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Surgical Criteria for Nissen Fundoplication and Gastrostomy in Gastroesophageal Reflux Disease and Surgical Treatment for Neurologically Impaired Children

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Key words : gastroesophageal reflux disease (GERD), Dor-Nissen fundoplication, laryngotracheal separation

ABSTRACT

Background: It was to investigate whether five items of serious recurrent vomiting, hematemesis, dysphagia, refractory aspiration pneumonia, and failure to thrive were suitable as the surgical criteria for Nissen fundoplication and gastrostomy in gastroesophageal reflux disease (GERD).

Methods: The validity of surgical criteria was examined through the clinical data of Nissen fundoplication and gastrostomy that were performed by the criteria in this hospital for 24 cases (14 pediatric cases ; 10 adult cases) on GERD-patients between March 1997 and November 2005. All antireflux operations were performed by open laparotomy. Antireflux operation for GERD in this hospital is Dor-Nissen fundoplication (partial fundic cuff) and no drainage operation (pyloroplasty or pyloromyotomy) was performed in order to avoid postoperative dumping syndrome. The existence of preoperative GERD was judged in measurement of pH index (%) according to 24-hour esophageal pH monitoring or from upper gastroesophageal

contrast radiography.

Results: These were two cases of reoperations due to postoperative complications because of ileus. One was regastrostomy due to a leaking gastrostomy tube, and the other was Nissen fundoplication and regastrostomy in order to prevent the progression of persistent vomiting, hematemesis, and aspiration pneumonia. Moreover, no gas bloat syndrome and delayed gastric emptying were accepted, and no recurrence of GERD and wrap failure were encountered.

Conclusion: Dor-Nissen fundoplication is suitable for antireflux operation for GERD, and it enables eructation after operation. Laryngotracheal separation is very effective for neurologically impaired children with refractory aspiration pneumonia. We decided on laryngotracheal separation by means of video assisted fluoroscopy.

INTRODUCTION

Gastroesophageal reflux disease (GERD) was mostly diagnosed by means of 24-hour esophageal pH monitoring or fluoroscopy by using soluble-contrast material through

a nasogastric tube. Physicians or pediatricians need to ask some questions to determine the optimal surgical timing of the antireflux operation for GERD. It is necessary to clarify the time of consultation from them when the patients have symptoms of clinical manifestations (i.e.; serious recurrent vomiting, hematemesis, dysphagia, refractory aspiration pneumonia, or failure to thrive). On the other hand, some physicians or pediatricians also think that it is easy to refer the patients with GERD by five items. According to the various reviews, however, no other institution or hospital had the clinical criteria to determine the timing of the antireflux operation for GERD. It is very important to determine the optimal timing of antireflux operation by the five items which we have advocated over and over. Antireflux operation and gastrostomy were performed based on the criteria in this hospital for 24 cases on GERD (14 pediatric cases and 10 adult cases) between March 1997 and November 2005. The aim of this study was to make sure whether the validity of surgical criteria for operative indication on GERD was suitable or not for pediatric or adult patients through the following postoperative status.

PATIENTS AND METHODS

Pediatric Patients Profiles

Antireflux operation or gastrostomy for 14 pediatric cases (13 patients) was

performed between March 1997 and November 2005. There were 7 male and 7 female children with an average age of 4.5 ± 1.4 years (range: 0.14-13.6 years; median: 1.9 years), height of 90.7 ± 31.6 cm (range: 54.2-135.0 cm; median: 87.0 cm), body weight of 12.4 ± 9.4 kg (range: 2.7-32.0 kg; median: 9.7 kg), and waiting for operation of 0.9 ± 0.4 years (range: 0.03-6.0 years, median: 0.18 years), respectively. Moreover, there were 8 neurologically impaired children and 2 children with scoliosis.

Adult Patients Profiles

Eight adult patients (10 cases) underwent antireflux operation or gastrostomy. The average age, height, body weight, and waiting for operation of the adult patients (7 male : 3 female) were 25.8 ± 7.2 years (range: 17.3-42.3 years; median: 23.6 years), 144.9 ± 8.0 cm (range: 129.0-156.0 cm; median: 142.0 cm), 31.4 ± 7.9 kg (range: 21.0-45.0 kg; median: 35.0 kg), and 3.3 ± 1.3 years (range: 0.17-10.8 years; median: 2.75 years), respectively (Table 1). Moreover, all adult patients were neurologically impaired and 4 patients had scoliosis.

Surgical Management

All antireflux operations were performed by means of open laparotomy, however, only 2 cases of gastrostomy (Adult: 1 case ; Child: 1 case) were performed by means of percutaneous endoscopic gastro-stomy (PEG). Antireflux operation for GERD in this hospital is Dor-Nissen fundoplication

Table 1. Patient demographics

Pediatric case (13 patients : n=14)		Adult case (8 patients : n=10)
Age (yr)	4.5 ± 1.4 (0.14-13.6)	25.8 ± 7.2 (17.3-42.3)
Gender	Male 7; Female 7	Male 7; Female 3
Height (cm)	90.7 ± 31.6 (54.2-135.0)	144.9 ± 8.0 (129.0-156.0)
Body weight (kg)	12.4 ± 9.4 (2.7-32.0)	31.4 ± 7.9 (21.0-45.0)
Waiting for operation (yr)	0.9 ± 0.4 (0.03-6.0)	3.3 ± 1.3 (0.17-10.8)

(partial fundic cuff) and gastrostomy altogether taking gas bloat syndrome into consideration and no drainage operation (pyloroplasty or pyloromyotomy) was performed in order to avoid postoperative dumping syndrome. Hepatic branch of vagus was preserved when Dor-Nissen's fundoplication was performed and jejunostomy instead of gastrostomy was considered before surgery in case of serious scoliosis (Fig. 1-a). In addition, the existence of preoperative GERD was judged in measurement of pH index (pH index \geq 4%) calculated by means of 24-hour esophageal pH monitoring or by using upper gastroesophageal contrast radiography¹⁾. The cause of refractory aspiration pneumonia was judged by means of video assisted fluoroscopy to discriminate between laryngotracheal disorder and esophagocardiac disorder. If the pulmonary infection is induced by the esophagocardiac disorder, the antireflux operation for GERD will be performed first. Moreover, if the pulmonary infection is induced by the laryngotracheal disorder, laryngotracheal separation procedure or tracheotomy will be performed first. But if the refractory aspiration pneumonia after the tracheotomy was accepted following life-threatening episodes, laryngotracheal separation procedure will probably be performed sooner or later.

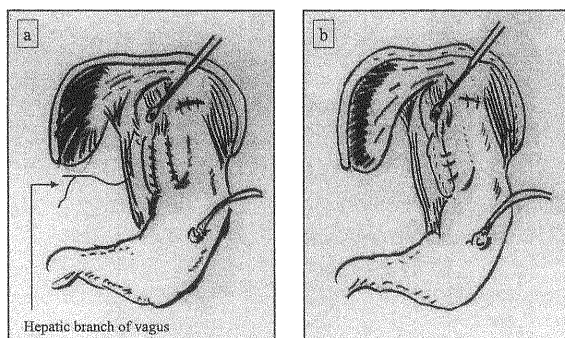


Fig. 1

Statistical Analysis

Values are shown as median and range. For statistical comparison, chi-squared test was used. P values of less than 0.05 were regarded as statistically significant.

RESULTS

Clinical manifestation

Five preoperative symptoms of GERD were persistent vomiting in 16 cases, hematemesis in 9 cases, dysphagia in 7 cases, refractory aspiration pneumonia in 4 cases, and failure to thrive in 3 cases (Table 2). Causes of neurological impairment were cerebral palsy or asphyxia in 16 cases, seizures in 8 cases, encephalitis in 2 cases, mental retardation in 1 case, and microcephaly in 1 case (Table 3). Eight children and 8 adults had neurological impairment at antireflux operation. The rate of neurologically impaired patients who underwent the antireflux operation for GERD was 76.2%. Moreover, scoliosis was seen in 2 pediatric and 4 adult patients.

Table 2. Clinical demographics

Preoperative symptoms suffering from GERD	
Severe recurrent vomiting	16
Hematemesis	9
Dysphagia	6
Refractory aspiration pneumonia	4
Failure to thrive	3

Table 3. Cause of GERD due to neurological impairment

Cause of neurological impairment	
Cerebral palsy/Asphyxia	16
Seizures	8
Encephalitis	2
Mental retardation	1
Microcephaly	1

Surgical management and postoperative patients' condition for GERD

In pediatric cases, there were Dor-Nissen fundoplication in 7 cases, gastrostomy in 2 cases, and Dor-Nissen with gastrostomy in 5 cases. In addition, there were tracheotomy in 3 cases and laryngotracheal separation in 2 cases. On the other hand, in adult cases, there was only Dor-Nissen in 1 case, gastrostomy in 3 cases, and Dor-Nissen fundoplication with gastrostomy in 6 cases. Moreover, there were tracheotomy in 2 cases and laryngotracheal separation in 2 cases. Nasogastric tube was removed from 11 pediatric patients within postoperative mean 18.9 days. On the other hand, it was removed from only 3 adult patients within 26.3 days. In pediatric cases, N-G tube was clearly removed earlier and enteral nutrition was started more speedily than adult cases ($p < 0.06$). In pediatric cases with little neurological impairment, enteral nutrition was started through the gastrostomy tube at postoperative early stage.

Postoperative Complications

Reoperations due to postoperative complications were regastrostomy due to ileus in 2 cases, regastrostomy due to leaking from the circumference of gastrostomy tube in 1 case, and Nissen fundoplication and regastrostomy because of the serious persistent vomiting, hematemesis, and aspiration pneumonia in 1 case (Table 4). Moreover, no gas bloat syndrome and delayed gastric emptying were seen, and neither recurrence of GERD nor wrap failure was encountered. At postoperative status, neuroleptic malignant syndrome (NLMS) was accepted in a 13-year-old boy (Fig. 2). One case of death due to other causes was accepted in a pediatric case.

Table 4. Details of complications at postoperative status

Reoperative case		Non Surgical case	
Ileus	2	Granulomatous inflammation around the gastrostomy tube	4
Leaking gastrostomy tube	1	NLMS*	1
Other**	1		

*NLMS: neuroleptic malignant syndrome

**Addition of Nissen fundoplication and regastrostomy after initial gastrostomy

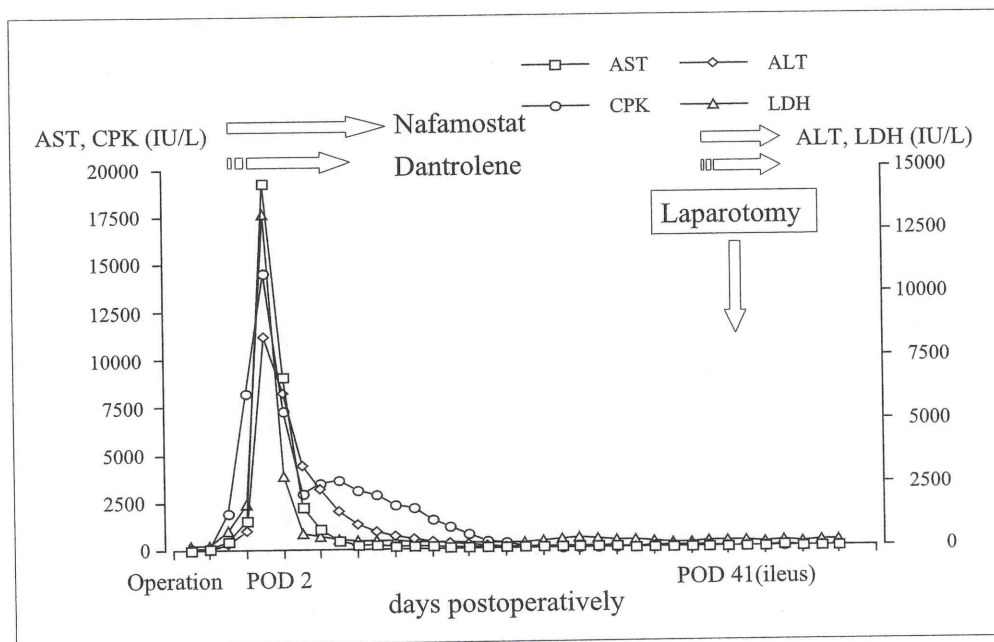


Fig. 2

DISCUSSION

Generally, there are measurements of pH index (%) according to 24-hour esophageal pH monitoring and upper gastroesophageal contrast radiography as the diagnostic method for GERD. Moreover, scintigraphy due to technetium (Tc) radioisotope was enabled to evaluate delayed gastric emptying induced wrap failure²⁾. It is essential to perform further examination by means of endoscopy about the extent of reflux esophagitis or the evaluation of esophageal ulcer. Indeed, surgical criteria to confirm the optimal timing of antireflux operation for GERD were individually judged at each hospital or institution even though these had already been established as the diagnostic evaluation method and a unified view based on various references was not found at all³⁾. At first, we will begin some medical management by positioning, H₂ blocker, and proton pump inhibitor in case that we diagnosed a case as GERD from the following symptoms; persistent vomiting,

hematemesis, failure to thrive, refractory aspiration pneumonia, dysphagia, or reflux esophagitis and so on. Surgical procedure will be adopted when conservative management is not successful (Fig. 3). There is especially noticeable confusion among pediatricians or physicians who administrate patients with GERD in case of deciding the optimal timing for antireflux operation. Then, we considered that it was necessary for the optimal timing to be judged easily and clearly. Now, we devised originally surgical criteria to judge the optimal timing of antireflux operation for GERD and we estimated whether the surgical criteria were feasible for antireflux operation or gastrostomy based on the retrospective investigation of the clinical data.

Antireflux operation by laparoscopic surgery or gastrostomy by endoscopic surgery are used nowadays, however, our surgical procedure is mainly performed through open laparotomy. Percutaneous endoscopic gastrostomy (PEG) in 2 cases (1 pediatric case ; 1 adult case) was

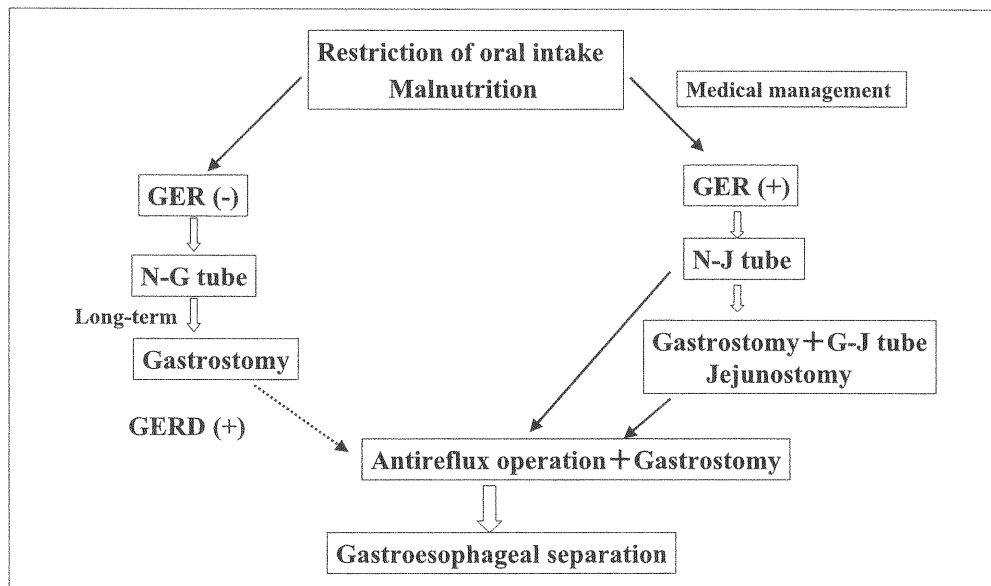


Fig. 3

performed by an endoscopist in Otsu Red-Cross Hospital between March 1997 and November 2005. Pediatric patients with GERD from childhood have a number of diseases including some disorders of the central nervous systems²⁾⁴⁾. The rate of neurologically impaired pediatric cases was 61.5% and of adult cases was 100% in this series. Antireflux operation which was performed at this hospital was Dor-Nissen fundoplication method performed through open laparotomy. We think that this method enables ease of eructation after surgery and avoids gas bloat syndrome or delayed gastric emptying, and that makes up for the demerit of tight fundoplication⁵⁾. The fundoplication as usual is called Old-Nissen fundoplication, but it is reported that the rate of refundoplication after Old-Nissen fundoplication is 14-35%⁶⁾⁷⁾. The cause of dysphagia after surgery may be based on tight fundoplication. It is recorded that the rate of wrap failure or recurrence of GER after the Old-Nissen fundoplication is 8-12%⁸⁾ (Fig. 1-b). Then, we think that it is necessary to take jejunostomy into consideration in the case of wrap failure after the fundoplication or with scoliosis⁹⁾. Moreover, it is said that the rate of complications after antireflux operation in neurologically impaired patients is four times that found in normal patients²⁾⁴⁾.

It is reported that neurologically impaired patients are apt to contract GERD and the rate of complication is approximately 15-20%¹⁰⁾. In fact, it is reported that the rate of neurologically impaired patients occupied in pediatric GERD to be an object of surgical procedure is approximately 50-80%¹⁰⁾. Many cases of GERD in neonates or infants will be able to improve

increasingly the child's development, however, GERD in neurologically impaired patients may not show successful improvement because induction of their GERD connected to stasis of contents in stomach or intraabdominal pressure due to progression of myotonia, deformity of body, and long term positioning with primary disease¹⁰⁾. Antireflux operation was briskly performed for GERD in neurologically impaired patients. As a result, many neurologically impaired patients suffering from intensive GERD have undergone disappearance of emesis and anemia, and improvement of chronic malnutrition. On the other hand, recurrence of GERD was a matter of concern for neurologically impaired patients with chronic airway disorder. Moreover, neurologically impaired patients with chronic airway disorder are susceptible to the onset of refractory aspiration pneumonia and it is reported that aspiration of pharyngeal secretion decreased, prevention of aspiration pneumonia was possible, recurrent GERD disappeared, and gastrointestinal bleeding stopped after laryngotracheal separation procedure had been performed. However, it is a matter of debate that whether antireflux operation should be performed previous to laryngotracheal separation procedure for neurologically impaired patients with refractory aspiration pneumonia or not.

Medical and surgical management for upper gastrointestinal disorder is showed in Fig. 3, and clinical strategy for serious pulmonary infection with or without GERD was showed in Fig. 4¹¹⁾. At times, it is the case that either GERD induces pulmonary infection or dysphagia causes aspiration pneumonia. When the pulmonary infection occurs over and over after antireflux

operation, at first, further examination of laryngotracheal portion will be performed using video assisted fluoroscopy because laryngotracheal function may be impaired. In this case, it is necessary to add laryngotracheal separation. This method is the most efficient technique as the surgical procedure for refractory aspiration pneumonia. That is, this method has fewer complications in comparison with glottis closure or laryngectomy and it is possible to try oral intake or reconstruction of airway¹⁰.

Generally, dysphagia and gas bloat syndrome after antireflux operation are mainly due to tight fundoplication. It is said that long cuff should not be made and loose wrap is preferred because eructation is easily possible¹². Then, the device of our antireflux operation is to adopt partial fundoplication, Dor-Nissen fundoplication and laryngotracheal separation procedure are added in the case of refractory aspiration pneumonia. Moreover,

the hepatic branch of the vagus is preserved to avoid cholecystitis, cholecystolithiasis, and choledocholithiasis¹³. We take into the method of esophagogastric dissociation with a Roux-en Y esophagojejunal anastomosis and jejuno-jejunostomy with gastrostomy (Bianchi's operation) consideration for serious refractory GERD and perform clinical management every day.

Finally, when neurologically impaired patients with GERD undergo surgical management, they may also get NLMS because they do not temporarily take anticonvulsants^{11,14}. At this hospital, onset of NLMS was seen in a 13-year-old boy with neurological impairment. We were fortunately able to rescue him by early detection of his abnormal clinical symptom and prompt administration of dantrolene sodium. NLMS rarely occurs but its onset should be always kept in mind whenever neurologically impaired patients undergo surgical management^{15,16}.

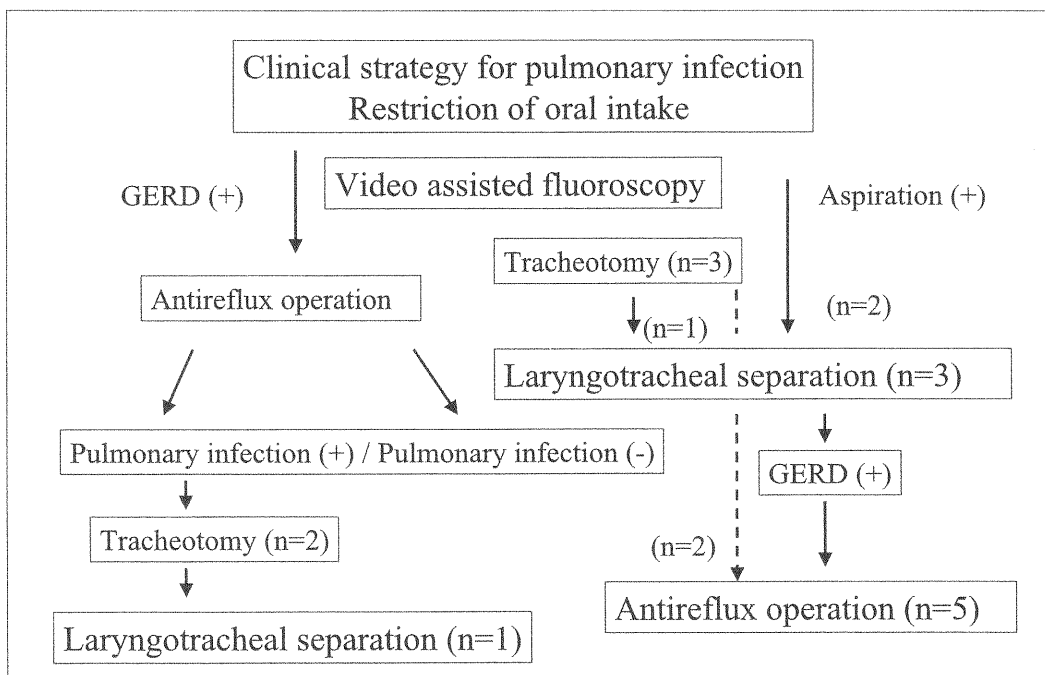


Fig. 4

CONCLUSION

Surgical criteria (serious recurrent vomiting, hematemesis, dysphagia, refractory aspiration pneumonia, and failure to thrive) for Dor-Nissen fundoplication and gastrostomy in GERD at this hospital are feasible. Nissen fundoplication and feeding gastrostomy lead to an improvement in the quality of life for neurologically impaired patients. Neurologically impaired patients with refractory pulmonary infection should be judged by means of video assisted fluoroscopy whether the refractory aspiration pneumonia is induced by GERD or laryngotracheal disorder. If aspiration pneumonia is induced by laryngotracheal disorder, the first choice of surgical procedure is tracheotomy and next is laryngotracheal separation at our hospital. But, if parents desire laryngotracheal separation therapy because of persistent apnea due to discharge of sputum at night, we consider laryngotracheal separation first.

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Figure legends

Figure 1-a.

Dor-Nissen fundoplication was performed by partial fundic cuff and the hepatic branch of the vagus was preserved. Jejunostomy instead of gastrostomy was considered in case of serious scoliosis.

Figure 1-b.

Nissen fundoplication performed by a complete 360° wrap, so-called Old-Nissen

fundoplication.

Figure 2.

Clinical episode due to NLMS was shown in a 13-year-old boy with neurological impairment after antireflux operation. NLMS was suspected because AST, ALT, CPK, and LDH were extremely elevated with pyrexia. Dantrolene sodium (d. i. v. 3 mg/kg/day) was administered immediately. Figure 3.

This algorithm shows surgical treatment for upper gastrointestinal disorders in neurologically impaired children.

N-G tube : naso-gastric tube. N-J tube : naso-jejuno tube. G-J tube : gastric jejuno tube. GERD : gastroesophageal reflux disease. Gastroesophageal separation : Bianchi's operation

Figure 4.

Surgical management for GERD with serious pulmonary infection. Typical decision-making algorithms are shown.