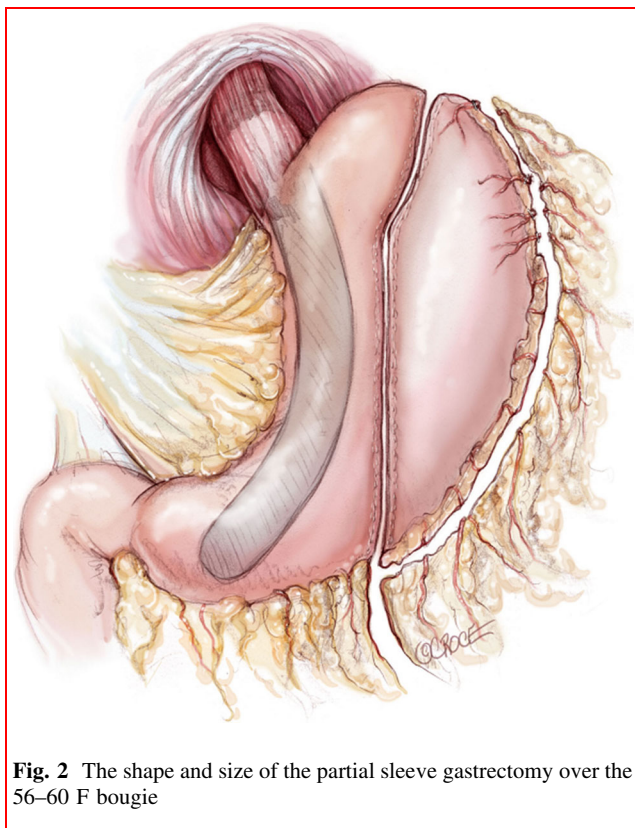


**Fig. 1** Diagram showing port placements. *a* 12 mm, optical entry; *b* 5 mm, nathanson liver retractor; *c* 5 mm, assistants right hand; *d* 15 mm, surgeons working port (for dissection/stapling/suturing); *e* 15 mm, surgeons left hand (for grasping/stapling/specimen removal)

lateral gastric body and lower fundus were then excised from below with the EndoGIA stapler (Covidien) with 3.5-mm staple size which was the largest available and suited to potentially hypertrophied gastric wall. The antrum was preserved and the gastric tube was generous (Fig. 2). Approaching the fundus the stapler was aimed laterally to leave a small fundal remnant for fundoplication. Care was taken to keep this broad based to improve its blood supply.

The hiatus was now repaired with deep bites of the crura posteriorly and anteriorly with interrupted 0 Ethibond (Ethicon Endo-surgery, OH, USA) sutures over the bougie (Fig. 3). An anterior  $120^\circ$  fundoplication was then fashioned. A continuous 2–0 Novofil suture (Covidien) was used between the medial fundal remnant and the distal oesophagus, recreating the angle of His and incorporating the left crus as an oesophagopexy. The fundus was then folded over the distal oesophagus anteriorly and similarly sutured to the right oesophagus. A gastropexy suture was placed from the fundoplication to the anterior crus.

The sleeve staple line was then sutured to the detached omentum to stabilise the sleeve. The excised stomach was removed under vision via the right lateral port, sent for histopathology and the skin was closed. Patients remained inpatients for 2–3 days and their diet progressed in two weekly increments from fluids to pureed diet, then onto a solid diet. Follow-up was at 1, 3 and 6 months. Patients completed GERD-HRQL questionnaires [5], routine GES and gastroscopy surveillance.



**Fig. 2** The shape and size of the partial sleeve gastrectomy over the 56–60 F bougie

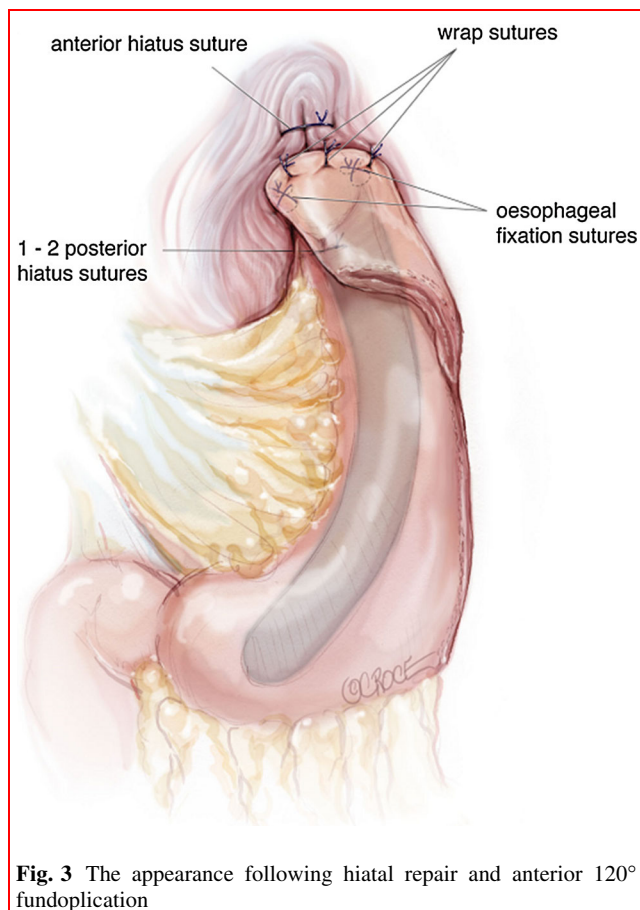
## Results and discussion

### Overall group

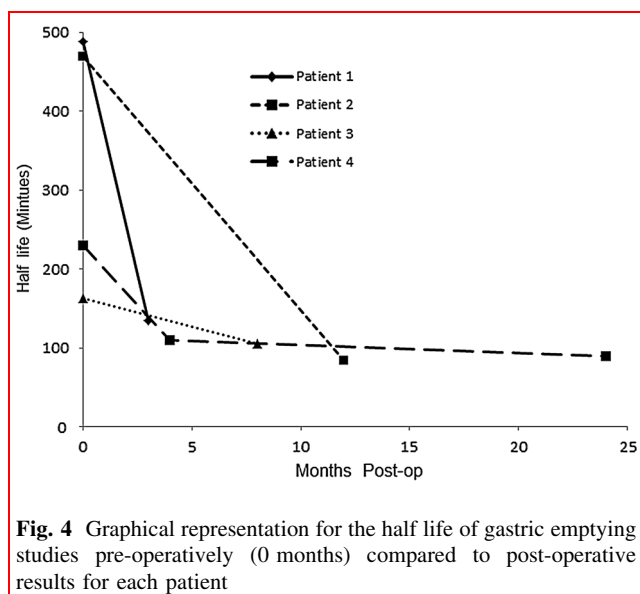
GET and GERD-HRQL improved in all four patients (Figs. 4, 5). Median GET fell from 350 min (163–488) pre-operatively to 108 min (84–135) at 10 months (3–24) post-operatively—median percentage improvement 67 % (36–82 %). Median GERD-HRQL (off medication) improved from 23 (3–25) pre-operatively to 4 (0–8) at 21 (6–30) months (Fig. 5)—median percentage improvement 85 % (62–100). Gas bloat improved in three patients (Fig. 6). Patient weight reduced by median 11 % (7–20) and BMI by three points to a median of 24 (Fig. 7). There was no significant morbidity and all remained off PPI.

### Case scenarios

Patient 1 was 63 and had been suffering from recurrent right upper quadrant pain and basic ultrasound, and CT abdomen investigations were normal. Gastroscopy revealed a moderate HH with ulcerative oesophagitis and Barrett's metaplasia on biopsy. A trial of PPI treatment was ineffective, as was cholecystectomy for HIDA scan diagnosed gall bladder dysfunction. GES were then undertaken revealing severe DGE at  $T_{1/2}$  488 min and 24 h pH showed marked GORD. Partial SG with HH repair led to maintained resolution of pain; however,



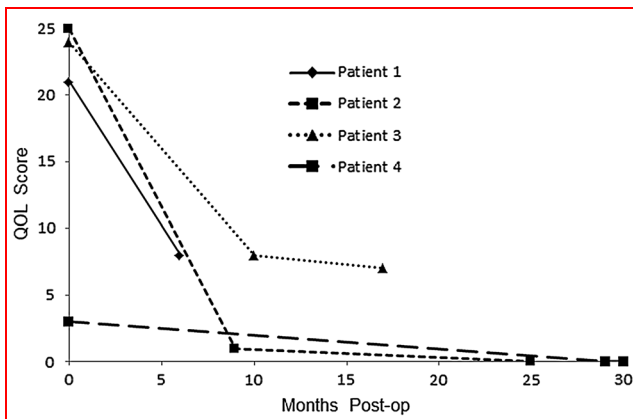
**Fig. 3** The appearance following hiatal repair and anterior 120° fundoplication



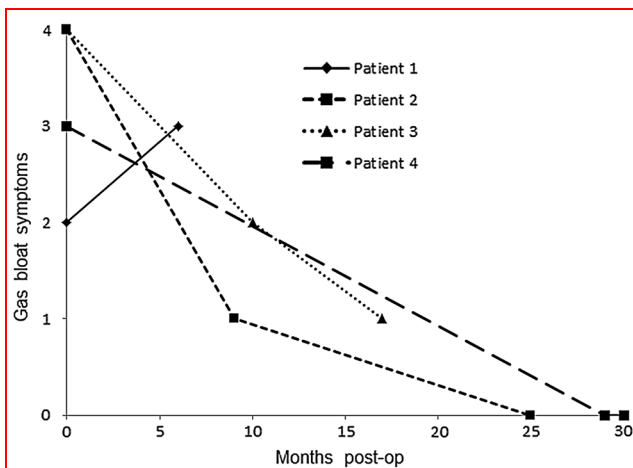
**Fig. 4** Graphical representation for the half life of gastric emptying studies pre-operatively (0 months) compared to post-operative results for each patient

interestingly her bloat score worsened by one point. There was significant reduction in GET to  $T_{1/2}$  135 min and resolution of oesophagitis and Barrett's metaplasia.

Patient 2 was 64 and was suffering from significant heartburn and volume reflux. She also described significant



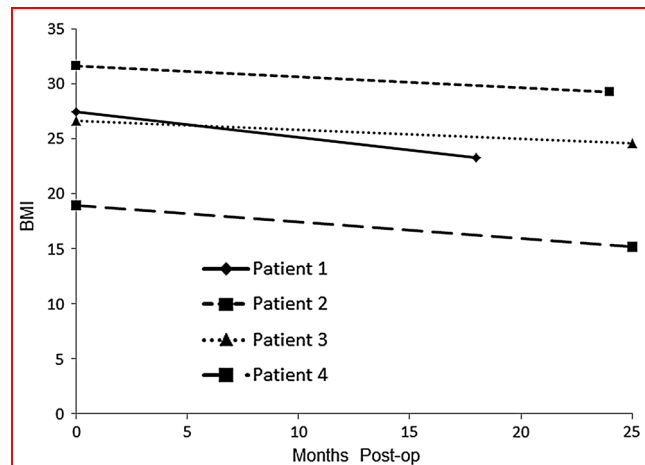
**Fig. 5** GERD-HRQL scores pre-operatively (0 months) compared to post-operative time for each patient (lower score is favourable)



**Fig. 6** Gas bloat score (as per GERD-HRQL) over time. Pre-operative score is just prior to surgery and represented by 0 months

post-prandial bloating and had a succussion splash. Gastroscopy and barium swallow revealed a 3-cm HH, oesophagitis and gastric food residue. GES identified severely prolonged GET at  $T_{1/2}$  469 min. Surgery also led to dramatic symptomatic improvement and reduced GET  $T_{1/2}$  to 84 min combined with resolution of oesophagitis on endoscopy.

Patient 3 was 55 and was suffering from belching, heartburn, volume reflux and also significant post-prandial bloating. Gastroscopy revealed 2-cm HH and mild oesophagitis, and GES showed continuous pharyngeal volume reflux. There was also prolonged but more modest DGE at  $T_{1/2}$  163 min. It was deemed that the stagnant gastric contents were leading to volume reflux and hence surgery addressing the DGE was essential. She achieved substantial reduction in all symptoms. There was a more modest  $T_{1/2}$  reduction to 105 min but reflux was eradicated on GES and gastroscopy.



**Fig. 7** Body mass index (BMI) pre-operatively compared to post-operative time for each patient

Patient 4 was 65 and had atypical unremitting epigastric pain associated with early satiety despite normal ultrasound and CT abdomen. Gastroscopy revealed 4-cm HH with mild oesophagitis and 1.8 cm proximal submucosal lesion. A trial of acid suppression was unhelpful and symptoms persisted. Her weight dropped from 50–45 kg and she began to describe early satiety. GES showed significant prolongation to  $T_{1/2}$  230 min and barium meal identified volume reflux. She initially experienced good resolution of bloating symptoms post-operatively but her abdominal pain recurred at 9 months despite normal GET on two studies and normal barium swallow/endoscopy. Her post-operative weight reduced to 36 kg and thence stabilised. It was unclear whether this was related to the surgery or from hospitalisation for subacute bowel obstructions (having had dense adhesions after previous open abdominal surgery).

## Conclusions

Patients suffering from GORD and significant DGE have varied symptom complex making diagnosis and management challenging. Partial SG with fundoplication substantially reduces GET, improves most DGE-related symptoms and also improves reflux and GERD-HRQL. We recommend careful pre-operative assessment and consent, caution its use in underweight patients and recommend careful auditing of outcomes and ongoing prospective research.

**Conflict of interest** The authors declare no conflict of interest.

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