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Operative Techniques

Comparison of transhiatal laparoscopy versus blind closed-chest cervicotomy and laparotomy for esophagectomy in children

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Abstract

Background: Esophageal replacement for caustic stenosis in children poses a challenging surgical problem. Blind removal of the injured esophagus without thoracotomy through a left cervical and transhiatal approach followed by an orthotopic esophageal replacement using either the colon or the stomach is a difficult procedure and can be dangerous in children. We performed our first total laparoscopic transhiatal esophagectomy in February 2007. We aim to compare this new technique to the previously applied method of blind closed-chest esophagectomy through a cervicotomy and laparotomy.

Methods: We analyzed the surgery and follow-up of 40 children operated upon for extensive irreversible caustic burns of the esophagus. The first 20 esophageal replacements were performed following a blind dissection of the mediastinum through a cervical incision and a laparotomy for esophagectomy (Group I). The last 20 esophageal replacements were performed after laparoscopic transhiatal dissection in the mediastinum and cervicotomy in the neck for esophagectomy (Group II). All operations were performed under the supervision of the same senior surgeon.

Results: Average age at the time of surgery was the same in both groups. Total esophagectomy was achieved in 45.0% of cases in Group I versus in 90.0% of cases in Group II. Colon was used in 80.0% of cases in Group I and in 90.0% in Group II. The mean duration of surgery was one hour longer in the laparoscopy group. One vascular injury was reported in the blind laparotomy group. Pneumothorax was more frequent in Group II without significant consequences besides drainage. Average time of extubation was about the same in both groups (1.8 days).

Conclusion: Laparoscopic transhiatal esophagectomy for caustic burns before esophageal replacement in children is safe and effective. It could avoid vascular and bronchial mediastinal injuries as the dissection is performed under direct visual control. The routine use of laparoscopic assistance by a senior surgeon improves the safety of esophageal dissection and reduces life-threatening complications.

Esophageal replacement in children may be necessary for irreversible caustic strictures. Caustic injuries are often caused by the ingestion of strong alkaline cleaning agents or, especially in Africa, to make homemade soap, straighten hairs or whiten skin. Caustic injury represents the most common cause for esophageal replacement in children. The esophagus may be replaced by using either the stomach, colon or small intestine. Colonic transplant is our first choice for esophageal replacement, and gastric tube the second.

In 1978, Orringer [1] was the first to describe a blind esophagectomy without thoracotomy. Since 1989 we have introduced the one-stage orthotopic esophageal replacement

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following closed-chest esophagectomy [2,3]. The esophagus is removed through a left cervical incision after its transhiatal dissection by laparotomy without thoracotomy. A blind digital dissection is performed on the middle part of the esophagus, where scarring and adhesions to the major vascular structures and bronchi are the most severe and can lead to potentially serious life threatening injuries [3].

Ideally, the damaged esophagus is totally removed before replacement. But in some cases, the adhesions to the surrounding structures are so dense that it becomes too dangerous to remove the esophagus. This is why we decided to try a new technique that allows esophageal dissection under direct visual control without thoracotomy or thoracoscopy, in order to avoid the need for a third surgical access. The experience with transhiatal dissection of the esophagus in adults with cancer encouraged us to also start using this procedure for caustic burns in children in February 2007. We presented our first ten consecutive cases at the 17th IPEG meeting in 2008 [4].

Many studies have described laparoscopic esophagectomy in adults, most of them for cancer, as feasible and safe compared to open esophagectomy [5–7]. Recent meta-analysis [8] cannot prove a benefit in terms of morbidity and mortality of esophageal dissection by laparoscopy as opposed to blind dissection of the esophagus, although other recent publications indicate a lower level of morbidity in an adult population [9,10].

Some cases of esophageal dissection in children by a combination of thoracoscopy [11–14] and laparoscopy have been reported, but very few by laparoscopy [15,16] alone, and no comparison of the open procedure with the laparoscopic one has been offered, although laparoscopy has been shown to have the potential to minimize the morbidity of esophageal resection, especially when associated with a transhiatal approach. The aim of the present study is to compare the safety and efficacy of laparoscopic transhiatal esophagectomy for esophageal replacement with esophagectomy by laparotomy and blind dissection of the mediastinum.

1. Material

1.1. Children

We analyzed 40 esophageal replacements performed in our Department of Pediatric Surgery between 2004 and 2011 following extensive irreversible caustic burns in children. We divided the children into two groups according to the type of surgery for esophageal dissection and esophagectomy: the first 20 children, Group I, were operated on before the introduction of laparoscopic esophagectomy, through a left cervical approach and a blind transhiatal dissection of the esophagus after a laparotomy (Group I); and the last consecutive 20, Group II, were operated on through a cervical dissection and a transhiatal laparoscopic dissection (Group II). No esophageal dilatation was carried out before surgery because of the severity of the stenosis evidenced by endoscopy and radiological exams.

All children were referred to us from West Africa (our pediatric department has been providing medical support to African countries since 1980 by organizing yearly surgical and follow-up missions). All children were hospitalized before the operation for radiological and laboratory investigations, evaluation of their general health and possible need for renourishment through their gastrostomies. The extent of the stenosis, the laryngo-tracheal junction and the general aspect of the esophagus were investigated by esophageal and laryngo-tracheal endoscopy and by UGI files.

1.2. Surgical technique

The preparation of the child by the anaesthetists routinely includes placement of a right radial artery catheter, a right central venous catheter and a urethral bladder catheter. An epidural catheter is inserted as well, to allow reinforced analgesia. The end-tidal CO_2 is monitored with special care, and the ventilator settings are adjusted according to the mediastinal pressure. Vascular lines are placed on the right side of the neck in order to keep the left side free for the surgeon.

For the laparoscopic procedure, the child lays supine at the foot end of the operating table. The legs are wrapped, if possible in the “frog position” to allow the surgeon to face the diaphragm. The head is turned to the right with shoulders slightly raised up to expose the neck. The surgeon stands at the lower end of the table, facing the baby, and the two assistants sit on each side of the table, one on the left for the camera, and one on the right for the liver retractor. The gastrostomy is temporarily closed with a cross stitch.

The first 5 or 7 mm port is placed through the umbilicus according to Hasson’s technique to insert a 5 or 7 mm × 30° telescope. A pneumoperitoneum is established by inflation to a maximum of 10 to 12 mm Hg of CO_2, depending on the age of the patient. Under direct vision, three 5-mm ports are inserted for instruments: a right lateral sub-costal port for the liver retractor, and two other ports on each side of the hypochondrium for bimanual surgery (Fig. 1). In order to allow good access to the esophagus, the right-hand port is placed in relation to the position of the gastrostomy: i.e. slightly inward and inferior to it. The table is then tilted to a 30° reversed Trendelenburg position. We use conventional 5 mm instruments, independently of the age of the patient. We use either bipolar electrocoagulation or Ligasure® (LS 1500 Dolphin Tip laparoscopic instrument by Covidien, Valleylab) for sealing and for dissection. A non-traumatic circular retractor (Diamond-Flex®, by Genzyme) is used, first for retracting the liver and later for lifting up the heart in order to widen the operating field in the thorax.

The first step is the lysis of peritoneal adhesions with Ligasure®. The liver is then retracted and the pars flaccida of the omentum opened. The crura are identified. The