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Surgical management of Boerhaave's syndrome with early and delayed diagnosis in adults: a retrospective study of 88 patients

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ABSTRACT

Background: spontaneous esophageal rupture (Boerhaave's syndrome) is a rare and challenging clinical condition.

Objective: to evaluate the outcome of different surgical treatments for patients with Boerhaave's syndrome with an early diagnosis (< 24 h) and delayed diagnosis (> 24 h), using a retrospective cohort study in a tertiary referral center.

Patients and methods: eighty-eight patients with Boerhaave's syndrome who underwent surgical treatment were identified from March 1994 to March 2019 in the First Hospital of Shanxi Medical University. Subsequently, they were retrospectively divided into two groups according to time from symptom onset to diagnosis (group 1, < 24 h, n = 16; group 2, > 24 h, n = 72). Primary suture repair was

used in group 1 and reinforcement with a vascular muscle flap was used in group 2, in order to reduce the incidence of fistula. Patients in group 2 were further divided into two subgroups according to reinforcement using diaphragmatic flaps (subgroup 1) or intercostal muscle flaps (subgroup 2).

Results: the duration of hospitalization and stay in Intensive Care Unit (ICU) was significantly shorter in group 1 ($p = 0.027$ and $p = 0.001$). Group 1 had fewer postoperative esophageal leaks ($p = 0.037$) compared to group 2. Various aspects were compared in the two subgroups and the differences were not statistically significant ($p > 0.05$).

Conclusions: it is very important to establish an early diagnosis for patients with Boerhaave's syndrome. Early (< 24 h) and primary suture repair is superior to delayed (> 24 h) primary repair, even for those reinforced with vascular muscle flaps. Furthermore, repair reinforcement with different muscle flaps appears to render similar results for patients with delayed diagnosis.

Keywords: Boerhaave's syndrome. Surgery. Early diagnosis. Suture. Reinforcement.

INTRODUCTION

Spontaneous esophageal rupture is a rare and challenging clinical condition with a high mortality (1-3) and was previously known as Boerhaave's syndrome (4). Due to the low incidence and lack of typical symptoms, the rate of delayed diagnosis and misdiagnosis is over 50 % and the mortality rate is more than 20 % (5-7). Its incidence accounts for approximately 40 % of all esophageal perforations (8,9) and around 90 % of spontaneous perforations of the esophagus occur in the lower esophagus (10). When an esophageal rupture occurs, the gastric contents enter the mediastinum and thorax due to the negative pressure suction effect of the pleural cavity. This can cause severe contamination of the mediastinum and thorax, leading to serious inflammatory reactions dominated by necrosis, sepsis and multi-organ failure (11,12). Treatment of spontaneous esophageal rupture is divided into three possible options: surgery, endoscopy and conservative management (10,13). The first documented successful surgery of a spontaneous esophageal rupture repair was

performed by Dr. Barrett in 1947 (14). The death rate from spontaneous esophageal rupture remains high, despite significant improvements in almost all treatment conditions, including intensive care management, surgical techniques and antibiotic use (5-7). In addition, there is no established standard and uniform surgical procedure for this condition (8). The objective of this study was to report the experience of a cardiothoracic surgery tertiary referral center with the surgical treatment of Boerhaave's syndrome over a 25-year period.

PATIENTS AND METHODS

Patients

The records of 92 patients with Boerhaave's syndrome admitted to the First Hospital of Shanxi Medical University from March 1994 to March 2019 were reviewed. A retrospective cohort study was performed and four cases that underwent non-surgical treatment were excluded from the study. Eighty-eight cases were enrolled in the cohort study and data were collected from each patient (Table 1).

Chest X-ray, computed tomography scan, esophagography and fibroscopy were used to make a diagnosis. Spontaneous esophageal rupture was defined as a full thickness disruption of the esophageal wall excluding those due to disease and trauma. The patients were divided into two groups (Fig. 1) to analyze the outcome of different diagnostic times on the spontaneous esophageal rupture. Sixteen cases (18.2 %) diagnosed within 24 hours (group 1) underwent primary suture repair and 72 cases (81.8 %) diagnosed after more than 24 hours (group 2) underwent primary suture repair that was reinforced with vascular muscle flaps to reduce the incidence of a fistula. In group 2, vascular muscle flaps were diaphragmatic flaps (subgroup 1) or intercostal muscle flaps (subgroup 2).

Surgical treatment

All patients were treated by senior surgeons. Prior to the surgical procedure, all patients were fasted, a thoracic tube was placed and gastrointestinal decompression and broad-spectrum intravenous antibiotics were started. Thoracotomy was performed under general anesthesia through an intercostal posterolateral incision.

The localization of the esophageal perforation determined the side of the thoracotomy. Seventy-one cases (80.7 %) underwent a left thoracotomy and 17 cases (19.3 %) underwent a right thoracotomy. After a thorough debridement, 16 cases (18.2 %) diagnosed within 24 hours underwent a primary suture repair and 72 cases (81.8 %) diagnosed after more than 24 hours underwent a primary suture repair reinforced with vascular muscle flaps to control leakage. In delayed patients, diaphragmatic flaps were used in 51 cases (70.8 %) due to a lower esophageal rupture and intercostal muscle flaps were used 21 cases (29.2 %) with a middle esophageal rupture (Fig. 1). Stents were not used following suture disruption during the surgery. If stents were used during the surgery, the operation time was extended, surgical trauma was increased and the use of stents might cause some complications (15).

The esophageal mucosal injury is usually longer than the muscular tear, which has important implications for the technical aspects of suture repair. The muscular layer was incised before the suture repair to ensure that the full-length mucosal defect was clearly visible. Interrupted sutures (suture interval: 0.3 cm) with absorbable Vicryl 4-0 thread were performed at the site of mucosal rupture. Interrupted sutures were then performed in the muscular layer, using non-absorbable silk 3-0 thread. The pleural spaces and mediastinum were fully irrigated and two drainage tubes were inserted. One tube was placed close to the esophageal suture line and the other tube was placed close to the diaphragm for effective drainage.

The posterior mediastinum was opened through an incision in the seventh intercostal space in patients with a primary suture repair reinforced with a diaphragmatic flap. After the primary suture repair, the diaphragmatic flap was made by a full-thickness incision in the diaphragm and then the pedicled diaphragm was overlaid on the primary suture area of the esophageal rupture and was interruptedly sutured using non-absorbable silk 3-0 thread.

The posterior mediastinum was opened via an incision in the fifth intercostal space in the patients with a primary suture repair reinforced with an intercostal muscle flap. After the primary suture repair, the periostium of the lower border of the fifth rib was incised and the muscle flap of the fifth intercostal space was prepared by

keeping contact with the fifth rib, to avoid injury of the intercostal vessels during harvesting. Then the pedicled intercostal muscle was overlaid on the primary suture area of the esophageal rupture and was adapted with interrupted sutures using non-absorbable silk 3-0 thread.

Postoperative management included the monitoring of vital signs, broad-spectrum antibiotics to prevent infection and total parenteral nutrition to strengthen support treatment. Liver function, renal function, ion and blood cell analysis were monitored on the third and seventh days postoperatively. The esophagography was performed on the 10th day after surgery and healing of esophageal rupture repair was observed. The patient had liquid food on the 11th postoperative day if the esophageal break healed well and gradually transitioned to semi-liquid food and general food.

Statistical analysis

All statistical analyses were performed using the SPSS version 24.0 statistical software package (IBM Corp., New York, USA). Continuous variables were reported as the mean ± standard deviation (SD) or median (range) with the Student's t-test or Mann-Whitney U test, as appropriate. Categorical variables were compared using the Pearson's Chi-squared test or Fisher's exact test. $p < 0.05$ was considered to be statistically significant.

RESULTS

Patient demographics and operative data

The median age at diagnosis was 61 years (range 47-74), 71 patients were male (80.7 %) and 17 were female (19.3 %). The median duration of hospitalization was 26 days (range, 19-65) in all the patients, including three days (range 1-16) in the Intensive Care Unit (ICU). Postoperative leakage occurred in 29 patients (33 %), including one case (6.3 %) from group 1 and 28 cases (38.9 %) from group 2, which were managed with a conservative approach using antibiotics and thoracic tubes. There were ten (11.4 %) disease-specific deaths in all the patients, one case (6.3 %) died from leakage in group 1 and nine cases (12.5 %) died in group 2. This included six patients due to leakage and three patients due to other causes including myocardial

infarction, pulmonary embolism and respiratory failure. The clinical signs leading to a diagnosis of esophageal perforation are shown in figure 2. Chest pain was the main sign (89.8 %), followed by fever (78.4 %) and vomiting (73.9 %). The classical Meckler's triad (vomiting, chest pain and subcutaneous emphysema) (15) was noted in 35 patients (39.8 %).

Comparison between groups 1 and 2

The time from symptom onset to diagnosis was significantly shorter in group 1 ($p = 0.000$). The duration of hospitalization and stay in ICU was significantly shorter in group 1 ($p = 0.027$ and $p = 0.001$). Group 1 had fewer postoperative leaks ($p = 0.037$) compared with group 2. Group 2 had a higher disease-specific mortality, but there were no significant differences ($p = 0.682$).

Diaphragmatic muscle flaps *versus* intercostal muscle flaps

Subgroup 1 and subgroup 2 were compared in table 2. Seventy-two patients were repaired with reinforcement, including diaphragmatic flaps (subgroup 1, n = 51) or intercostal muscle flaps (subgroup 2, n = 21). Different aspects were compared in the two subgroups and the differences were not statistical significant ($p > 0.05$).

DISCUSSION

Spontaneous esophageal rupture is a rare clinical emergency with a high misdiagnosis rate. Treatment should be active once the diagnosis is clear, due to the rapid progression of the disease and high mortality (8,17). Typical clinical manifestations of spontaneous esophageal rupture are known as the Mackler's triad (16). However, only a small number of patients have all the triple signs at the same time (5). As a result, delayed diagnosis is common in spontaneous esophageal rupture. In general, admission within 24 hours of symptom onset is a major prognostic factor for patients with esophageal rupture (18). In the present study, we showed that primary suture repair can achieve a good outcome in the early group. In fact, the early primary suture repair group had a significantly shorter duration of hospitalization and stay in ICU compared with the delayed primary repair, even

those reinforced with muscle flaps. Furthermore, there were lower rates of postoperative leakage formation in the early group.

Nowadays, the attitudes in the literature toward spontaneous esophageal rupture generally support that the patients undergo a surgical repair, even for a delayed diagnosis if the patient can tolerate the surgical procedure. However, complicated surgery should be avoided when choosing the surgical methods in order to reduce surgical trauma (9,19,20). Therefore, for the less than 24 hours patients with esophageal rupture, only suture repair of the esophageal rupture was performed to reduce surgical trauma and the results were good.

It is important to control the formation of postoperative leakage in patients with a delayed diagnosis. In these adverse situations, the use of muscle flaps to enhance sutures can get good results, as it has been previously demonstrated in the literature (5,7,21). However, it should be noted that the selection of the muscle flaps should be free from obvious hyperemia, edema and pollution to ensure the therapeutic effect. Primary repair reinforced with an intercostal or diaphragmatic muscle flap is safe and feasible for patients with a delayed diagnosis since the postoperative mortality is acceptable (12.5 % in group 2 of our study compared to 20 % in the literature) (5-7).

Treatment methods of Boerhaave's syndrome mainly include surgical treatment, non-surgical treatment and endoscopic stent treatment. At present, the treatment of esophageal continuity reconstruction is divided into surgical treatment and endoesophageal self-expanding covered stent implantation (22-24). However, a self-expanding stent implantation has the risk of migration and post-procedure stricture. Furthermore, most patients require a debridement in the presence of a badly contaminated thoracic cavity (15,22). As a result, self-expanding stent implantation can be considered as a treatment option only when there is limited mediastinal contamination. In recent years, thoracoscopic esophageal repair has been an alternative surgical method for patients with Boerhaave's syndrome. Although we have no experience of this technique, it may alleviate postoperative pain and improve ventilation function (25,26).

This study has some limitations as it is a retrospective study with the inherent biases. A prospective study will be of greater value to define treatment decision-making and

outcomes.

CONCLUSION

Early diagnosis for patients with Boerhaave's syndrome is very important. Our findings show that early and primary suture repair is superior to delayed suture repair, even when reinforced with muscle flaps. Furthermore, primary repair reinforced with intercostal or diaphragmatic muscle flap is safe, feasible and indiscriminate for patients with a delayed diagnosis.

ETHICAL APPROVAL

This study was approved by the ethics committee of the First Hospital of Shanxi Medical University (accession number 2019-K-K001).

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Table 1. Characteristics and outcomes of patients in the study of group 1 and group 2

	Total n = 88	Group 1 (< 24 h) Primary suture repair n = 16	Group 2 (> 24 h) Reinforced repair n = 72	p value
Age (years)*	61 (47-74)	59 (47-70)	62 (49-74)	0.249
Male†	71 (80.7)	12 (75)	59 (81.9)	0.733
Body mass index (kg/m^2)‡	24.09 ± 5.04	24.64 ± 5.76	23.97 ± 4.90	0.812
Time to diagnosis (hours)*	37 (8-73)	15 (8-23)	45 (25-73)	0.000
Localization of perforation				
Left†	71 (80.7 %)	10 (62.5)	61 (84.7)	0.074
Right†	17 (19.3 %)	6 (37.5)	11 (15.3)	
Size of perforation (cm)				
< 3 cm†	39 (44.3)	6 (37.5)	33 (45.8)	0.544
> 3 cm†	49 (55.7)	10 (62.5)	39 (54.2)	
Stay in ICU (days)*	3 (1-16)	1 (1-5)	3 (1-16)	0.001
Stay in hospital (days)*	26 (19-65)	24 (19-33)	26 (19-65)	0.027
Postoperative leakage†	29 (33)	1 (6.3)	28 (38.9)	0.037
Disease-specific mortality†	10 (11.4)	1 (6.3)	9 (12.5)	0.682

ICU: Intensive Care Unit. *Values are median (range). †Values are n (%). ‡Values are mean ± standard deviation.

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Table 2. Characteristics and the outcome of patients in study subgroup 1 and subgroup 2

	Subgroup 1 reinforcement with diaphragmatic flaps n = 51	Subgroup 2 reinforcement with intercostal muscle flaps n = 21	p value
Age (years)*	62 (49-72)	59 (49-74)	0.932
Male†	41 (80.4)	18 (85.7)	0.743
Body mass index (kg/m²)‡	23.83 ± 4.80	24.33 ± 5.24	0.785
Time to diagnosis (hours)*	46 (25-73)	39 (25-72)	0.410
Localization of perforation			
Left†	43 (84.3)	18 (85.7)	1.000
Right†	8 (15.7)	3 (14.3)	
Size of perforation (cm)			
< 3 cm†	23 (45.1)	10 (47.6)	0.845
> 3 cm†	28 (54.9)	11 (52.4)	
Stay in ICU (days)*	3 (1-16)	3 (1-15)	0.544
Stay in hospital (days)*	26 (19-54)	27 (19-65)	0.542
Postoperative leakages†	18 (35.3)	10 (47.6)	0.330
Disease-specific mortality†	7 (13.7)	2 (9.5)	1.000

ICU: intensive care unit. *Values are median (range). †Values are n (%). ‡Values are mean ± standard deviation.

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Fig. 1. Selection criteria of surgical methods.

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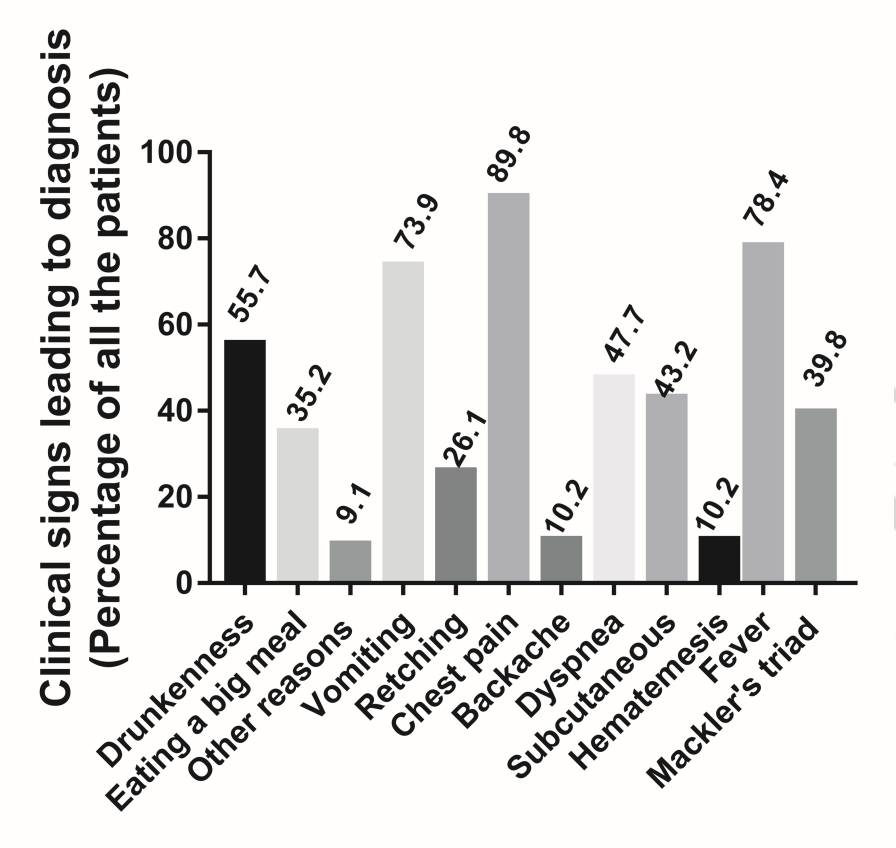

Fig. 2. Clinical signs leading to diagnosis.