



Surgical Technique

GASTRODIAPHRAGMATIC PLICATION, A MODIFICATION OF BELSEY MARK IV REPAIR FOR TREATMENT OF HIATAL HERNIA

By

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Aim: *Gastrodiaphragmatic plication, (G.D.P.) around the lower oesophageal segment (L.O.S.) has been designed on mechanical and functional basis. It is evaluated, with advantage, as a major modification of Belsey Mark IV repair for the treatment of hiatal hernia. It provides a wider area of fixation of the stomach under the diaphragm and good support of the (L.O.S.).*

Methods: *Thirty five patients with hiatal hernia were operated upon during the period 1993-2001 with a median follow up of 5 years through left 7th rib thoracotomy. The lower 1/3 of oesophagus is mobilized in the mediastinum and elongated to the high pressure zone (H.P.Z) in the abdomen. Two levels of gastric fundic wraps of 270° around the L.O.S. The stitches are passed transversely sideways through the muscle wall to widen the area of fixation of stomach under the diaphragm. G.D.P. is accomplished by tying the adjacent sutures together on the diaphragm.*

Results: *There is clinical cure to all patients with no refluxes and no recurrences. The LOP ascribes an average increase of 20 mm Hg.*

Conclusions: *The G.D.P. over 270° of the oesophageal circumference increases LOS pressure as a competent antireflux technique. The free 90° acts as a safety segment for the passage of food without dysphagia. Vomiting and belching are quite possible. Widening of subdiaphragmatic gastric fixation prevents recurrence.*

Keywords: *Gastrodiaphragmatic plication, Anti-reflux, Hiatal hernia.*

INTRODUCTION

In the early 1950s Belsey developed the first successful operation to prevent reflux. The introduction of his Mark IV repair in 1955 represented an effective anti-reflux procedure.⁽²⁾

Working with Mr. Ronald Belsey intermittently (1977-1985) during his visits to Maady Military Hospital in Cairo and Chicago Pritzker School of Medicine in Illinois USA, gave me a good perspective of his technique.

The G.D.P. is designed to make up for the mechanical defects of the second row of sutures i.e. radial pull out on

the L.O.S. and the blind fixation of the stomach to the diaphragm. In addition, it provides wider area of fixation of stomach to the diaphragm.

A technique for treatment of hiatal hernia has been designed with success.

PATIENTS AND METHODS

The study was conducted mainly at Kobri El-Kobba Military and As-Salam International Hospitals in Cairo with a median follow up of 5 years. The manometry and pH monitoring were assessed in collaboration with the head of the Medical Department one week before and 2

months after the operation and followed up yearly from 2-5 years.

Thirty five patients underwent the gastroduaphragmatic plication (G.D.P.) operation for the treatment of hiatal hernia during the period 1993-2001. There were 28 men and 7 women with a mean age of 35.4 ± 7.05 (S.E.M.) years (range 26-52). All patients were diagnosed and pre-operatively assessed by clinical evaluation, Barium swallow, flexible upper gastro-intestinal (G.I.T.) endoscopy, oesophageal manometry and pH studies.

Barium study in erect, supine and Trendelenburg positions revealed sliding hernia of variable lengths (range 4.5 - 8 cm). Attention was paid to reflux, the quality of peristalsis and gastric emptying.

Upper gastro-intestinal endoscopy revealed lower oesophageal incompetence and variable degrees of oesophagitis in 28 patients. The length of the sliding hernia was recorded as the distance between the squamocolumnar junction (S.C.J.) and the diaphragm. Sliding hernia was diagnosed when this length was equal or more than 2cm. J-endoscopic manoever was performed pre and postoperatively. Swallowing of bolus of coloured jelly (red or white) and follow through was performed in the last 10 cases of the series to assess the site of its passage into the stomach.

All operations are carried out through the bed of the 7th rib thoracotomy.

The mainstay of intrathoracic dissection is mobilization of the oesophagus and dissection at the oesophageal hiatus. The oesophagus is mobilized completely down to the diaphragm and up to the level of the aortic arch.

Repair and reduction of hiatal hernia is effected through 6 surgical steps:

1. Preparation for hiatal repair is effected by insersion of 3 size 2 silk sutures between the two crura of the diaphragm and left untied. This is facilitated by pulling on the central tendon of the diaphragm by Allis forceps which makes the crura tense and standing out.
2. The first row of embricating sutures is effected by 3/0 silk mattress stitches between the stomach and the oesophagus: each is taken with one cm horizontal bites and 2 cm vertical length over the gastro-oesophageal junction. The stitches are so placed to encircle $\frac{3}{4}$ of the oesophageal circumference leaving $\frac{1}{4}$ free adjacent to the vagus nerves. Care is taken to insert the stitches in the oesophagus obliquely so that they catch both circular and longitudinal muscle. The stitches are tied

starting with the middle first with reasonable tension, to maintain tissue apposition without tissue strangulation. If too tight the sutures will cut out.

3. The second row of embricating sutures is then inserted on the same principle between stomach and oesophagus 2 cm over the oesophago-gastric junction. The sutures are now tied on the stomach (New).
4. The next new step is to fashion a wide horizontal area of the stomach for fixation to the under surface of the diaphragm. This is effected by passing the needle through the gastric musculature sideways for 1 cm from the site of the knot. The other end of the thread is pulled by an aneurysm needle inserted through the musculature of the stomach (New).
5. Reduction of the gastro-oesophageal repaired segment under the diaphragm is achieved by passing the two limbs of each stitch radially 3 cm from the edge of the diaphragm. The distance between the limbs of the stitch is about 2.5 cm. One limb is passed by the needle and the other is picked up by an aneurysm needle from below upwards. Special cocktail spoon can be used to protect the abdominal viscera. The repaired segment is now displaced downwards into the peritoneal cavity manually and not by traction on the sutures. The sutures are then tied gently to maintain the reduction just achieved (New).
6. Horizontal plication of the gastro-diaphragmatic cuff is achieved by tying the adjacent limbs together, thus antagonizing the radial pull out on the lower oesophageal segment as with Belsey's operation (New).
7. Creation of a posterior buttress is achieved by tying the crural sutures from behind forwards. The operators' finger should pass easily through the hiatus. If it is tight the third suture is not tied (New).

Thus during inspiration the oesophagus is compressed on the posterior buttress by positive intra-abdominal pressure.

An intercostal catheter is inserted into the pleural cavity and connected to an underwater seal. The intercostal incision is closed by pericostal steel wire sutures encircling the sixth and seventh ribs.

POST-OPERATIVE CARE: The patient is allowed out of bed on the second post-operative day. The intercostal catheter is maintained for 48 hours until expansion of the lung is complete.

The Ryle tube is removed as soon as intestinal sounds return. A fluid diet is started on the first post-operative day followed by well minced food. The patient is rapidly restored to full normal diet. All patients have had uneventful recovery.

RESULTS

Thirty five patients were subject to post-operative clinical evaluation, radiological and endoscopic examination.

CLINICAL EVALUATION: There has been dramatic clinical response post-operatively as illustrated in Table 1.

Table 1. Prevalance of symptoms in 35 patients.

Symptoms	Pre-operative		Post-operative	
	No of patients	%	No of patients	%
Heartburn	32	91	0	0
Regurgitation	28	80	0	0
Dysphagia	16	46	1*	3

* Dysphagia disappeared after 2 months.
(Orientation: to face page 8).

BARIUM STUDY: This is performed after Barium or gastrograffin swallow. Pictures are taken pre-and post-operatively in the erect, supine and Trendelenburg positions. Sliding hernia with a mean length of 4.4 ± 2.8 cm is recorded in 35 patients.

Post-operatively, there has been complete reduction of the hiatal hernia. The lower oesophageal segment has been elongated and subdiaphragmatic in the high pressure zone.

UPPER GASTRO-INTESTINAL ENDOSCOPY: Preoperatively, there has been hiatal hernia and incompetence of L.O.S. with gastric mucosa above (Fig. 1). Post-operatively, there has been absence of hiatal hernia and competent lower oesophageal segment with no reflux. Plication is apparent at the lower oesophageal segment anteriorly and right postero-laterally (Fig. 2). The J-endoscopic manoeuvre certifies snug-fit lower oesophageal segment around the endoscope cable (Fig. 3). My plan of following the passage of the swallowed bolus of coloured jelly (red or white) in the last 10 cases of the series is very informative. It reveals the passage of the bolus postero-laterally and to the left i.e. site of 90° safety segment without plication (Fig. 4).

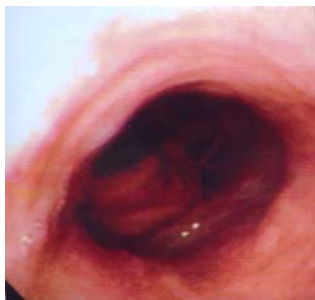


Fig 1. Upper G.I.T. Endoscopy. Pre op.: L.O.S. incompetence, gastric mucosa above diaphragm.



Fig 2. Post op.: L.O.S. competence with oes. Plication above.

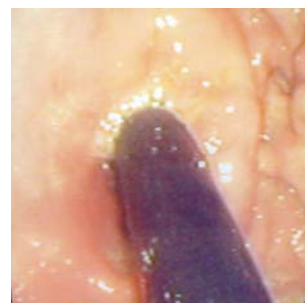


Fig 3. Post op.: L.O.S. Competence snug-fit around endoscope.

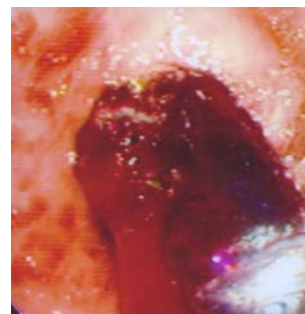


Fig 4. Post op.: L.O.S. Coloured jelly passage at the site free of fundoplication.

MANOMETRIC STUDY: Technique: Open tip, trilumen, continuously water perfused triple lumen catheter system and distal electromagnetic transducer system.

Three patients refused to continue the manometric study. However, there has been significant increase of the mean lower oesophageal sphincter pressure (L.O.S.) in all 32 patients compared with the baseline. The total length of L.O.S. shows an increase of 0.5 - 1 cm. The intra-abdominal oesophageal length shows an increase of 3.5 - 5 cm. There has been an increase of oesophageal body length of 5 cm due to straitening by mobilization. Table 2.

Table 2. Oesophageal Manometry results before and after surgery.

	Preoperative	Post operative
L.O.S (Pressure mm Hg) mean	9.5 (± 5)	25 ± 3.2
L.O.S (Total length cm) mean	3 (1.3 - 5.7)	4.5 (2.3 - 6.7)
L.O.S (Intra abdominal length cm)	0	3.5 - 5

(Orientation: to face page 8).

PH STUDY: Technique: A glass electrode is placed at 5 cm above the proximal limit of the lower oesophageal sphincter as detected by manometry. Reflux episodes are considered when pH drops below 4. Total monitoring period is 240 minutes. Resting pH is 7. No reflux episodes are noticed post operatively. This is available in only 22 patients.

DISCUSSION

There is a pressing need for a more effective procedure offering improved long-term results for the repair of hiatal hernia. The preference of one technique over another may largely depend on personal experience, mechanical strength and functional outcome. A good operation must fulfill:

- Complete and permanent relief of all symptoms of reflux.
- The ability to belch and vomit when necessary.
- Lowest rate of recurrence.

The pace of increase of our knowledge of the mechanical approach to hiatal hernia repair has led to the development of G.D.P. technique as an appropriate modification of Belsey Mark IV.

The merits of Belsey Mark IV over other described techniques are elongation of the mobilized oesophagus to the high pressure zone (H.P.Z.).⁽¹⁾

It has 2 levels of gastric fundic wraps of 270° around the distal oesophageal segment.⁽²⁾

Nevertheless, the G.D.P. is designed to make up for the mechanical defects of the second row of sutures i.e. the radial pull out on the distal oesophageal segment. It avoids, likewise, the blind fixation of the second fundic wrap to the diaphragm. In the G.D.P. technique the second fundic wrap is done, with advantage, in two steps. The stitches are tied directly on the stomach under vision, with appropriate tension. This avoids a possible mechanical defect of Belsey's operation since the sutures are tied blindly after reduction. If the sutures are tied tightly they may break due to strangulation of the oesophageal muscle.

This may end in migration of the oesophagus into the chest with consequent recurrence.⁽²⁾

The second modification of the G.D.P. is providing a wider area of fixation of the stomach to under diaphragm. This is effected by passing the needle sideways, through the stomach wall. The sutures are then passed through the diaphragm for reduction and secure fixation. The third modification is the stage of transverse plication which is effected by tying the adjacent limbs of the 3 sutures together

(Figs. 5,6). This evidently, avoids the radial pull out of the sutures on the lower oesophageal segment. The lower oesophageal pressure is consequently increased. The ingenious design of Mr. Ronald Belsey to spare one fourth of the oesophageal circumference provides spectacular functional outcome. This has been verified by the J-endoscopic manoeuvre. It revealed the passage of the bolus of coloured jelly postero-laterally and to the left i.e. at the site of 90° safety segment without plication.

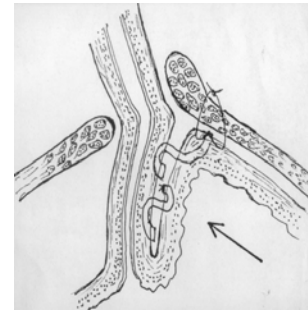


Fig 5. Design of G.D.P. the L.O.S., restored, is compressed by positive intra-abdominal pressure against posterior crural buttress.

Design of G.D.P. Pictorial stages

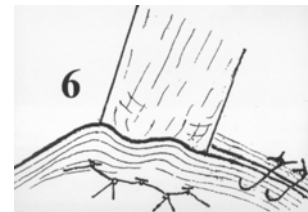


Fig 6. Tying the adjacent stitches G.D.P. (New). One hiatal stitch is removed.

In the laparoscopic era Toupet fundoplication has been designed on Belsey's principle i.e. 270° wrap with advantage⁽³⁾ over Nissen's 360° wrap. The latter is more frequently attended with wrap related complications such as bloating dysphagia and inability to belch or vomit.⁽⁴⁾ Specific post-fundoplication complaints remained a problem though it restores a competent barrier for all types of reflux.^(5,6) Laparoscopic fundoplication may have such

complications like perforated viscus, pneumothorax, transhiatal migration of the stomach into the chest due to wrap disruption.⁽⁷⁻⁹⁾ Laparoscopic mobilization of the oesophagus through the hiatus is effected by stripping towards the mediastinum.^(10,11) Nevertheless, trans thoracic mobilization is by far more anatomically effective up to the level of the inferior pulmonary vein.

In conclusion; just before the turn of the century, the advent of G.D.P. provides the first orderly and logical approach to the treatment of hiatal hernia. The results have been analysed in terms of cure of the reflux. There has been dramatic postoperative clinical response of complete relief of heart-burn, regurgitation and dysphagia. Patients can belch and vomit when necessary. Cure is certified by Barium study, upper G.I.T. endoscopy including the J-endoscopic manoeuvre. G.D.P. significantly increases L.O.S. pressure, total and intra-abdominal length of the oesophagus. Unlike, other described techniques, G.D.P. gives predictive value of non-recurrence. In this series there has been no recurrence among 35 patients followed from 2 to 8 years. In review of 272 patients operated upon in Belsey's clinic at Frenchay Hospital, Bristol, followed from 10 to 15 years; the recurrence rate was 15%.⁽²⁾

The G.D.P. technique has yielded eminently spectacular results in 35 patients with hiatal hernia. The number of cases is rather small. However, if extensively performed this technique is both mechanically competent and functionally adequate and is worthy of becoming popular in common surgical practice.

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REFERENCES

1. Arringer M, Skinner D, Belsey R. Long-term results of the Mark IV operation for hiatal hernia and analyses of recurrences and their treatment. *J. Thorac. Cardiovasc. Surg.* 1972;63:25.
2. Skinner DB, Belsey RHR. Surgical management of oesophageal reflux and hiatal hernia. *J. Thoracic Cardiovascular Surg.* 1967;53:33.

3. Zoring, C, Strate V, Fibbe C, Emmermann A, Layer, P. Nissen VS Toupet Laparoscopic fundoplication. *Surg. Endosc.* 2002;16:758-66.
4. Fernando HC, Luketich JD, Christie NA, Kramuddin SL, Schauer PR. Outcomes of Laparoscopic Toupet compared to laparoscopic Nissen fundoplication., *Surg. Endosc.* 2002;16:905-8.
5. L Lundell, P Miettinen, HE Myrvold, JG Hatlebakk, L Wallin, A Malm, et al. Seven-year follow-up of a randomized clinical trial comparing, proton-pump inhibition with surgical therapy for reflux oesophagitis. *Br. J. Surg.* 2007;94:198-203.
6. S Roman, G Poncet, I Serraj, F Zerbib, J Bovlez, F Mion. Characterization of reflux events after fundoplication using combined impedance - pH recording. *Br J. Surg.* 2007;94:48-52.
7. Eubanks TR, Omelanczuk P, Richards C, Pellegrini A, Washington S. Outcomes of Laparoscopic antireflux procedures. *Am. J. Surg*2000;169:391-395.
8. Watson DI, Jamieson GG. Antireflux Surgery in Laparoscopic era *J. Surg.* 2001;85:1173-84.
9. Bussell R, Finch R, Gotley D, Smithers BM, Nalhason LK, Menzies BR. Chronic Dysphagia Following Laparoscopic Fundoplication. *Br. J. Surg.* 2000;87:1341-5.
10. Nilsson G, Wenner J, Larsson S, Johnsson F. Randomised clinical trial of laparoscopic versus open fundoplication for gastro-oesophageal reflux *Br. J. Surg.* 2004;9:552-9.
11. Natsuya Katada, Shinichi, Sakuramoto, Nabryuki Kobayashi. Laparoscopic Heller myotomy with Toupet fundoplication for achalasia straightens the oesophagus and relieves dysphagia. *Am. J. of Surg.* 2006;192:1-8.