Results of Collis gastroplasty and selective fundoplication, using a left thoracoabdominal approach, for failed antireflux surgery

J.-F. Legare, H.J. Henteleff, A.G. Casson*

Division of Thoracic Surgery, Dalhousie University, QEII Health Sciences Centre, Victoria Building 7S-013, 1275 Tower Road, Halifax, NS B3H 2Y9, Canada

Received 12 September 2001; received in revised form 6 December 2001; accepted 20 December 2001

Abstract

Objective: To study patterns of failure following primary antireflux surgery and to evaluate efficacy of reoperation using a left thoracoabdominal Collis gastroplasty and selective fundoplication. Methods: Thirty-one patients who underwent reoperative antireflux surgery between 1991 and 2000 were studied. Transabdominal fundoplication had been performed in 21 patients, and ten patients had a partial fundoplication by left thoracotomy, 1–33 years (mean, 15 years) previously. All patients presented with clinically disabling symptoms. Objective studies documented for all patients, a disrupted fundoplication, a short esophagus, and an associated hiatus hernia (Type I: 21 patients, 68%; Type III: ten patients, 32%), esophagitis (nine patients, 29%), and Barrett’s mucosa (five patients, 16%). Abnormal esophageal motility was found in nine of 26 (36%) patients studied. All patients were reoperated using a left thoracoabdominal approach, with epidural analgesia. A Collis gastroplasty was used to lengthen the esophagus, incorporating a complete (24 patients, 77%) or partial (seven patients, 23%) fundoplication based of preoperative esophageal function studies. Results: There was no perioperative mortality. Median length of hospitalization was 8 days, and was uncomplicated for 18 (58%) patients. Postoperative morbidity was considered minimal, and comprised left lower lobe infiltrates (six patients, 19%), atrial fibrillation (three patients, 10%), urinary tract infection (one patient, 3%), superficial wound infection (one patient, 3%), aspiration (one patient, 3%), and nausea (one patient, 3%). Median follow-up was 42 months (6–105 months), and was complete for 29 patients. Six patients (21%) had moderate–severe post-thoracotomy pain, for up to 18 months post-operatively, and five patients (17%) required esophageal dilation, ranging from two to six dilations within the first 6 months after surgery. Overall, 93% (27/29) of patients were satisfied with the results of surgery, in terms of quality of swallowing and control of preoperative symptoms. Conclusions: In this series, failure of primary antireflux surgery was related to short esophagus. Intermediate-term subjective results of reoperative antireflux surgery were good for selected patients who undergo esophageal lengthening and fundoplication. The left thoracoabdominal approach was safe, generally well tolerated, and provided excellent exposure of the esophagogastric junction for complex reoperative antireflux surgery. © 2002 Elsevier Science B.V. All rights reserved.

Keywords: Reoperative antireflux surgery; Collis gastroplasty

1. Introduction

With careful patient selection, the long-term results of primary antireflux surgery are generally good [1]. However, it is estimated that 5–20% of patients will experience recurrent reflux symptoms, or additional new symptoms attributable to surgical intervention [2]. The precise reasons for failure of primary antireflux surgery are not known with certainty. Subsequent management, particularly selection of patients for reoperative antireflux surgery, is also controversial. Outcomes following reoperation are generally reported to be less satisfactory than after primary antireflux surgery, with success rates ranging from 40 to 90% [3–8].

This study examined patterns of failure following primary antireflux surgery in a consecutive series of patients referred for reoperation after long-term medical therapy. Anticipating significant adhesions, complex hiatal and esophagogastric anatomy, the primary purpose of this study was to critically evaluate the results of reoperation using a left thoracoabdominal approach. As all patients in this series were found to have a short esophagus, the subjective results of Collis gastroplasty and selective fundoplication were assessed as a secondary objective.
2. Materials and methods

2.1. Patients

Between January 1991 and December 2000, 31 patients underwent reoperative antireflux surgery for recurrent gastroesophageal reflux disease and associated complications. There were 19 female (12 male) patients in this consecutive single-surgeon series, and the mean age of all patients was 56 years (range, 19–81 years).

A single primary antireflux procedure had been performed at various centres (multiple surgeons) from 1 to 33 years (mean, 15 years) previously. Usually described as a ‘hiatus hernia repair’, review of the operative notes determined that these initial procedures were variations of a transabdominal (Nissen-type) fundoplication (21 patients), or a partial (Belsey-type) fundoplication performed by left thoracotomy (ten patients). No patient in this series had undergone laparoscopic antireflux surgery.

All patients had clinically disabling symptoms, comprising heartburn (28 patients, 90%), regurgitation (17 patients, 55%), dysphagia (16 patients, 52%), epigastric pain distinct from heartburn (nine patients, 29%), and pulmonary symptoms secondary to aspiration (six patients, 19%). Two patients (7%) presented with profound anemia, each having a hemoglobin of 4 g/l (normal range 140–180 g/l). The mean duration of symptoms prior to surgical referral was 60 months (range, 12–120 months), and despite maximal medical therapy, all patients indicated that their symptoms were worsening.

Objective studies included esophagogastroduodenoscopy (EGD) (all patients), barium swallow (30 patients, 97%), esophageal motility studies (26 patients, 85%) and ambulatory 24-h pH studies (17 patients, 55%). EGD (with selective biopsy) was performed preoperatively by the operating surgeon under local anesthesia using flexible fiberoptic instrumentation. The anatomic esophagogastric junction (where the tubular esophagus dilates into stomach) was measured in all patients and recorded as centimetres (cm) from the incisors. Barium contrast studies were used to define foregut anatomy. One patient who required urgent surgery for suspected ischaemia secondary to organoaxial volvulus did not have a preoperative barium swallow. Hiatus hernia was classified as: Type I (sliding, associated with an intrathoracic EGJ); II (paraesophageal, with an intraabdominal EGJ); III (mixed sliding and paraesophageal, associated with an intrathoracic EGJ); and IV (herniation of other intraabdominal contents). A short esophagus was therefore defined when the EGJ was found to be intrathoracic and irreducible, based on both endoscopic measurement and correlative barium swallow. Esophagitis was classified as: Grade I (mucosal erythema); II (erythema with superficial linear ulceration); III (deep, confluent or circumferential ulceration); and IV (stricture). A columnar epithelium-lined (Barrett’s) esophagus was diagnosed endoscopically when the squamocolumnar junction extended greater than 3 cm proximal to the anatomic EGJ, or histologically by the presence of specialized intestinal epithelium (goblet cells) at any level.

Esophageal motility studies were used to evaluate peristalsis in the body of the esophagus (for planning fundoplication), to exclude associated primary esophageal motor disorders, and to define the lower esophageal sphincter (LES). These studies were not technically complete for two patients (the catheter could not be advanced beyond the intrathoracic stomach); two patients refused this investigation; and were not attempted for one patient who required urgent surgery.

Ambulatory 24-h pH studies were used to quantitate acid reflux, and were complete for only 17 (55%) patients. Of the 14 remaining patients, seven patients refused to have pH studies (inability to tolerate the naso-esophageal probe), the probe could not be positioned satisfactorily in six patients (inability to define the upper border of the LES using manometry), and one patient required urgent surgery. Patients were selected for reoperation based on severity of symptoms, and objective studies as summarized above. Full informed consent was obtained. From January 1991, representing the first appointment of the senior author, the reoperative strategy has remained consistent for patients shown to have a short esophagus: (1) use of a left thoracoabdominal incision to obtain accurate anatomic exposure; (2) esophageal lengthening (Collis gastroplasty) to restore an intraabdominal EGJ; (3) selective fundoplication based on preoperative esophageal function studies; (4) reapproximation of the crura; and (5) postoperative epidural analgesia.

2.2. Operative technique

A thoracic epidural catheter was placed by the anesthetist. After induction of general anesthesia, the left lung was excluded by placement of a double-lumen endotracheal tube. Patients were positioned semi-lateral for a left thoracoabdominal incision, which extended antero-medially from a point 2 cm below the tip of the scapula, across the costal margin to the midline, to a point corresponding to the upper one-third between the xiphoid and umbilicus. The diaphragm was incised circumferentially preserving the left phrenic nerve, leaving at least a 2 cm margin adjacent to the chest wall for reconstruction. After division of the inferior pulmonary ligament, the thoracic esophagus was encircled above the level of the inferior pulmonary vein, taking care to identify and preserve the vagi. By simultaneous dissection in the upper abdomen and left chest, all adhesions were divided, any hernia sac excised, the diaphragmatic crura and hiatus clearly defined, and the previous fundoplication taken down to accurately identify the anatomic EGJ. In this series, all patients were confirmed to have a short esophagus at surgery, and therefore a Collis gastroplasty was created. A Maloney bougie, tailored to the esophageal diameter (usually 48–58 French), was placed by
the anesthetist, and guided by the surgeon across the EGJ. While held firmly against the lesser curvature of the stomach, a cut gastroplasty was created by application of a mechanical stapling instrument (linear cutter, GIA). The staple line was oversewn with a running 3-0 continuous non-absorbable silk suture. The overall length of gastroplasty was variable, but a minimum length of 5 cm was usually required to position the neoesophagus in a tension-free, intraabdominal location.

For seven patients with non-propagated or significantly reduced esophageal peristalsis, a partial (270° Belsey-type) fundoplication was created with two to three tiers of interrupted 3-0 silk plicating sutures. For all remaining patients (including the five patients who did not have preoperative motility studies, and who did not have dysphagia clinically), a complete (360° Nissen-type) fundoplication was created. The fundoplication was 2 cm in length, incorporated both vagi, and was considered tension-free or ‘floppy’. With the bougie still in place, the cura were reapproximated posteriorly with interrupted non-absorbable No. 2 silk sutures. Pleural drainage tubes were positioned above the reapproximated left hemidiaphragm, adjacent to, but not touching, the upper margin of the gastroplasty.

The only modification to this procedure was reconstruction of the costal margin. Up to 1995, primary approximation of the costal margin was attempted, but subsequently, a 2 cm portion of costal cartilage was resected, and only the underlying musculature was closed.

Postoperative management comprised continuous nasogastric drainage to decompress the stomach, EKG monitoring for a minimum of 24 h, early ambulation and chest physiotherapy. A water soluble contrast study was performed routinely on the fifth to seventh postoperative day, and if no leakage from the gastroplasty was seen, the study was repeated using dilute barium. After removal of the nasogastric tube, patients were progressed from water to semi-solids over 2–3 days. If patients reported satisfactory swallowing with a soft diet at the first (3 week) follow-up visit, a regular diet was instituted.

2.3. Follow-up

Demographic data, including clinical presentation, results of objective studies, operative findings, surgical procedures, and postoperative complications, were collected prospectively. Follow-up was obtained by personal patient interview, phone interview or by contact with the primary care physician. A structured questionnaire was used to evaluate dysphagia (none, solids, semisolids, liquids), severity of reflux (episodes of heartburn, regurgitation, and medication use), weight, and duration and intensity of post-thoracotomy pain (mild if requiring occasional non-narcotic analgesia, moderate if requiring regular analgesia, and severe if requiring narcotics or intercostal nerve blocks). Global patient satisfaction with the outcome of surgery was assessed by a simple four-point subjective scale: very satisfied, generally satisfied, disappointed, and ‘would not have had surgery’.

With the exception of surveillance for Barrett’s metaplasia (five patients), postoperative objective studies were not performed routinely. Selective investigations (EGD, 14 patients; barium swallow, five patients; motility studies, one patient) were performed to investigate symptoms if clinically indicated.

3. Results

Preoperative objective studies documented for all patients, a short esophagus with an irreducible intrathoracic EGI, and an associated hiatus hernia (Type I, 21 patients; Type III, ten patients). Representative barium contrast studies illustrating Type I and III hiatus hernia are shown in Fig. 1. Median endoscopic measurements (from the incisors) for the anatomic EGI were 38 cm (range, 30–40 cm) for patients with Type I hiatus hernia, and 35 cm (range, 30–38 cm) for patients with Type III hiatus hernia. Nine (29%) patients had endoscopic evidence of esophagitis (Grade I, four patients; Grade II, three patients; Grade IV, two patients). Barrett’s metaplasia was documented histologically in five (16%) patients (long-segment, two patients; short-segment, three patients), and are subject to ongoing surveillance. Esophageal body peristalsis was abnormal in nine of 26 (36%) patients studied by manometry. Non-peristaltic or reduced amplitude of peristaltic waves was recorded in seven patients; minimal non-specific alterations (judged secondary to reflux) were found in two patients. The LES was generally hypotensive (median pressure 8 mmHg; range 4–15 mmHg). Objective evidence of abnormal acid reflux was documented in 15 of 17 (88%) patients studied. However, both patients with normal acid profiles had severe clinical symptoms and esophagitis, despite maximal medical therapy.

Intraoperative findings confirmed the presence of a short esophagus in all patients. Despite frequent periesophageal inflammatory adhesions, the EGJ was accurately defined operatively, and could not be reduced below the diaphragm after mobilization of the foregut. All patients had a disrupted hiatus generally associated with attenuated crural musculature. Dense adhesions, with variable suture material or surgical clips (Fig. 1) placed at the time of the initial procedure, were inevitably present throughout the upper abdomen and within the hernia sac. In ten patients demonstrated to have a mixed (Type III) hiatus hernia, the previous fundoplication had disrupted completely, and the stomach had herniated into the lower mediastinum. Dense adhesions within the hernia sac prevented reduction, and resulted in some degree of gastric volvulus. All patients with a Type I (sliding) hernia were demonstrated to have a short esophagus, extensive upper abdominal and mediastinal adhesions, and a deficient hiatus. However, the degree of disruption of the fundoplication was quite variable. Only one patient had a ‘slipped Nissen’.
There was no perioperative mortality. The median length of hospitalization was 8 days (range, 6–17 days), and was uncomplicated for 18 (58%) patients. Postoperative morbidity was minimal, and comprised left lower lobe infiltrates (six patients, 16%) diagnosed by chest radiography and treated by physiotherapy and antibiotics; atrial fibrillation (three patients, 10%) detected by routine EKG monitoring and treated by antiarrhythmic medication; urinary tract infection (one patient, 3%) treated by removal of the urinary catheter and antibiotics; a superficial wound infection (one patient, 3%) treated by opening a portion of the incision, saline dressings and oral antibiotics; aspiration (one patient, 3%) treated by chest physiotherapy; nausea and vomiting (one patient, 3%) which was thought to be medication-induced.

Two patients were lost to follow-up, which was otherwise complete for 29 patients to June 2001 (median 42 months; range, 6–105 months postoperatively). Overall, the majority of evaluable patients (27/29; 93%) were satisfied with the results of the surgery, Fig. 2. One patient was disappointed with the surgical outcome in terms of reflux symptoms, and one patient ‘would not have had surgery’ because of postoperative pain.

Twenty-four (83%) patients reported unrestricted swallowing. Five patients described sticking of food within the 1st month postoperatively. These included two patients with minimal non-specific esophageal motility disorders (thought to be secondary to reflux), who underwent a complete fundoplication, and two patients who did not undergo manometry preoperatively, but who reported no dysphagia. No anatomic obstruction was demonstrated in these four patients by barium swallow and EGD. Careful dilation under local anesthesia using Maloney bougies to a maximum 48 French resulted in improved swallowing. Further dilation was performed (two times, two patients; three times, one patient; six times, one patient) during the first 6 months postoperatively. One additional patient, with normal preoperative motility, presented 3 weeks postoperatively with complete dysphagia, and was found to have a hard food bolus impacted above the fundoplication, which was removed endoscopically under general anesthesia. As the fundoplication appeared ‘tight’, esophageal dilation (54 French) was performed on this one occasion only. At last follow-up, all patients reported normal swallowing.

Antacids (including proton pump blockers) were taken intermittently by all patients for the first 6 months postoperatively. At last follow-up, 20 (69%) patients had no reflux symptoms and were taking no antacids. However, nine (31%) patients still experienced occasional heartburn (reported to be significantly less than before surgery) which

Fig. 1. Representative barium swallows in patients presenting with recurrent symptoms after antireflux surgery or hiatus hernia repair. These studies require interpretation with other preoperative objective studies, particularly esophagogastroscopy, to evaluate the esophagogastric junction and associated short esophagus. (A) A Type III mixed sliding and paraesophageal hiatus hernia, associated with a non-reducible intrathoracic esophagogastric junction. (B) A Type I sliding hiatus hernia, associated with a short esophagus. Note the large number of surgical clips used at the initial operation.

Fig. 2. Table summarizing global patient satisfaction after reoperative antireflux surgery.
was controlled by simple antacids or by low-dose H2 blockers. Of the 19 patients who underwent EGD postoperatively, no patient was found to have esophagitis or a disrupted fundoplication.

Post-thoracotomy pain was prevalent for 3–6 months postoperative, but was judged to be moderate to severe in only six patients. Although post-thoracotomy pain had resolved for all patients up to 18 months, one patient who required repeated intercostal nerve block (local anaesthetic), indicated he ‘would not have had surgery’, despite satisfactory swallowing and improvement of reflux symptoms. Two (7%) patients reported the symptom of movement at the costal margin. A malunion was found in one patient whose costal margin was reapproximated initially by primary suture, and regrowth of cartilage was found in the other patient whose costal margin was initially excised. Both were treated by wide local excision of costal cartilage.

4. Discussion

Failure of antireflux surgery represents a complex clinical problem, as symptoms may arise from anatomic and physiologic abnormalities. Technical factors and inappropriate patient selection are considered the most common reasons for failure of primary antireflux surgery. [2] As the primary antireflux procedures were performed several (mean 15) years earlier by various surgeons in other centres, the initial indications for surgery, and individual surgical expertise were impossible to evaluate. In this series, the most consistent objective anatomic finding was a short esophagus with an irreducible, intrathoracic EGD. The importance of esophageal length to the long-term success of primary and reoperative antireflux surgery has long been recognized [5,6,8–13], and we considered the finding of a short esophagus to be the primary cause of failure. However, it is impossible to say whether the short esophagus was unrecognized at the time of the initial antireflux procedure, or whether this evolved postoperatively as a secondary event.

Associated anatomic findings in all patients were hiatus hernia, and a disrupted fundoplication. The latter is thought to account for recurrent reflux symptoms, and wrap disruption is reported to generally occur within the first postoperative year [7]. Although all our patients reported reflux-related symptoms, these did not generally occur within the 1st year postoperatively, suggesting a more complex etiology. The consistent finding of extensive adhesions, and in ten patients a mixed (Type III) hiatus hernia, would likely provide an anatomic basis for symptoms of epigastric pain and dysphagia.

Objective studies were essential to evaluate all patients preoperatively. We found EGD to be the most useful investigation to diagnose a short esophagus [12], based on preoperative measurements and with a correlative barium swallow. In contrast to recent reports, we did not find esophageal manometry useful in the diagnosis of a short esophagus [9,10]. Barium contrast studies were considered complimentary to EGD, especially to establish the diagnosis of a hiatus hernia, a disrupted fundoplication [7], and in planning the operative approach. In keeping with other studies, we found a high percentage of patients to have functional disorders of the foregut. Although technical factors and patient refusal limited routine use of ambulatory 24 h pH studies, 88% of patients evaluated had objective evidence of pathologic acid reflux. Motility studies similarly demonstrated motor disorders in the esophageal body of 36% of patients evaluated, and were used in planning the fundoplication.

The conventional approach favored by thoracic surgeons for reoperative antireflux surgery has generally been the left thoracotomy [3,4,6,8]. Extension of the incision into the abdomen is considered by many to be unnecessary, but if required, division of the diaphragm peripherally is recommended [6]. The left thoracoabdominal approach, or thoracolaparotomy, has traditionally been considered to be a painful incision, despite excellent exposure of the upper abdomen and chest [14,15]. This approach has been reported infrequently for reoperative antireflux surgery. In 1981, Henderson reported his personal experience with thoracoabdominal total fundoplication gastroplasty in 121 patients with recurrent hiatus hernia and gastroesophageal reflux, achieving excellent results in over 90% of patients [5]. Despite these impressive results in terms of swallowing and control of reflux, postthoracotomy pain, in the era before widespread use of epidural analgesia, was not discussed. In a 35 year review (1960–1995) of 185 patients who underwent reoperative antireflux surgery at the Mayo Clinic (multiple surgeons), only 25 patients were reoperated using a left thoracoabdominal incision [8]. The primary indication for this approach was to improve exposure for more extensive antireflux procedures, such as antrectomy or esophageal resection.

We report a consecutive series of 31 patients who underwent reoperative antireflux surgery using a left thoracoabdominal approach. This incision was primarily utilized to provide excellent anatomic exposure of the esophagus, stomach, vagi, and associated structures in what we considered to be technically challenging reoperative surgery. With epidural analgesia, this incision was well tolerated and facilitated early mobilization. Median length of hospital stay (8 days), and postoperative morbidity was minimal. Although postthoracotomy pain was prevalent after discharge, symptoms were comparable to patients undergoing thoracotomy alone, and in all patients, resolution by 18 months was usual. However, one patient who required intercostal nerve blocks indicated initially that he ‘would not have had surgery’, despite improved reflux symptoms and satisfactory swallowing.

The antireflux procedure consistently used comprised a cut Collis gastroplasty to lengthen the esophagus, and a selective fundoplication based on preoperative manometry. Although not the primary purpose of this study, we evaluated intermediate-term results of reoperative antireflux...
surgery (median 42 months follow-up) for 29 patients as a secondary objective. Subjectively, the majority of patients were satisfied with the results of reoperation. It is well recognized that subjective results do not necessarily correlate with objective findings, and clearly one limitation of this study was that only 19 of 29 evaluable patients had postoperative objective investigations, which were not performed routinely. In this series, nine (31%) patients required long-term antacid therapy for occasional heartburn, but this was easily controlled with simple antacids and low-dose H2 blockers. No patient had evidence of ongoing esophagitis, and the fundoplication was judged to be intact. Although the results of re-operation are generally reported to be less satisfactory, very few surgical studies have reported antacid use as an end point [16].

The most disturbing postoperative symptom was dysphagia, which was reported by five patients within the first postoperative month. One patient, who presented with an impacted food bolus above the fundoplication, improved following one esophageal dilation, suggesting that early postoperative edema was the etiology of the esophageal obstruction. It is likely that esophageal motor dysfunction was the primary etiology of dysphagia in the remaining four patients, as no anatomic obstruction was demonstrated objectively. As Nissen-type fundoplications were performed on two patients with minimal non-specific motility alterations (judged secondary to reflux), and on two additional patients who did not have preoperative esophageal manometry, it is likely that the complete fundoplication resulted in a functional obstruction at the neoesophagus. Dysphagia improved with further dilation (two to six times), and had resolved completely by 6 months postoperatively.

In addition to fundoplication, several alternative approaches (i.e. vagotomy and antrectomy, duodenal diversion procedures) have been reported to be useful for re-operative antireflux surgery in selected patients [8]. However, recent studies have reported the feasibility of laparoscopic approaches for reoperative antireflux surgery [17–20]. Minimally invasive approaches currently appear well suited to repair a disrupted fundoplication in patients with an adequate length of intraabdominal esophagus, to reduce a paraesophageal herniation and reapproximate the crura. Although it is anticipated that further technical advances will expand the role of laparoscopy or thoracoscopic in reoperative antireflux surgery, it is also likely that selected patients will still require ‘open’ surgery, particularly in the setting of failed anti-reflux procedures secondary to short esophagus. We report the thoracoabdominal approach, with epideral analgesia, to be safe, well tolerated, and to provide excellent exposure of the esophagogastric junction for complex reoperative antireflux surgery.

Acknowledgements

We wish to thank Dr F. Griff Pearson (Professor Emeritus, University of Toronto) for his review of these data and thoughtful comments and suggestions.

References

Appendix A. Conference discussion

Mr J. Thorpe (Leeds, UK): It is a very good paper and thank you for reconfirming the role of the Pearson and the Henderson operation in this difficult area. I find in my practice that the incidence of this complication is getting less and less and we don’t often have to do this operation now. But in your experience with this group of patients, how many had an inappropriate operation the first time around? Did they have a shortened esophagus and should they have had a gastroplasty at the first operation, not at the second operation?

Dr Legare: It is difficult a little bit to tell from this group because the majority of the patients were 10–12 years after the original operation, and most of the data we had from the original operation, because they came from other centers, were essentially the operative report and some comments from the surgeon. It was therefore difficult to trace whether truly they had a short esophagus. But you are correct this is an important point.

Dr A. Lerut (Leuven, Belgium): Thank you very much for taking up such a difficult subject. Certainly today with the vast majority of the patients having operations performed laparoscopically, it is getting increasingly difficult in redo surgery to convince patients to have a thoracic approach, and you rightly pointed out the problem of post-thoracotomy pain. You showed your two most representative examples of a hiatal hernia, but it is not always that easy to diagnose a hiatal hernia, but it is not always that easy to diagnose of a hiatal hernia and/or esophageal shortening. So what is the definition of hiatal hernia and in how far can you preoperatively judge that you have to go from the thoracic side or perhaps can go from an abdominal side? That is the first question.

Secondly, I think in your follow-up you showed a number of patients that were on PPI, and I haven’t seen any 24-h pH study in the follow-up.

Finally, there were a number of patients that had Barrett’s metaplasia, and doing a lengthening plasty in that subset of patients I think is putting the patients at risk for further development of dysplasia and recurrent reflux. So have you seen any dysplasias and how did you perform your follow-up afterwards?

Dr Legare: To answer your first question, basically the definition for a short esophagus we used two diagnostic tests. Firstly esophagoscopy measurements were taken from the incisors down to the level of the diaphragm and the esophagogastric junction, and this, obviously, in an awake patient. Whether it was reducible or not, it was always unreducible, and assessed in the patient if you asked them to talk and you could see where the diaphragm marking were. Secondly this was always documented at barium swallow; as you saw, 30 out of 31 patients had barium swallow. And thirdly, at intraoperative findings, all patients were found after dissection of the anatomy to have an unreducible hiatal hernia. But, you are right, it is sometimes difficult to judge preoperatively. But those were the two studies that we used preoperatively.

In terms of your second question, very few patients have follow-up studies in terms of pH studies, and you are right, we tend to follow clinically if patients have problems. In patients who have Barrett’s findings, there were no metaplastic changes, however, they were followed yearly and they continue to be followed yearly from that point of view.

Regarding the Collis gastroplasty, as you know, it is, again, a debatable issue, but they continue to be followed in that setting, and we haven’t had any need for resection or increased metaplasia from that point of view.

In terms of a pH study or follow-up studies, 19 out of the total patients had a follow-up esophagoscopy and all have shown an intra-abdominal segment of stomach. All patients also prior to starting eating, had a Gastrografin followed by barium swallow postoperatively, which showed again a lengthening procedure and intra-abdominal stomach segments.