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Laparoscopic fundoplication for neurologically impaired adolescents with severe scoliosis☆

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ABSTRACT

Laparoscopic antireflux procedure for patients with severe scoliosis is often challenging, as the esophageal hiatus lies in an extremely deep position and is frequently rotated. Reports regarding the clinical results of laparoscopic fundoplication are scarce, especially in patients with severe scoliosis. In this study, laparoscopic Nissen fundoplication was applied to seven adolescent patients aged between 19 and 29 years with neurological impairment and gastroesophageal reflux disease (GERD). The scoliosis among them was considerably severe with a median Cobb angle of 131°. Follow-up was conducted with a median period of 7.8 years. There was no intraoperative complication or recurrence of GERD. Two patients required tracheostomy, and one died due to recurrent pneumonia after fundoplication. Our experience suggested the feasibility of laparoscopic Nissen fundoplication with an arrangement of port layout even in neurologically impaired adolescents with severe scoliosis. As recurrent aspiration pneumonia can persist after fundoplication in some patients, an anti-aspiration procedure may be considered to achieve a higher quality of life.

Laparoscopic antireflux procedures have replaced the open approach and have since become the standard surgical option for the treatment of gastroesophageal reflux disease (GERD) in the pediatric population [1]. Although antireflux procedures are recently being applied to neurologically impaired children with GERD, there remains a high-risk group who actually experienced a worse outcome after such procedures [2–4]. Neurologically impaired adolescents who have suffered from GERD since their pediatric period are included in this high-risk group as well. Laparoscopic surgery in patients with severe scoliosis can be challenging because of a limited working space between the subcostal margins, iliac crests, and the spinal column due to lateral bending of the trunk [5]. In view of the fact that the esophageal hiatus lies extremely deep in the subphrenic space and is frequently rotated in cases of severe scoliosis, the port site arrangement may be key for a successful laparoscopic procedure [5,6]. Although long-term outcome of laparoscopic antireflux procedure in neurologically impaired children is well-documented [7,8], reports concerning the technical aspect, especially in neurologically impaired adolescents, are scarce. The aim of this study is to characterize GERD in neurologically impaired adolescents and to investigate whether laparoscopic Nissen fundoplication is feasible for such patients.

1. Patients and methods

Seven patients with a neurologically impaired condition lasting beyond the pediatric period, and who underwent laparoscopic Nissen fundoplication, were included in this study. The Cobb angles to evaluate the severity of scoliosis were calculated based on X-ray of the chest and abdomen. Preoperative diagnosis of GERD was based on the following: esophagogastric reflux revealed by barium contrast study, endoscopic evidence of esophagitis with pathological findings of esophageal biopsy, and reflux index of >5% in 24-h esophageal pH monitoring after the withdrawal of H2-blocker or proton pump inhibitor. Indications for surgery were persistent GERD even after pharmacological treatment, as well as feeding problems or any symptoms associated with GERD.

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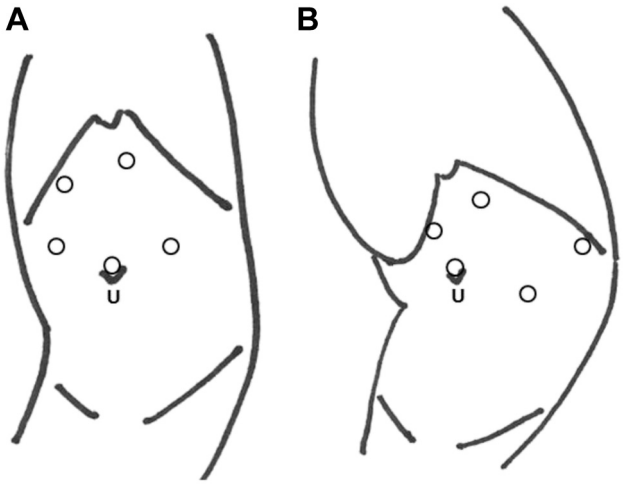

Fig. 1. Two types of port arrangement in scoliotic patients. Less scoliotic patients have normal port placement (A). Port placement was shifted to the left of the abdomen using umbilicus for the left working port (B) (U: umbilicus).

1.1. Laparoscopic fundoplication

Five 5-mm ports were placed at the umbilicus, both of the midquadrants, the right lateral quadrant and the epigastric region (Fig. 1A). As the abdominal space for the ports was very limited due to the deformation of the ribs in severe scoliosis, port placement was shifted to the left to expose the hiatus, allowing a wider working space (Fig. 1B). The fundus of the stomach was mobilized with laparoscopic coagulating shears. After surgery to expose the region around the lower end of the esophagus, the esophagogastric junction was drawn down intra-abdominally by a vessel loop at a distance of 3–5 cm from the hiatus. Diaphragmatic crural repair and esophageal anchoring were accomplished with 3-0 non-absorbable sutures. Care was taken to avoid injury to the anterior and posterior vagal nerves as well as the hepatic branches. The 360-degree fundal wrapping cuff was made 2–3 cm in length with 3-0 non-absorbable sutures. A Stamm gastrostomy was placed at one of the port sites, while a Witzel jejunostomy was created in patients with mal-duodenal passage identified by contrast study.

2. Results

The preoperative characteristics of the seven patients are shown in Table 1. There were five males and two females (median age, 27 years). The scoliosis in them was considerably severe with a median Cobb angle of 131°. In five patients, the status of GERD was considered severe due to sliding hernia (resulting in a median reflux index of 18%). Preoperative history involved recurrent pneumonia in all patients. Esophagitis with hematemesis or bloody gastric fluid was present in five patients while malnutrition was present in four.

Operative findings, post-operative complication and outcome of each patient are shown in Table 2. The port site was designed as a type B in four patients with a Cobb angle of >90° (Fig. 2). With the modification of the port placement, laparoscopic operative view was excellent, allowing meticulous dissection around the deep esophageal hiatus. The median operative time was 256 min, including the creation of a nutritional access. In patients 1 and 7, the adhesion around the esophagogastric junction was severe due to repeated reflux. As a result, detection of the vagal nerve and the exact layer for dissection was difficult and time-consuming. There was no intraoperative complication or conversion to an open procedure required in any of the patients. The median postoperative hospital stay was 47 days.

Post-operatively, a digestive fluid leakage through the side of the nutritional access due to bad wound healing was observed in patients 1, 4 and 6. In patients 1 and 6, severe scoliosis persisted and resulted in direct aspiration pneumonia. A longer hospital stay was required for these patients for respiratory management. The median follow-up was 7.8 years. No recurrence of GERD was observed, but tracheostomy was required in patients 5 and 6 to control recurrent aspiration pneumonia. Patient 1 died of septic shock arising from severe pneumonia that required artificial ventilation.

3. Discussion

Surgical treatment of gastroesophageal reflux in patients with severe scoliosis can be challenging because of the limited working space between the subcostal margins, iliac crest, and spinal column. Furthermore, the esophageal hiatus lies deep in the abdomen and is frequently rotated, making surgery even more difficult. To resolve these anatomical problems, Drucker et al. performed transthoracic Nissen fundoplication in five mentally retarded patients with severe kypho-roto-scoliosis [6]. Since neurologically impaired patients remain as a high-risk group for an even worse outcome after antireflux procedures [2–4], total esophagogastric dissociation (EGD) is elected to be the definitive solution as it eliminates all risk of recurrent reflux. EGD can be the primary treatment of choice for severe neurologically impaired patients who are experiencing GERD with a total dependence on tube feeds [9]. However, EGD may not be an appropriate option for patients with severe scoliosis due to the problem of visibility of the surgical site. As such, the laparoscopic approach may have an edge in terms of reaching the deep hiatus [5]. Moreover, a trocar layout is an important factor to consider in order to achieve a wider working space in such patients; it should be shifted to the left of the trunk to expose the hiatus. However, intercostal port placement is not recommended due to a risk of pneumothorax. Even if the stomach is located deep in the costal arch, it is not difficult to introduce tube gastrostomy in the epigastric region, although intercostal positioning of a gastrostomy

Table 1
Demographics of each patient.

Pt.	Age	Sex	Cobb angle	Sliding hernia	Reflux index (%)	Endoscopy (Los Angeles classification)	Preoperative history
1	26	M	168	(+)	18	N/A	NPE
2	19	M	137	(+)	46	C	PE
3	18	F	71	(−)	8	A	P
4	28	F	16	(−)	9	A	PN
5	27	M	151	(+)	21	N/A	NPE
6	27	M	131	(+)	30	B	NPE
7	29	M	55	(+)	15	C	NPE

N/A: not available, N: malnutrition, P: recurrent pneumonia, E: esophagitis.

Table 2
Post-operative complication and outcome of each patient.

Pt.	Port site	Ope time (min)	Nutritional access	Operative findings	Hospital stay (day)	Complication	Follow up (year)	Outcome
1	B	364	G	Severe circumesophageal adhesion	370	G leakage	5.8	Died of septic shock
2	B	247	G	smooth operative procedure	12	(−)	9.2	Alive without recurrence
3	A	256	G	Smooth operative procedure	50	(−)	8.7	Alive without recurrence
4	A	282	G	Smooth operative procedure	47	G leakage	8.7	Alive without recurrence
5	B	198	G	Smooth operative procedure	45	(−)	7.8	Alive with tracheostomy (6.9 POY)
6	B	249	GJ	Smooth operative procedure	64	J leakage	7.7	Alive with tracheostomy (3.1 POY)
7	A	308	GJ	Severe circumesophageal adhesion	38	(−)	7.5	Alive without recurrence

G: gastrostomy, J: jejunostomy, POY: post-operative year.

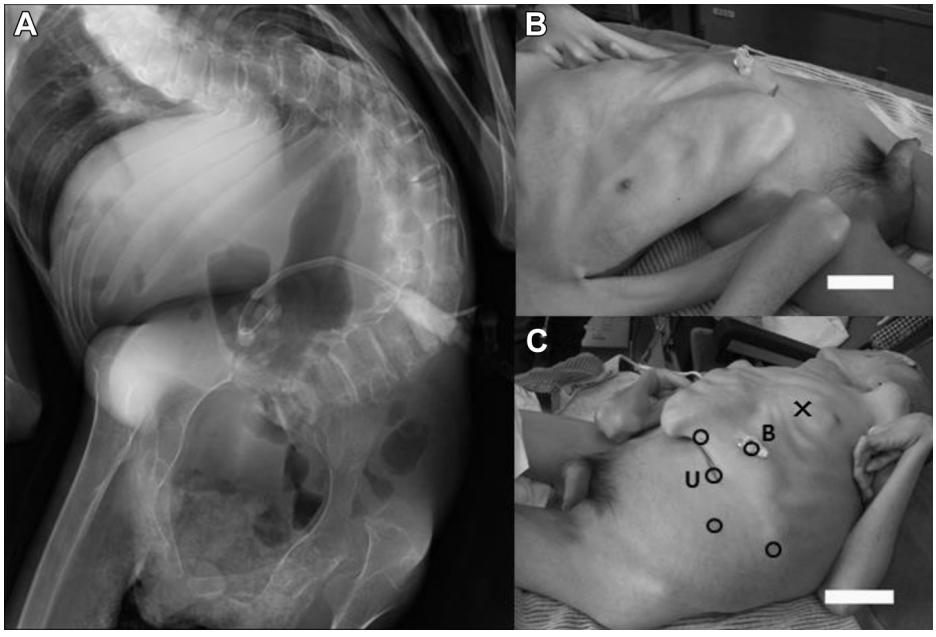

Fig. 2. (A) A plain X-ray of patient 5 showed considerably severe scoliosis with a Cobb angle of 151°. (B), (C) A narrow abdominal space due to the wing-shaped deformation of the ribs. X beside the left nipple indicates the deep hiatus, and the circles indicate the port placement (U: umbilicus, B: gastrostomy button).

has been reported in the literature [10]. Duodenal obstruction due to vertebral deformity or superior mesenteric artery syndrome in patients with severe scoliosis is also a demanding aspect to manage [11]. In such patients, a combined tube jejunostomy for enteral nutrition should be considered together with a gastrostomy for gastric drainage.

The high morbidity rate of direct aspiration is one issue in neurologically impaired patients. Diminished cough reflex owing to chronic intratracheal aspiration is also responsible for progressive deterioration of an infected respiratory tract in such patients [12]. Kawahara et al. reported that respiratory symptoms remained poorly controlled in 52% of the patients who underwent laparoscopic fundoplication, with some of them requiring further respiratory care including nasal airway tube, tracheostomy and laryngotracheal separation (LTS) [12]. Two out of the seven patients in our series required tracheostomy, and one died due to recurrent pneumonia after fundoplication. Takamizawa et al. stated that simultaneous LTS with fundoplication and gastrostomy may be recommended for patients who have impaired swallowing and GERD [13]. Respiratory resuscitation, including tracheostomy and LTS, should be considered in the treatment of handicapped patients with respiratory symptoms when the indication for fundoplication has been determined or respiratory symptoms remained after fundoplication [12,13].

In our experience, the outcome of laparoscopic Nissen fundoplication in adolescents with severely scoliosis and neurological impairments was satisfactory without recurrence of GERD. However, recurrent aspiration pneumonia remained in some patients even after fundoplication. In such cases, an anti-aspiration procedure may be considered to achieve a higher quality of life.

Conflict of interest

All authors have no conflict of interest.

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