Gastro-oesophageal reflux in children: surgical management

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Abstract

Gastro-oesophageal reflux disease (GORD) is symptomatic reflux of gastric contents into the oesophagus. Factors predisposing to GORD are loss of the physiological antireflux barrier and anatomic abnormalities of the oesophagus or diaphragm. Conservative measures and medical management results in resolution of symptoms in a majority of children. Surgery is indicated in the event of failure of medical management or severe complications. Surgical procedures include open or laparoscopic fundoplication in children with normal neurology; fundoplication with or without vagotomy and pyloroplasty; surgical feeding jejunostomy and oesophago-gastric dissociation in the severely neurologically impaired children.

Keywords Antireflux procedure; fundoplication; gastro-oesophageal reflux; non-bilious vomiting

Definition and epidemiology

Gastro-oesophageal reflux (GOR) is passage of gastric contents into the oesophagus associated with or without regurgitation or vomiting. Gastro-oesophageal reflux disease (GORD) is defined as the presence of GOR with symptoms or complications. A recent Italian population study reported a prevalence of 12% for GOR in infants.

Aetiology

The process of swallowing involves the onset of oesophageal peristaltic waves and associated relaxation of upper and lower oeophageal sphincter. This is regulated by the vagus and sympathetic nerves through the intrinsic neural network on oesophagus. In GOR, non-deglutatory peristaltic waves are triggered to achieve clearance. The factors promoting GOR are increased intra-abdominal pressure, strong stomach contractions, negative pressure in oesophagus during inspiration and lying down position.

The physiological antireflux barrier (Figure 1) is mainly constituted by the following:

- The lower oeophageal sphincter (LOS) composed of
  - the inner circular smooth muscle layer of oesophagus
  - high normal resting tone of lower oeophagus which relaxes only during swallowing.
- The flutter valve formed by the mucosal fold below the LOS.
- The diaphragmatic crural sling composed of the striated muscle which contracts rhythmically during the respiratory cycle and displaces gastro-oesophageal junction downwards, closing it tightly during inspiration and forming an external pinchcock mechanism.

There are several other minor components protecting against GOR, including increased intra-abdominal oesophageal pressure, angle of His, and alkaline saliva in oesophagus buffering gastric acid.

Anatomical disruption (e.g. hiatus hernia, congenital diaphragmatic hernia, oesophageal atresia) or functional abolition (neurological disorders) of one or more of the protective mechanisms result in GOR. The occurrence of non-deglutatory transient lower oesophageal sphincteric relaxation accounts for most episodes of GOR.

Clinical presentation

Most infants with GORD present with varying degrees of non-bilious vomiting or discomfort following feeds. ENT symptoms including recurrent tonsillitis, otitis and laryngeal polyps are less commonly reported. Infants with severe GORD can present with complications including apparent life-threatening events (ALTE), aspiration pneumonia, chronic cough or recurrent wheeze. Severe GORD also results in nutritional deficiencies and failure to thrive. Older children tend to present with heartburn and dysphagia especially when the GORD has resulted in a stricture.

Continuing reflux of acid contents into the oesophagus results in ulceration of oeophageal wall causing pain. Older children can present with complications of oesophagitis including iron deficiency anaemia and stricture causing dysphagia. Sandifer syndrome has also been reported as a result of chronic reflux, and is characterized by dystonic body movements or spastic torticollis. Aspiration of gastric contents into the respiratory tract can result in bronchospasm, recurrent lower respiratory infections and atelectasis. Cases of sudden death have also been reported. Long-term risks of GORD include oesophageal strictures, Barrett's oesophagus and increased risk of oesophageal carcinoma.

Investigations

In a recent survey of American paediatric surgeons, most surgeons reported that their decision to proceed to an antireflux procedure was based mainly on the clinical history from parents than on investigations demonstrating GORD. There is no single investigation which predicts response to medical or surgical therapy.

Upper gastrointestinal contrast studies may be used to delineate the anatomy of LOS and rule out a hiatus hernia. GOR can be classified on contrast swallow examination as follows: grade 1 (reflux into distal oesophagus); grade 2 (reflux into proximal thoracic oesophagus; grade 3 (reflux into cervical oesophagus; grade 4 (continuous reflux); and grade 5 (aspiration into respiratory tract). Figure 2 shows upper GI contrast swallow demonstrating severe gastro-oesophageal reflux. However, routine performance is not recommended due to the high false

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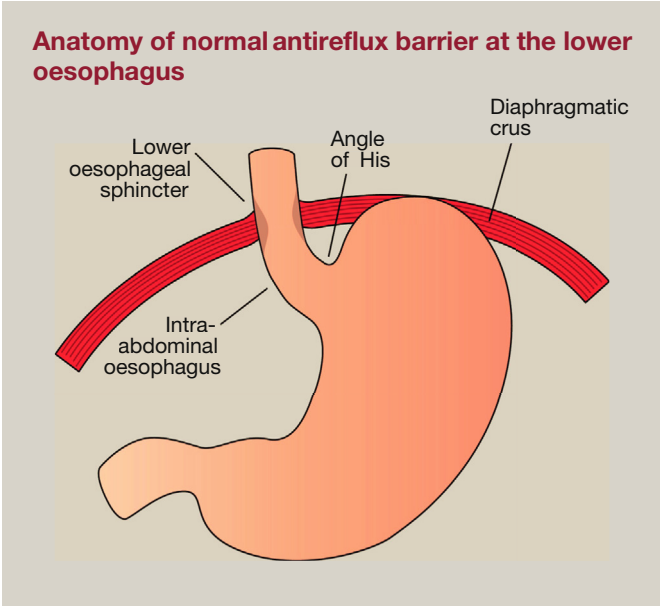

Figure 1

positivity and negativity rates and also the associated risk of radiation. Contrast meal radiograph can rule out other causes of vomiting such as malrotation and gastric or bowel obstruction.

pH studies have long been the best available method to quantify the duration and severity of reflux. A reflux index (defined as the percentage of time the measured oesophageal pH is less than 4) above 5% is considered positive for GOR. This has not been shown to correlate accurately with symptom severity in infants and is believed to be due to the acid buffering by milk feeds in this population. Both the North American and European Societies for Paediatric Gastroenterology and Nutrition have made specific recommendations for the indications for use of oesophageal pH monitoring in children.

Multichannel intraluminal impedance (MII) measures changes in electrical resistance between multiple electrodes placed along the oesophagus and can be used to calculate the direction and velocity of bolus in the oesophagus. This has the advantage of being able to detect not only oesophageal acid exposure, but also neutral or even alkaline reflux events that are more common in newborns. MII with pH motoring has been shown to double the probability of documenting an association between symptoms and reflux compared to pH monitoring alone in infants.

Although useful in diagnosing GORD, studies in adult and paediatric populations report no association between pH studies or MII with surgical outcomes of resolution of symptoms of reflux.

Upper GI endoscopy is used by many to assess the oesophagitis secondary to reflux. Using endoscopy, oesophagitis is classified by Savary Miller scoring system as grade 1 (erythema of mucosa), grade 2 (linear non-circular ulceration), grade 3 (confluent ulceration) and grade 4 (stricture). A negative endoscopic examination however does not exclude GORD in infants or patients on H2 blocker or PPI treatment. Endoscopic biopsy helps to rule out other causes of oesophagitis and to diagnose and monitor Barret's oesophagus.

Oesophageal manometry is sometimes used in older children to assess the function of LES. However non-deglutatory relaxations are difficult to record accurately.

It is worth noting that in many (or even most) neuro-disabled patients, objective evidence of GORD can be difficult to obtain, even in the presence of extreme symptom severity. This suggests that, in these patients, the condition is more than mere 'acid reflux', and that it is compounded by an inappropriate neurological response to the presence of nutrients in the stomach and proximal bowel. This disordered physiological response has been demonstrated by electro-gastrographic and gastric emptying studies, but despite considerable research it remains ill-understood.

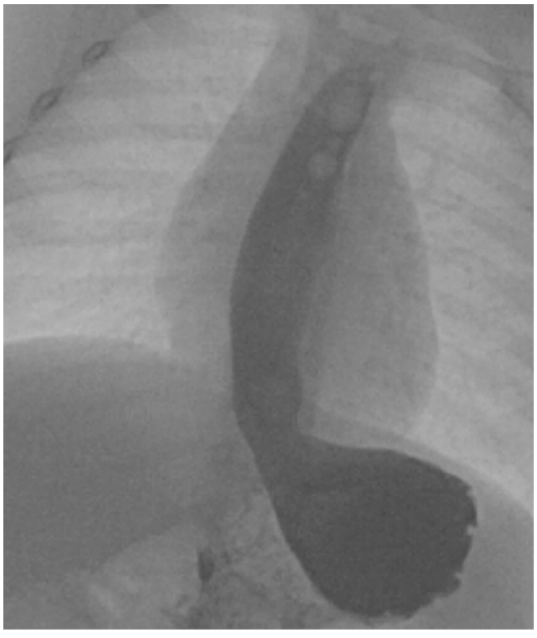

Figure 2 Contrast swallow demonstrating severe gastro-oesophageal reflux.

Management

Most neonates have a physiological level of GOR that resolve spontaneously by the age of 12–18 months when they take up an upright position. Infants with GORD are initially managed using conservative measures. Use of thickened feeds reduces visible regurgitation but does not decrease in the frequency of measurable oesophageal reflux episodes. Head end elevation has not been shown to have a beneficial effect in infants with GOR. Prone or left-sided sleeping position with elevation of the bed has been shown to benefit in adults with GOR.

H_2-Receptor antagonists help in symptomatic improvement of GORD, but has the problems of tachyphylaxis and tolerance. Proton pump inhibitors (PPI) inactivate the H+K+ATPase pump and are currently the medical treatment of choice for symptoms of GORD and oesophagitis. Complications of PPI include increased risk of community-acquired pneumonias especially in children with immunocompromise. However, evidence does not support the use of PPIs in infants. Recent studies suggest a potential role for baclofen in inhibiting the lower oesophageal

sphincter relaxation. Motility agents such as domperidone are widely used although not supported by evidence from randomized controlled trials.

Surgical management

Surgery for GORD is indicated when there is inadequate response to medical management or presence of significant or recurrent respiratory complications. Surgery may be considered early in children with neurological impairment and those with anatomical factors contributing to GORD (such as oesophageal atresia, CDH, etc.). The aim of antireflux surgery is to reconstruct an effective antireflux barrier maintaining the free passage of food through the gastro-oesophageal junction. The most common procedure used is a fundoplication, which decreases reflux by increasing the LOS pressure, decreasing the number of TLESRs and the lowest pressure during swallow-induced LOS relaxation.

The gold standard surgical treatment for GORD is Nissen fundoplication (Figure 3). This entails a 360 degree wrap of gastric fundus around the lower oesophagus that acts as a very effective pneumohydraulic valve. The procedure involves mobilization of the upper third to half of the greater curvature with or without ligation of short gastric vessels. This is followed by mobilization of the abdominal oesophagus to enable encircling of the fundus around the oesophagus above the left gastric vessels. A single or double layer of braided non-absorbable sutures have been advocated by different experts. Increased length or tightness of the wrap results in gas bloat and dysphagia. The fundoplication is combined with a repair of the diaphragmatic hiatus repair when indicated.

Laparoscopic fundoplication is now being increasingly performed with short-term success rates similar to the open procedure and the advantages of shorter post operative stay and lesser analgesic requirements. Long-term results from randomized controlled trials are awaited.

Anterior (Thal) or posterior (Toupet) wraps of 180 degrees are preferred by some surgeons for fundoplication in patients who have had repair of oeophageal atresia to avoid dysphagia in this group of children.

In children with neurological disorders, delayed gastric emptying and overall spasticity and retching contribute to the severity of symptoms. In the senior author's experience, Nissen fundoplication alone (whether open or laparoscopic) achieves only modest symptomatic relief, whereas fundoplication combined with vagotomy and pyloroplasty results in both a better functional outcome and a lower rate of subsequent revision. Since most children in this group have difficulty feeding by mouth, they also tend to have a feeding gastrostomy.

An alternative to fundoplication and feeding gastrostomy in children with neurological impairment is to form a surgical jejunostomy for feeding to reduce reflux episodes while providing nutrition. The main long-term complication of a surgical feeding jejunostomy is volvulus of the jejunal limb.

Children with severe neurological impairment who fail to respond to the above procedures may be considered for an oesophago-gastric dissociation with a Roux-en-Y feeding jejunostomy (Figure 4). This technically demanding procedure may be complicated by severe gas bloating within the distal bowel, presumably because the rearranged anatomy precludes the aspiration of swallowed gas, and should thus be avoided in children with poor colonic motility.

Recent advances in endoscopy have introduced new antireflux procedures including endoluminal fundoplication, radiofrequency application to oesophago gastric junction and injection of an inert material at the LOS reducing its distensibility.

Outcomes

A recent systematic review reported a median success rate of 86% (57–100%) for antireflux surgery in children with GORD. The 4-year follow-up from the randomized controlled study from the UK showed significantly higher rate of retching in the open fundoplication group compared to the laparoscopic group.

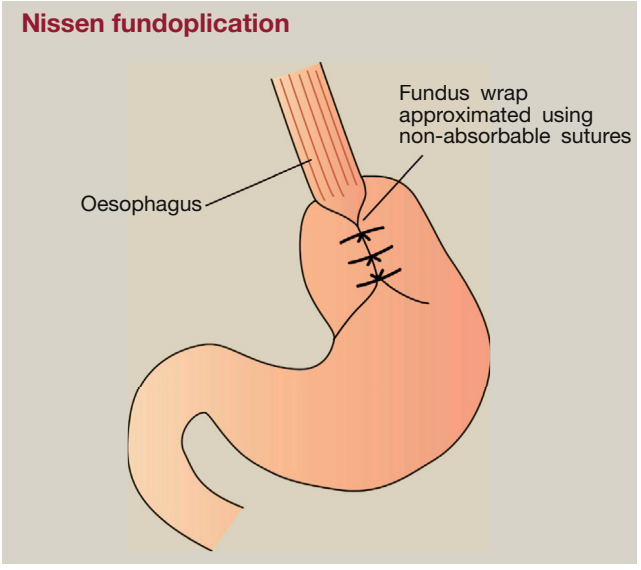

Figure 3

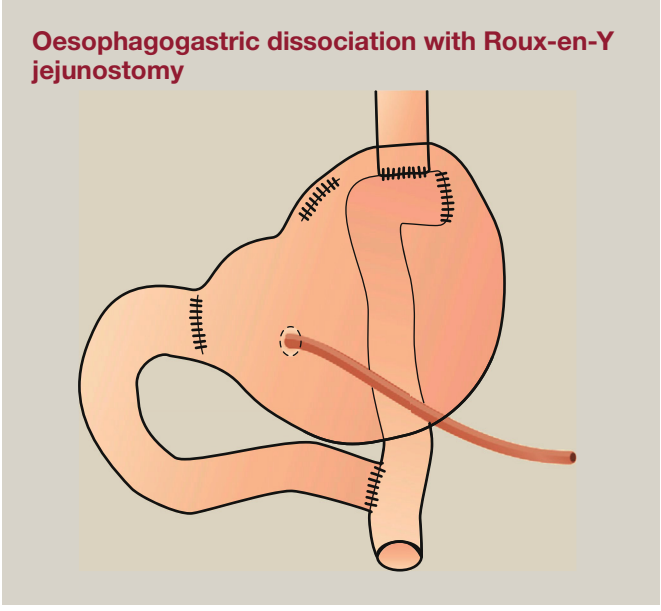

Figure 4

Similar recurrence rates have been reported for open and laparoscopic fundoplication. Success rates for redo fundoplication have been reported between 7% and 26%. Risk factors for recurrence are younger age and co-morbidities including neurological impairment. A recent randomized controlled trial in adults reported the use of antireflux medications in 44% of patients 5 years following laparoscopic fundoplication.

Dysphagia can result when the wrap is too long or too tight. A recent randomized controlled trial comparing laparoscopic Nissen and Thal fundoplications reported a significantly lower rate of recurrence for Nissen procedure but with a higher rate of dysphagia in neurologically normal children. Other early postoperative complications include oesophageal perforation, pneumonia and wound infection. Gas bloat can also result due to a tight wrap. Dumping has been reported following fundoplication especially when performed with a pyloromyotomy.

Children with neurological diseases are at highest risk of postoperative complications including wrap failure, respiratory complications and death. Wrap failure has been reported between 20% and 50% in neurologically impaired children. The mortality following fundoplication in children with cerebral palsy has been reported at 10% at 30 days and 40% at 5 years. Antireflux surgery has been shown to reduce significant respiratory events causing hospital admissions in neurologically impaired children under 4 years of age but not in older children.

Conclusions

GORD is a common pathology in neonates and spontaneously settles in the majority of children after infancy. Diagnosis is mainly based on history and supportive investigations are used in selected patients. Surgery is indicated for those who fail to respond to conservative management and for complications. The surgical armamentarium of antireflux surgery includes fundoplication, feeding jejunostomy and oesophago gastric dissociation. Outcomes of surgery are variable and failure rates and complications are higher in children with neurological impairment. ◆

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