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DISEASES OF THE ESOPHAGUS

Original article

Prevention and management of complications after colon interposition for corrosive esophageal burns

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SUMMARY. **We present our experience in the management of complications after a colon interposition for corrosive esophageal burns. From April 1976 to December 2006, 85 patients with caustic esophageal burns were included in this study. The superior belly median incision with an anterior border incision of the left sternocleidomastoid was used. Anastomosis between the colon and the cervical esophagus was performed in 68 and between the colon and pharyngeal portion in 14 patients. An esophageal scar part resection and gastric-esophageal anastomosis was performed in one patient who had been given an unsuccessful colon and jejunum interposition at another institute. An anastomotic modeling operation was performed in one patient with anastomotic stricture who had been managed with colon interposition at another institute. Exploratory thoracotomy and gastrostomy was performed in one patient who had an unsuccessful colon interposition at another institute. Seven of 14 patients (8.5% of 17.1%) died with serious complications such as aspirated pneumonia, interposition colon necrosis, abdominal wound dehiscence and degradation of swallowing and concordance function. However, others with such serious complications survived and were discharged for rehabilitation after corresponding treatment. The 25 patients (30.1%) with other mild complications were discharged for rehabilitation and corresponding management. Two patients from other institutes were discharged for rehabilitation and one was lost to follow-up. The most dangerous complication of this procedure is colon necrosis, and the stomach is the best organ for re-operation. Otherwise, aspiration in infants due to hypoplasia and degradation of swallowing co-ordination needs attention. Peri-operative management is very important, including the control of mediastinal and pulmonary infection and systemic nutritional support to avoid abdominal wound dehiscence. The platysma flap is an excellent method for the treatment of anastomotic stricture.**

KEY WORDS: **colon interposition, complication, corrosive esophageal burn, necrosis, platysma.**

INTRODUCTION

Corrosive esophageal burns occur frequently after the consumption of a strong acid or base. Alimentary tract reconstruction is necessary for the treatment of scar stricture after burns. A colon interposition is one of the most frequently used methods of alimentary tract reconstruction for the treatment of esophageal scar stricture after corrosive esophageal burns.[1,2] However, the complications are usually difficult to handle and their incidence is very high[3,4] because of poor body nutrition, complicated operative procedures and contamination of the anastomotic site. The prevention and management of postoperative complications is critical to the success of this operation and requires attention.

We present our experience of the prevention and management of complications in the past 30 years. In our case report, there are 82 patients for whom colon interpositions had been performed in our institute and three who were admitted to our institute for further treatment of complications after colon interpositions performed in other hospitals.

PATIENTS AND METHODS

Patients

From April 1976 through December 2006, there were 85 patients with caustic esophageal burns who were

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included in this study. There were 55 male and 30 female patients, ranging in age from 5 to 68 years (average age 28.6 years). Twenty patients were below 14 years of age. The most common caustic agent was alkali in 71 (83.5%) patients, followed by acids in 10 patients (11.7%). Two patients swallowed pesticide. The other two patients ingested an undetermined liquid. Among the 85 patients with caustic agent ingestion, 80 ingestions were accidental and five were suicide attempts. The time between ingestion and the hospital visit ranged from 1 h to 5112 days. The esophagogram before operation indicated nine stenoses in the upper chest part, 11 in the middle chest part, 15 in the lower chest and 50 with widespread stenosis.

In the 85 patients, 82 colon interpositions were performed in our institute including two patients in whom intraluminal stenting was unsuccessful and three patients with esophago-pleural fistulas resulting from esophageal dilation performed at other hospitals.

Three patients were admitted to our department for further management of complications after a colon interposition from other hospitals. Their history is as follows:

Patient Wang, male, 16 years old. When he was 4 years old he was given a colon interposition in a local hospital because of corrosive esophageal burns. However, transplanted colon necrosis occurred. As a result, he had been feeding through a stomach stoma for 11 years. When he was 16 years old, he was given a retrosternal jejunum interposition procedure with microsurgical technique. Unfortunately, chest pain, high fever and toxic shock occurred in the 2 months after the operation. A chest X-ray showed several air fluid levels behind the sternum and indicated jejunum necrosis. The patient was admitted to our institute for further treatment.

Patient Qin, female, 12 years old. When she was 7 years old she was given a colon interposition procedure in a local hospital after corrosive esophageal burns. However, a cervical anastomotic leak occurred after the operation. Then a swallow barrier developed and only liquid food could be taken. The patient was admitted to our institute and barium swallow showed a cervical anastomotic stricture.

Patient Zou, male, 29 years old. When he was 28 years old he was given a colon interposition in a local hospital because of corrosive esophageal burns. However, cervical anastomotic leak occurred after the operation. Then thrill, high fever and toxic shock symptoms developed. Bilateral pleural effusion on chest X-ray indicated mediastinal infection. As a result the patient was admitted to our institute urgently for further treatment.

Methods

The 82 patients were given the a colon interposition procedure in our institute within half a year after their corrosive esophageal burns. Esophageal and gastric intestinal preparations were performed before the operation: (i) high protein, low fiber liquid food was given 72 h before the operation; (ii) metronidazole in the dose of 0.4 g t.i.d. (adult dose for 50 kg weight, conversion by weight for the children) was given by mouth or gastric-enterostomy stoma; (iii) 110 mL of 42.75% glycerine was given for a cleaning enema every night in the 48 h before the operation and on the morning of the operation day; (iv) Vitamin K was maintained at a dose of 30 mg, four times daily for three days; and (v) on the morning of the operation day, the esophagus was cleaned with a mixture of 100 mL of sodium chloride, 0.5% metronidazole, 4×10^6 μ benzyl-penicillin sodium and 1.2×10^6 μ gentamicin sulfate. Supportive treatments such as anti-infection measures, fluid replacement and nutrition support were given to the five patients in whom intraluminal stenting or esophageal dilation were unsuccessful.

During the operation, endotracheal intubation and general anesthesia were used. A superior belly median incision with an anterior border incision of the left sternocleidomastoid was performed. First, the skin, subcutaneous tissue and linea alba abdominis in the superior belly median line were cut open from the xiphoid process to the point below the umbilicus. The abdominal cavity was cut open with the excision of xiphoid process for detection. The part of the colon that was prepared to be transplanted was liberated and blocked without injuries for 15 min. The color and peristalsis state was observed and estimated. Then an anterior border incision of the left sternocleidomastoid was performed and the esophagus for anastomosis was liberated beyond the superior border of the scar. The upper end of the transplant colon was anastomosed with the cervical esophagus in 68 patients and the hypopharynx in 14 patients. In these 14 patients, when the colon was anastomosed with the pharyngeal portion, the debouchment of the pharyngeal portion was at least 3 cm, and the colon could be cut open between 1.0 and 1.5 cm longitudinally and sutured transversely. Three patients were given a total gastrectomy and jejunum substitution for the stomach. The left hemicolon was adopted in 77 and the right hemicolon was adopted in five patients. Nasogastric tubes could be fixed so as to avoid the adherence of the anterior and posterior walls of the anastomosis.

The management of the complications in the three patients transferred from other hospitals was as follows:

Patient Wang was given an emergency operation to split open his sternum. The transplanted colon was found to be necrosed and resected in the operation. In addition, a gastrostomy was performed in the patient for nutrient support. After the operation,

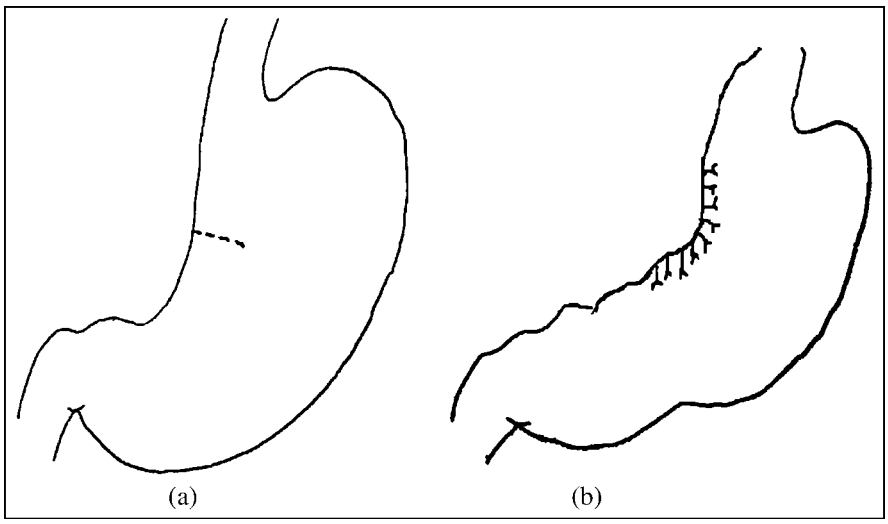

Fig. 1 The gastric wall in the lesser curvature of the stomach near the third branches of the right gastric artery, (a) can be cut open partially, and (b) sutured accurately so that the passage way could be enlarged.

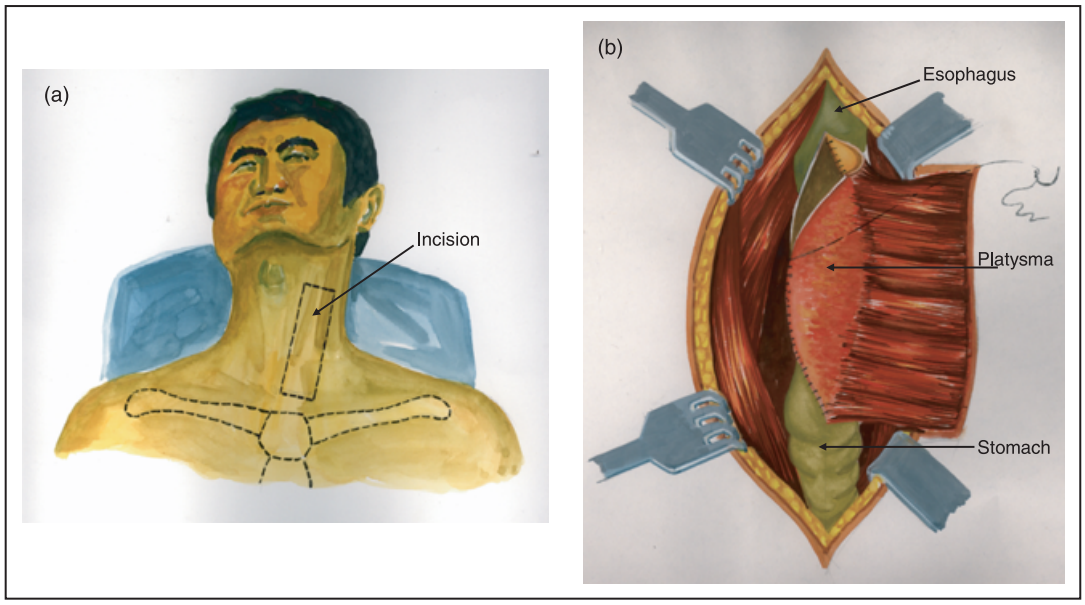

Fig. 2 (a) Incision along the anterior border of the left sternocleidomastoid, (b) complete cervical esophageal stricture repair with a platysma myocutaneous flap. The skin flap is rolled up with the skin side facing the esophageal lumen.

we advised the patient to enlarge his gastric volume with a large amount of liquid food through gastric stoma, step by step. Then, another operation was performed to resect the esophageal scar formation and make a gastric-esophageal anastomosis via a neck–chest–abdomen incision after 1.5 years. In order to ensure that the volume was large enough, we had designed two pre-emergency schemes before the operation as follows:

1 The gastric wall in the lesser curvature of the stomach near the third branches of the right gastric artery were to be cut open so as to be sutured accurately. Thus the passage way could be enlarged (Fig. 1). Previously, we had performed this kind of operation successfully in another group of three patients with gastric transposition for corrosive esophageal burns.[5] All these patients had been discharged to rehabilitation.

2 If the first scheme did not work, and the gastric volume was still not large enough, a second scheme would be used. An anastomosis was made with lower edge of the platysma myocutaneous flap (Fig. 2). Previously, we had performed this kind of operation successfully in another group of 18 patients with a platysma myocutaneous flap repair for corrosive esophageal burns.[6] There were no major complications, but one patient had an anastomotic leak that was

Table 1 Report and analysis of complications

Complication	Case number	Incidence	Treatment	Therapeutic efficacy
Aspirated pneumonia	4	4.8%	Intubation or incision of the trachea, antibiotics to which the bacteria are sensitive according to bacterial culture and breathing machine support	Two deaths due to acute respiratory distress syndrome and two discharges for rehabilitation
Interposition colon necrosis	2	2.4%	Antibiotics, drainage of the thoracic cavity and mediastinum and nutritional support	Two deaths due to infection
Abdominal wound dehiscence	3	3.6%	Two with emergent debridement and suture	One death due to acute peritonitis and two discharges for rehabilitation after emergent debridement and suture
Degradation of swallowing and concordance function	5	6.1%	Four with functional swallowing training with solid food by mouth	Four discharges for rehabilitation and one death
Cervical anastomotic leak	15	18.2%	The changing of wound dressing, drainage and other supportive management	discharged for rehabilitation
Gastric–colon anastomotic leak	2	2.4%	Re-operation to patch the leak	discharged for rehabilitation
Clolon anastomotic leak	1	1.2%	Re-operation to patch the leak	discharged for rehabilitation
Anastomotic stricture	7	8.4%	Two cases with esophagus dilation, two cases with stenosis shaping operation, three cases with patching by a platysma flap[15]	one gastrostomy after failure of esophagus dilation and six discharged for rehabilitation

Table 2 The report and analysis of death with serious complications

Number	Sex	Age	Cause of death	Time from the operation to occurrence of complication	Time from the operation to death
1	Male	8	Acute respiratory failure caused by aspirated pneumonia	3 days	8 days
2	Male	4	Acute respiratory failure caused by aspirated pneumonia	3 days	10 days
3	Male	18	Toxic myocarditis caused by necrosis of colon	4 days	10 days
4	Male	27	Serious mediastinal infection caused by necrosis of colon	10 days	17 days
5	Female	8	Peritonitis and toxic shock caused by abdominal wound dehiscence	7 days	10 days
6	Female	65	Systemic exhaustion after long-term vomiting caused by the degradation of swallowing and concordance function	10 days	50 days
7	Male	8	Disseminated intravascular coagulation and toxic shock caused by unclear infection	3 days	8 days

managed with drainage for 1 week. All of the patients could eat soft or solid food postoperatively. The operation procedure is complicated an is described in detail as follows. An incision was made along the anterior border of the left sternocleidomastoid muscle. Then the stricture was split longitudinally, extending to 1 cm each beyond the proximal and distal edges. A left platysma myocutaneous flap was used to widen its lumen. The designed area of the platysma myocutaneous flap was generally 4–5 cm in width and 7–8 cm in length. The anterior, superior and inferior incisions of the myocutaneous flap were extended through the platysma. The skin flap was rolled up with the skin facing the lumen and the stomach could then be sutured to the distal edge of platysma myocutaneous flap.

In this operation for patient Wang, we cut open the gastric wall in the lesser curvature of the stomach near the third branches of right gastric artery, then sutured it accurately to enlarge the passage way. Fortunately, using first scheme, the gastric volume was large enough for anastomosis and we performed it successfully.

Patient Qin was given a cervical anastomotic modeling operation, in which the stricture was cut open longitudinally to 1 cm each beyond the proximal and distal edges. It was then sutured transversally.

Patient Zou was given an exploratory thoracotomy and no intestinal tissue was seen in the operation. Then a gastrostomy was performed.

RESULTS

Of the 82 patients from our institute, seven patients with serious complications died after the operation. The mortality rate decreased from 10.8% before 1995

to 6.7% since 1995. The analysis of complications and death is shown in Table 1 and Table 2. The treatment results of the complications in the three patients transferred from other hospitals were as follows. Patient Wang could take food by mouth for 2 weeks after the operation and was discharged from our hospital. An anastomotic leak of the cervical esophagus occurred in Patient Qin after the anastomotic modeling operation. Supportive management, such as changing of the dressing and wound drainage, was applied for 2 weeks until the patient was discharged for rehabilitation. Patient Zou was given Ensure Powder through the gastric stoma and discharged. The patient was lost to follow-up.

DISCUSSION

The swallowing of strong acid or strong base can result in corrosive esophageal burns. The people of Chongqing (with a population of 30 million) in China have the habit of using a chafing dish. Caustic soda kept in drinking bottles for warming food, such as chitlings, is occasionally mistaken for a drink. As living standards in China develop, corrosive esophageal burns due to accidental ingestion of toilet cleanser (strong acid) occurs occasionally. Intraluminal stenting[7,8] or esophageal dilation may sometimes be helpful for the relief of the swallowing barrier in localized and light burns. However, esophagus reconstruction is often necessary for the serious and extensive stenosis that occurs after corrosive esophageal burns.[5,9] A colon interposition is widely used[10,11] because of its abundant blood supply and because it is long enough for the transplant. It can be transferred to the cervical or even the pharyngeal esophagus to make an anastomosis. The surgical trauma of a colon interposition is large and its manipulation is complicated.[12] The incidence of complication and death is high. The most serious complications include aspirated pneumonia, interposition colon necrosis, degradation of swallowing function and abdominal wound dehiscence. All these may lead to death. We present our experience with the 82 patients from our hospital and specifically describe the three patients from other hospitals whose complications were very difficult to treat.

Aspirated pneumonia might often occur in infant patients because of aspiration resulting from epiglottis hypoplasia. It should be found in time and intubation or incision of the tracheal should be performed immediately to apply breathing machine support (lower tidal volume, high frequency ventilation). In our series, the two infant patients were discharged for rehabilitation after such treatment.

Colon necrosis is the most dangerous complication. Two cases of interposition colon necrosis in our institute occurred before 2001. After that we instituted the following steps:

1 We gave great attention to the preparation of the alimentary canal, including the oral cavity and cleaning the esophagus with antibiotic liquid.
2 The interposition colon was anastomosed first with the cervical esophagus. Then the lower edge of interposition colon was cut off. Thus, the twisting of colon resulting from excess length was avoided. A proximal anastomosis with a single-layer suture was performed so that the tension of the interposition colon was lower down.

There was no case of colon necrosis after 2001. When this does unfortunately happen, a reconstruction operation should be performed. The stomach is the best organ for the re-operation. However, there are difficulties in anastomosis because of the small gastric volume. For example, Patient Wang had been given a colon and jejunum interposition procedure unsuccessfully at another hospital. The opacification through the gastric stoma before re-operation indicated that the gastric volume was not large enough for anastomosis in the cervical esophagus. Thus, it was enlarged with a large amount of liquid food through the gastric stoma, step by step for 1.5 years, after which the re-operation was successful.

Peri-operative management is very important. One patient was admitted in our hospital 5 months after receiving corrosive esophageal burns. A colon interposition was performed directly without nutrition support through the gastric stoma because of the patient's financial constraints. Abdominal wound dehiscence happened in 7 days after the operation because of malnutrition, leading to serious infection and consequently the patient died 10 days later.

Another patient had been given esophageal dilation three times in local hospitals, after which perforation of the esophagus occurred. The patient was then admitted to our hospital for further treatment and a colon interposition was performed. However, the patient had a high fever 3 days after the operation and a chest X-ray indicated a serious infection in both lungs. Treatment with antibiotics and sputum aspiration by bronchofibroscope was applied, when the temperature came down and the infection in the lungs was controlled. However, a high fever occurred again two days later. No clear infection in the lungs and in the wound of the cervical esophagus had been detected. The patient died of disseminated intravascular coagulation despite the active treatment and the patient's family members declined an autopsy, so the cause of death is unclear. However, it may have been mediastinal infection.

Thus, peri-operative management is very important, including the control of mediastinal and pulmonary infection and systemic nutrition support.

An esophagus dilation for corrosive esophagus burns must be considered. Corrosive esophageal burns in European countries are comparatively less serious because the injurious agent, such as detergent, is mild and the esophagus dilation success ratio has reduced to 60–80%. However, burns in China are very severe because the injurious agent is strong and the esophagus dilation success ratio is very low, while the complications ratio is very high). A chest computed tomography can be used to identify a mediastinal infection when an unclear infection occurs. Moreover, after colon interposition, the duodenal nutrient canal should be maintained for 3 weeks for prolonging the stage of enteral nutrition to avoid degradation of swallowing and concordance function.

Besides those serious complications, leak and stricture of the anastomosis is the most frequent complication after colon interposition. Since 1995 certain procedures have been adopted, such as 'wide margins, single-layered interrupted suture' in the cervical esophagus, stepping down the tension of anastomotic stoma, careful washing of operating field and drainage by Pan's drainage strip. The incidence of anastomotic leaks decreased in our institute since 1995. Anastomotic leaks in the cervical esophagus can be healed with management of drainage and changing the wound dressing. However, anastomotic strictures happen frequently in patients who have had an anastomotic leak. The reason may be the proliferation of granulation and scar tissue resulting from local infection. In addition, strictures occur frequently in anastomoses with the colon and normal esophageal tissue above the scar formation. It is therefore necessary to study the histomorphological differences between normal esophagus tissue above the corrosive esophagus and ordinary esophageal tissue.

The study is important for the determination of the anastomosis site. We have found that enlarging anastomosis in the operation is very important for the prevention of anastomotic strictures. Esophageal dilation is helpful for the relief of strictures in anastomoses. However, for a non-responder, an anastomotic modeling operation (a longitudinal incision and transversal saturation) is necessary in some shorter anastomotic strictures. Several other methods, such as major pectoral and latissimus dorsi myocutaneous flaps, have disadvantages.[13] We designed a platysma flap patching for anastomotic strictures and applied it successfully in three patients. Because the flap is very thin and rich in blood supply,[14] it is easy to canalize and likely to survive. Manipulation is very convenient and brings little injury. The platysma flap is an excellent way to patch cervical anastomotic strictures.

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