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Frenali Gheewala

Senior Resident, SMIMER, Surat,
Gujarat, India

Dinesh Prasad

Professor, SMIMER, Surat,
Gujarat, India

Jigar Ratnottar

Assistant Professor, Army College
of Medical Sciences, Delhi, India

Rishabh Patadiya

Third Year Resident, SMIMER,
Surat, Gujarat, India

Manometric evidence of reversal of ineffective esophageal motility in patients of GERD after laparoscopic partial Toupet's fundoplication

Frenali Gheewala, Dinesh Prasad, Jigar Ratnottar and Rishabh Patadiya

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Abstract

GERD is the most common benign condition of the esophagus, which is characterized by progressive worsening of symptoms until they are frequent, persistent, and troublesome. Treatment of GERD consists of medical and surgical interventions. Here we present a case study of a patient with GERD symptoms with absent contractility/ motility operated with laparoscopic 270-degree TOUPET'S Fundoplication who upon 2-year post-op follow up is found to have the return of near normal oesophageal motility.

Keywords: Esophageal motility, TOUPET'S, GERD, gastroesophageal reflux disease

Introduction

GERD is defined as the retrograde flow of gastric contents through LES into the esophagus / oral cavity. GERD occurs when intragastric pressure is greater than the high-pressure zone of the distal esophagus, which can be due to hypotensive LES and spontaneous LES relaxation. The distinction between physiologic reflux and pathologic reflux hinges on the total amount of oesophageal acid exposure, the patient's symptoms, and the presence of mucosal damage to the esophagus. GERD has a complex and multifactorial pathogenesis. Indeed, defective saliva production, oesophageal motor dysfunction, the presence of a hiatal hernia, the gastric acid pocket, gastric hypersecretory states as well as delayed gastric emptying can all contribute to gastroesophageal reflux occurrence [3]. The most common typical symptoms of GERD are Heartburn and Regurgitation.

24-hour ambulatory pH monitoring quantifies distal oesophageal acid exposure and is the gold standard test to diagnose GERD [1]. DeMeester score is calculated from the ambulatory PH monitoring and it is a composite of the Total number of reflux episodes (pH < 4.0), Longest episode of reflux, Number of episodes lasting longer than 5 minutes and Percentage of time spent in reflux in the upright and supine positions. Abnormal distal oesophageal acid exposure is defined by a DeMeester score of 14.7 or higher.

Following are the various parameters measured with 24-hour ambulatory pH monitoring

CDP (Contractile Deceleration Point) represents the inflection point in the contractile front propagation velocity in the distal esophagus.

DL (Distal Latency) represents the interval between UES relaxation and the CDP. It is considered an important metric indicating the integrity of the inhibitory pathway in the distal esophagus. A value of less than 4.5 seconds defines a premature contraction, indicative of spasm.

IRP (Integral Relaxation Pressure) is defined as the mean pressure for the 4 seconds of maximal deglutitive upper oesophageal sphincter (UES) relaxation and is the best metric to differentiate between normal and impaired EGJ relaxation. Normal IRP is less than 15 mmHg

DCI (Distal Contractile Integral) is measured as the "volume" of the oesophageal contraction spanning from the transition zone to the EGJ. The DCI is the product of the integral of the amplitude exceeding 20 mmHg, the duration, and the length of the contractile segment between the transition zone and the EGJ. Cut-off values defining different diagnostic categories depend on the type of HRM hardware and software used.

Corresponding Author:

Frenali Gheewala

Senior Resident, SMIMER, Surat,
Gujarat, India

DCI in normal subjects ranges between 450 and 8000 mmHg-s-cm. Hypercontractility is defined by a DCI greater than 8000 mmHg-s-cm. A DCI ranging between 100 and 450 mmHg-s-cm defines weak peristalsis, whereas a DCI lower than 100 mmHg-s-cm identifies failed peristalsis. Both failed and weak contractions are considered ineffective.

Many oesophageal motility disorders are associated with GERD, the most common of them associated with GERD is Ineffective Esophageal Motility (IEM). Diagnosis of IEM is made by Manometry. IEM is defined by greater than 50% of swallows being deemed ineffective (DCI < 450 mmHg.s.cm). The best treatment of IEM is prevention, which is associated with effective treatment of GERD.

The most common treatment for GERD is a step-up approach starting first lifestyle medications (i.e., weight loss; avoiding alcohol, spicy foods, and eating before lying down). This is followed by H₂ receptor antagonists or Proton pump inhibitors with symptomatic relief. Refractory to medical treatment and alternative to medical treatment consists of LARS and robotic-assisted fundoplication, TIF (Transoral Incision less Fundoplication), and MSAD (Magnetic Sphincter Augmentation Device).

Proton pump inhibitors (PPIs) are commonly used to treat patients with GERD. Patients who present with either medically refractory GERD, non-compliance, experiencing side effects with medical therapy, with underlying large Hiatal hernia, or individuals who desire to discontinue long-term medical treatment can be considered for surgical management. LARS (Laparoscopic Anti Reflux Surgery) can be used for long-term control of GERD.

Laparoscopic 360° NISSEN Fundoplication (LTF) is the gold standard surgical treatment for GERD. Partial fundoplication's (Dor's anterior and TOUPET'S posterior) guarantee similar outcomes in terms of symptom control with a lower risk of postoperative dysphagia [2]. A Nissen fundoplication is performed in all patients except those with severely ineffective motility or aperistaltic esophagus. In such patients, a Toupet fundoplication is performed. However, Dysphagia of any degree and chest pain while eating are more prevalent at 1 year in the Nissen group than in the patients who underwent TOUPET'S procedure [4, 5].

Neuropathology of ineffective esophageal motility

Ineffective esophageal motility (IEM) is characterized by both failed peristalsis and frequent swallows with breaks in the middle/distal peristaltic wave and it may result in symptoms reflecting poor esophageal emptying. As such, IEM may play a role in gastroesophageal reflux disease (GERD) and nonobstructive dysphagia [9]. The definition of IEM has evolved after the introduction of high-resolution manometry (HRM), esophageal pressure topography (EPT), and the Chicago Classification of esophageal motility, that - in its second version - defined IEM as weak peristalsis, small (2-5 cm) and large (over 5 cm) peristaltic defects, or frequent (>30%) failed peristalsis [10]. More recently however, the updated third version of the Chicago Classification eliminated small and large breaks from the list of criteria and defined ineffective swallows by a DCI < 450 mmHg.s.cm with ≥50% ineffective swallows constituting IEM, thus eliminating the distinction between failed swallows and weak swallows [11]. IEM, as well as fragmented peristalsis, is considered as minor disorders of peristalsis and their clinical significance remains debatable.

Regardless, the pathophysiology of IEM is unclear. The condition may result from an intermittent defect in triggering

distal esophageal peristalsis with or without weakness of the muscle contraction, possibly due to release of inflammatory mediators, such as interleukin-6 and platelet activating factor, that are known to reduce acetylcholine release from excitatory myenteric neurons [12]. Abnormalities in peristalsis may lead to abnormal esophageal clearance and dysphagia [9, 13]. Failed peristalsis and weak peristalsis with large defects are uniformly associated with incomplete bolus transit (IBT) (sensitivity 71%, specificity 100%). In contrast, weak peristalsis with small defects (in the range of 2-5 cm) is variably associated with IBT (16% of instances) (sensitivity 100%, specificity 84%).

Case

A 25-year-old Hindu married female, Housewife by occupation presented to SMIMER OPD with chief troublesome complaints of Burning in chest and throat region, Regurgitation of food, Sour taste in mouth, Nausea and Intermittent Vomiting, Chronic Cough, Difficulty in swallowing solid food and liquids since 3 years.

Vomiting was intermittent and non-projectile in nature with gastric contents and food particles. The patient had no complaint of abdominal pain or any other associated symptoms. The patient had complaints of Cough that lasted for more than 8 weeks.

The patient had no history of Smoking; Asthma; or any primary Laryngeal, Bronchial, or Pulmonary cause for extra-oesophageal symptoms of chronic cough. Currently not taking any Cough-inducing agents (like Angiotensin Converting Enzyme Inhibitors). No history of any menstrual abnormalities and no history of past or present immune-compromisation. The patient has no relevant family history.

She was treated medically with Proton Pump Inhibitors (PPI) initially with a conventional dose then followed by the high dose of PPI. Despite medical treatment, symptoms persisted and were debilitating to the patient, affecting her sleep, daily routine work, and lifestyle. She constantly drinks water to facilitate oesophageal clearance and sits in a leaning-forward position.

Investigations

The patient undergoes several tests which include Upper GI scopy, Oesophageal Manometry, and 24 24-hour ambulatory pH monitoring (after 1 week off PPI).

Upper GI scope findings were suggestive of Esophagitis, Antral gastritis, and large Hiatus Hernia. Los Angeles classification- B and Savary Millard classification showed grade 3 changes.

Oesophageal Manometry showed Absent Contractility of the esophagus with 100% ineffective contractions on a series of 10 swallows 5 ml each. Other findings included DCI of 7 mmHg-sec-cm, Distal latency of -3.7 seconds, and IRP of 7.4 mm Hg at LES with its intraabdominal length of just 1.6 cm.

24-hour ambulatory pH monitoring showed a DeMeester score of 60.20 which is positive for significant reflux disease. The patient is planned for Laparoscopic Anti-Reflux Surgery with a Posterior wrap of 270 degree TOUPET'S after all the careful consideration and pre-operative blood workup.

Operative Steps

The procedure is carried out using General anesthesia with the patient in the Low Lithotomy (or legs apart) with reverse Trendelenberg position. The surgeon stands in between the legs, the assistant holding the camera stands on the right of the patient; and the other assisting surgeon, on the left. All the ports are ergonomically positioned under vision to make sure that the distance between the hiatus and the working port is 10 to 15 cm.

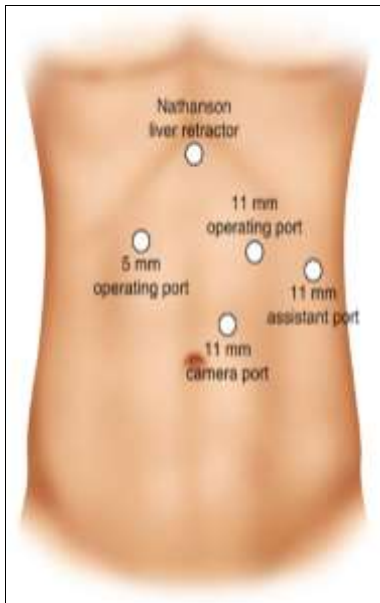


Fig 1: Port placements in Laparoscopic Fundoplication

The left lobe of the liver is retracted by Nathanson's retractor in such a way that the anterior hiatus is visible. Dissection started at the left crus by dividing the phreno-gastric membrane and then entering the lesser sac at the level of the inferior edge of the spleen. After the fundus is mobilized, the phrenoesophageal membrane is divided to expose the entire length of the left crus. Right crural dissection is then performed. A retro-esophageal window is created. Care is taken to preserve the anterior and posterior vagus nerves during this mobilization. An umbilical tape is passed posterior to the esophagus to help in retraction. Then circumferential dissection of the esophagus is completed avoiding injury to right and left pleura and anterior vagus to achieve a minimum 3 cm length of lower esophagus inside the abdomen (to minimize the likelihood of post-operative Hiatal hernia). Crurorrhaphy is done by Ethibond 1-0 interrupted suture without impinging the esophagus. In TOUPET'S Fundoplication fundus of the stomach is wrapped 270 degrees around the posterior aspect of the esophagus. With the use of 3 or 4 interrupted permanent sutures (Ethibond 3-0), the fundoplication

is created to a length of 2.5 to 3 cm. On both sides of the esophagus, the most cephalad sutures of the fundoplication incorporate the fundus, crus, and esophagus; the remaining sutures anchor the fundus to either the crura or the esophagus. Floppiness of the wrap is checked by passing the instrument between the esophagus and fundal wrap so that under surface of the diaphragm is visible (Shoeshine maneuver). At last, an upper GI scopy is done to check the floppiness of fundoplication, and an Omega sign is elicited which suggests ideal fundoplication.

The patient's immediate post-operative period was uneventful with no evidence of post-operative ileus, pneumothorax, dysphagia, or other minor complications. The patient experienced minor pain episodes which were effectively managed by adequate analgesia. She was discharged with proper counseling to chew the food well and eat small meals and was acknowledged about aerophagia and unable to belch. She was prescribed PPI and syrup Simethicone for 15 days. Full diet without limitations was allowed in about 4 to 6 weeks after the operation.

Standard post-operative advice was given to the patient. The patient was on tele follow-up.

The patient came to out-patient department for follow-up after 2 years with mild symptoms of reflux, not resembling the pre-operative status.

Thorough evaluation of patient was done. Following are the findings

- **Contrast Enhanced CT scan:** Suggestive of no significant abnormality in abdomen or pelvis. Narrowing is seen at coeliac axis origin, likely due to compression by median arcuate ligament. On further examination by coeliac artery doppler, the inspiration velocity of flow at coeliac artery is found to be normal, hence ruling out Median Arcuate Ligament Syndrome.
- **Esophageal Manometry:** Suggestive of near 100% return of esophageal motility with near normal manometric measurements
- **Upper GI scopy:** Showed no signs of esophagitis and normal position of fundoplication ligature. No other abnormality was detected.

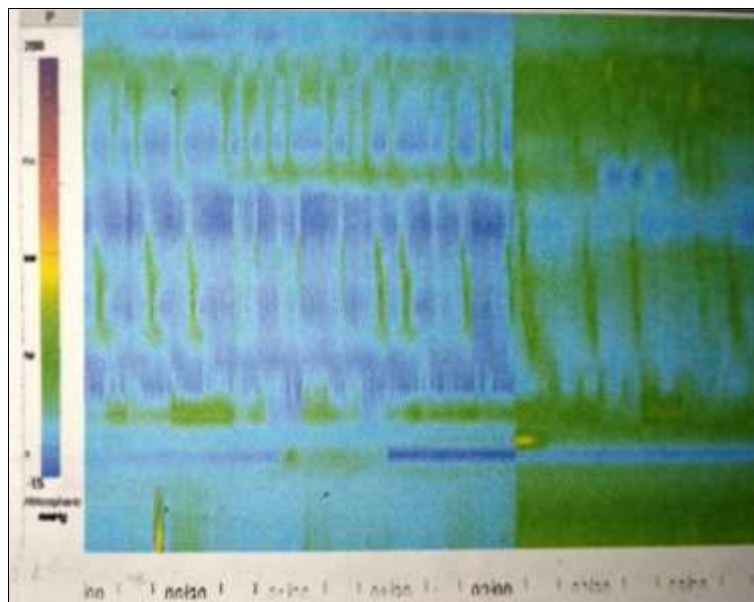


Fig 2: Absent Esophageal motility (pre-operative status)

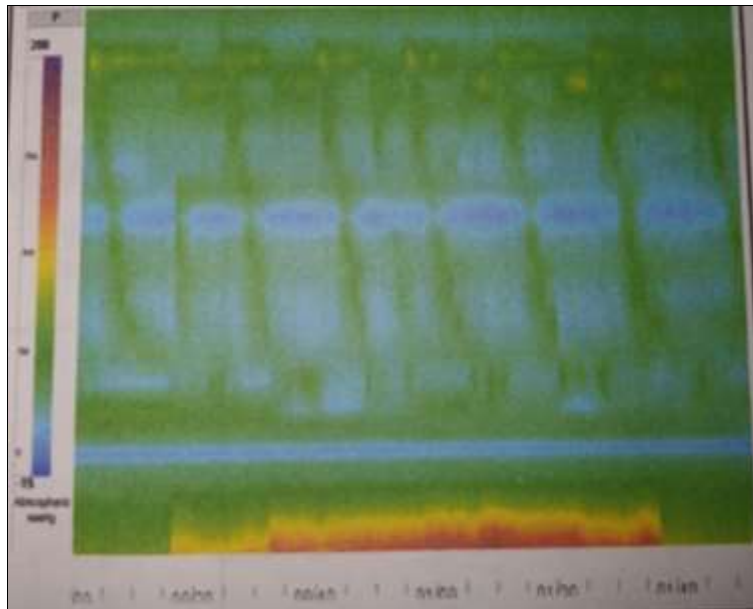


Fig 3: Normal oesophageal motility (After 2 years of postop during follow up)

Table 1: Comparison of Esophageal Motility Parameters Before and After Surgery

Parameters	Normal	Pre-op	Post-op
Distal Contractile Integral	450-8000 mmHg	7 mmHg	732 mmHg
Distal Latency	>4.5 seconds	-3.7 seconds	13.1 seconds
Intra-abdominal length of LES	>2.5 cm	1.6 cm	2.8 cm
Integral Resting potential	<15 mmHg	7.4 mmHg	-38.6 mmHg
a) Normal contractions b) Ineffective contractions	100%	0%	86%
	0%	100%	14%

Result

Upon 2 year follow up of the surgery patient had no complaints of symptom recurrence. Oesophageal Manometry was done again which showed Normal Oesophageal Motility with 86% Normal contractions and 14% ineffective contractions of esophagus with DCI of 732 mmHg-sec-cm, Distal Latency of 13.1 seconds, IRP of -38.6 mmHg at 4 seconds at LES with it’s intraabdominal length of 2.8 cm. Hence, giving manometric confirmation of return of near normal esophageal motility with TOUPET’S partial fundoplication.

Discussion

Medical therapy has been successful in the treatment of GERD, and maintenance therapy with PPIs can be used to afford patients high rates of symptom resolution and esophageal healing. GERD, however, is a chronic disease, and patients are often reluctant to take medications for their entire lifetime. LARS has become established as an effective alternative to long-term PPI therapy. The LOTUS trial, published in 2011, was a 5-year randomized, multi-center control trial comparing optimized PPI therapy vs. standardized LARS in patients with chronic GERD [5]. While the estimated remission rate in the PPI therapy group was 92% vs. 85% in the LARS group, the prevalence and severity of heartburn and acid regurgitation were lower in the LARS group [5]. There were significantly higher rates of dysphagia, bloating, and flatulence with LARS. However, in our case, patient has no such symptoms and almost 100% return of effective esophageal peristalsis.

Multiple randomized clinical trials and meta-analyses have found LARS to be safe and effective with reduced perioperative morbidity as compared to its open counterpart. In 2009, a meta-analysis of 12 randomized clinical trials comparing open anti-

reflux surgery to LARS found that patients who underwent LARS had a reduction in total length of hospital stay and had a 65% reduction in their postoperative complication rate [10].

Patti *et al.* reported that 19% of patients with esophageal dysmotility (n=141) who underwent a partial (240 degrees) fundoplication had objective evidence of symptomatic reflux, compared to 4% symptomatic failure rate in the group of patients (n=94) who underwent a laparoscopic Nissen fundoplication; the incidence of postoperative dysphagia was similar between the 2 groups and the average duration of follow-up was 67 months [6].

Two randomized trials were also conducted to investigate the need for tailoring fundoplication. Booth *et al.* stratified 127 patients with established GERD into effective (n=75) and ineffective (n=52) esophageal motility groups, based on preoperative manometry. Patients in each group were randomized to either Nissen (n=64) or Toupet (n=63) fundoplication. Dysphagia of any degree (27% vs. 9%; P=0.018) and chest pain while eating (22% vs. 5%; P=0.018) were more prevalent at 1 year in the Nissen group. On postoperative manometry at 6 months (75 out of the 127 patients), there was also no clear pattern of transition from normal preoperative motility to IEM, or the other way around [7].

Although dysphagia was seen more often in the total group of Nissen patients than in the total group of Toupet patients, there was no difference between the effective and IEM groups; furthermore, satisfaction with surgery was comparable between the latter 2 groups (83% vs. 87%, respectively). On manometry at 2 years, both Nissen and Toupet fundoplications significantly increased the postoperative LES intra-abdominal length, but a significantly increased LES pressure was only seen after Nissen [8].

Armijo and colleagues recently reported a series of 51 patients

with esophageal dysmotility on either conventional manometry or HRM, who underwent a Toupet fundoplication with a hiatal hernia repair (31 patients had an HH >5 cm). At a mean follow-up of 25 months (1-7 years), the authors reported significant improvement in GI symptoms, including heartburn, regurgitation, and use of PPI.

There is a school of thought that because peristaltic force improves after fundoplication, patients with poor peristaltic contractility at baseline are still able to tolerate a full fundoplication. However, the impact of fundoplication on modulating esophageal motility is complex with studies reporting conflicting results. Scheffer and colleagues [14] reported that nadir EGJ relaxation, intrabolar pressure (iBP), and distal esophageal contractile force, all increase following Nissen fundoplication. However, Fibbe *et al.* [15] found that esophageal motor function remains unchanged following laparoscopic Nissen and Toupet fundoplication, reporting improvement in primary peristalsis only in patients with preoperative dysmotility and only after Toupet fundoplication. Furthermore, some authors have reported more vigorous contractions after Nissen compared to partial fundoplication [16, 17].

Conclusion

The outcome of TOUPET'S fundoplication in this instance suggests that patients with GERD, Ineffective Esophageal motility, and hiatus hernia may document normal or near normal restoration of esophageal motility. Consequently, this underscores the necessity for more extensive and multicentric data to be gathered to customize a surgical strategy for individuals with long standing GERD and Ineffective Esophageal Motility.

Conflict of Interest: Not available.

Financial Support: Not available.

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