Operative versus nonoperative techniques in emergency management of iatrogenic esophageal perforations

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Received: 2 January 2021
Revised: 14 January 2021
Accepted: 23 January 2021
Published: 12 October 2021

The Egyptian Journal of Surgery 2021, 40:515–521

Background
Iatrogenic esophageal perforation is a rare, challenging, and life-threatening clinical condition. It can be cervical, thoracic, or abdominal. Its diagnosis depends on clinical suspicion combined with radiological modalities. It can be managed by either nonoperative or operative means.
The aim of the study is to evaluate the efficacy of nonoperative compared with operative management of iatrogenic esophageal perforations.
Study design
This was a nonrandomized controlled study.
Patients and methods
This study included 30 patients presented with iatrogenic esophageal perforations after undergoing upper gastrointestinal tract endoscopic procedures. There were two groups of patients: group A included 12 patients who were subjected to nonoperative management, and group B included 18 patients who were subjected to operative management.
Results
The mean age of group A patients was 43 years, whereas for group B patients was 46 years. Most of the group A patients were males (66.66%), and 61.2% of the group B patients were males. The average length of hospital stay was 11 days (range, 8–15 days) for the group A patients and 14 days (range, 9–22 days) for the group B patients. Mortality was 16.6 and 22.3% for group A and group B, respectively.
Conclusion
Iatrogenic esophageal perforation is a rare and dangerous event. It can be managed by either nonoperative or operative techniques. Both methods have nearly the same success and morbidity and mortality rates when applied; however, the nonoperative techniques can be used only in certain cases under specific criteria.

Keywords:
esophageal perforation, iatrogenic perforation, nonoperative, operative management

Egyptian J Surgery 40:515–521

1110-1121

Introduction

Esophageal injuries are rare but represent serious and maybe lethal conditions. They are associated with high morbidity and mortality [1].

Iatrogenic perforations represent a large majority (60%) of esophageal perforations and occur mostly during either diagnostic or therapeutic endoscopic procedures like esophageal dilation, stent insertion, variceal ligation, and sclerotherapy [2].

The risk of perforation ranges from 0.03% in flexible esophagoscopy to 1–5% in pneumatic dilation of achalasia, as well as for variceal injection sclerotherapy, with all other endoscopic procedures falling within nearly the same range of risk [3].

The patient presentation depends on the site of the perforation and the time of the initial presentation. However, pain is the most common presenting symptom, which is usually of sudden onset after the initial esophageal procedure [4].

The imaging examination of choice in patients with suspected esophageal perforations is contrast-enhanced computed tomography (CT), and CT esophagography, which has a high sensitivity of up to 92–100% in detecting esophageal perforations and helps also to diagnose the presence of air or fluid collections in the mediastinum, pleural effusion, and intraperitoneal collections and to guide initial therapy [5].

Nonoperative management of esophageal perforations can be taken into consideration in stable patients with early presentation after injury, contained perforation, and minimal contamination of surroundings if adequate and strict follow-up is available. However, if the circumstances are not suitable for nonoperative management, the patient should be taken to the operation theater as soon as possible because any delay will be associated with higher morbidity and mortality [6,7].

Patients and methods

This study was performed at Ain Shams University hospitals between August 2018 and August 2020 on 30 patients who were referred to the upper gastrointestinal tract (GIT) surgery unit presented with esophageal perforation after undergoing upper GIT endoscopy procedures for esophageal pathologies like dilatation of achalasia, injection sclerotherapy for varices, and endoscopic stent insertion. Approval of the ethical committee was obtained before starting the study and all patients signed written consent after describing the procedure and the possible complication. Full history was taken from the patients, good clinical examination was done, and also their medical records were reviewed.

Laboratory investigations were done urgently for all the patients, which included CBC, PT, PTT, clotting time, and full chemistry, and also radiological investigations were done in the form of plain radiograph chest and abdomen in both erect and supine positions to confirm the presence of mediastinal emphysema, pleural effusion, pneumothorax, subcutaneous emphysema, or air under the diaphragm. Pelviabdominal ultrasound was done to detect the presence of any collection and then contrast-enhanced chest and abdominal CT were done to confirm the diagnosis.

During the period of diagnosis, the patients received the initial treatment in the form of antibiotics, fluid resuscitation, and analgesics under strict monitoring.

The management of patients either nonoperative or operative depends on certain factors like age of the patient, time of presentation after injury, site and severity of the perforation, general condition of the patient, degree of damage to the surrounding tissues, and the extent of contamination, and also concomitant esophageal pathology must be considered. So, there were two groups of patients: group A, which included 12 patients who were subjected to nonoperative management, and group B, which included 18 patients who were subjected to operative management.

Nonoperative management

Nonoperative management is suitable in stable patients with early presentation after injury, minimal contamination of surrounding spaces, and contained esophageal disruption. There are certain criteria for nonoperative management that have been proposed by Altorjay *et al*. [8], as illustrated in Table 1.

Patients candidate for nonoperative treatment were kept on nothing by mouth for a minimum of 7 days, nasogastric tube placement to prevent reflux, broad-spectrum antibiotics (aerobic and anaerobic bacteria), proton pump inhibitor therapy, and total parenteral nutrition with early initiation of enteral feeding to support esophageal healing. If there was associated pleural effusion or pneumothorax on chest radiograph, chest tube was inserted for drainage. If the patient was doing well on nonoperative management, we completed the procedure on it until control of sepsis and sealing of the perforation. However, if the patient's condition deteriorated, we proceeded with other measures like percutaneous radiology-guided drainage of persistent periesophageal or pleural collections or sometimes we were taking the decision for surgical intervention.

Moreover, endoscopic management like endoscopic stent insertion can be a part of nonoperative management when combined with the other lines of it.

Operative management

Surgical treatment was considered when the patient was not suitable for nonoperative management or if clinical deterioration occurred with such management. Once surgery was indicated, the patient was transferred to the operation theater as soon as possible without any delay.

The surgical procedure was different for every patient according to the location and size of the perforation, and time of presentation; however, there were certain principles to be followed, which included the following: (a) good exposure of the field, (b) debridement and excision of nonhealthy tissues, (c) repair and closure of the perforation if possible, and (d) good drainage.

Table 1 Criteria for nonoperative management of iatrogenic esophageal perforations

Early detection of perforation within 24 h
Nontumoral perforation
Availability of advanced imaging modalities and thoracic surgery
Absence of distal esophageal obstruction
Cervical or thoracic esophageal perforation
Contained perforation (limited extravasations of the contrast into esophageal lumen)
Absence of clinical sepsis

The surgical incision is tailored according to the perforation site where the cervical esophagus is approached through a left-sided neck incision along the anterior border of the sternocleidomastoid muscle or by collar incision if bilateral neck exploration is needed, while the middle third of the esophagus is explored through right thoracotomy at the level of the sixth intercostal space, while the lower third of the esophagus is reached via left thoracotomy at the level of the seventh intercostal space. Regarding the perforated abdominal esophagus, it should be approached through midline exploratory incision.

Regarding the cervical esophageal perforation, we were attempting to repair it directly when available where the esophagus was circumferentially mobilized for easy repair followed by drainage and debridement of the edges of the perforation then closure by single-layer interrupted suture with reinforcement of the repair with healthy surrounding vascularized tissue like sternocleidomastoid or digastric muscles with good drainage, and also we applied Ryle or jejunostomy tube for feeding and to support healing. When primary repair was not available as there was much disruption of more than 50% of the esophageal circumference or late surgical intervention, drainage was to be considered together with diversion (esophagostomy) to decrease sepsis and contamination.

Primary repair is the treatment of choice for the thoracic esophageal perforation, where the esophagus was approached with debridement of the edges of the perforation, washed, and cleared of any mediastinal or pleural contamination, followed by tension-free repair of the perforation, which was reinforced by intercostal muscle flap, pleural, or pericardial patch to decrease the possibility of postoperative leakage with adequate external drainage. A midline laparotomy was needed to create decompressing gastrostomy and jejunostomy for enteral feeding to allow successive healing. If primary repair is not available because of hemodynamic instability, delayed surgical exploration, extensive esophageal damage, or severe mediastinal sepsis, surgical options include exclusion and diversion and esophagectomy with delayed or immediate reconstruction.

Primary repair remains also the preferred surgical method in abdominal esophageal perforation, where we debrided necrotic tissue around the perforation together with drainage of any collection and relief of contamination, followed by single or double tension-free repair that was buttressed with an omental flap or gastric fundus wrap, creation of feeding jejunostomy, and adequate external drainage.

Statistical analysis

Data were collected, revised, coded, and entered to the Statistical Package for Social Science (IBM SPSS, Armonk, NY, USA), version 23. Data were presented as percentages. The differences in surgical outcomes between the two groups were compared using the Pearson χ^2 and Fisher exact tests. *P* values were reported where the results were considered to be significant with *P* value less than 0.05, highly significant with *P* value less than 0.01, and nonsignificant with *P* value more than 0.05 (Figs 1–6).

Results

This study was conducted on 30 patients who were referred to the upper GIT surgery unit complaining of esophageal perforation after undergoing upper GIT endoscopy procedures. Group A included 12 patients who were subjected to nonoperative management, and group B included 18 patients who were subjected to operative management.

Figure 1

Esophagoscopy showing iatrogenic perforation.

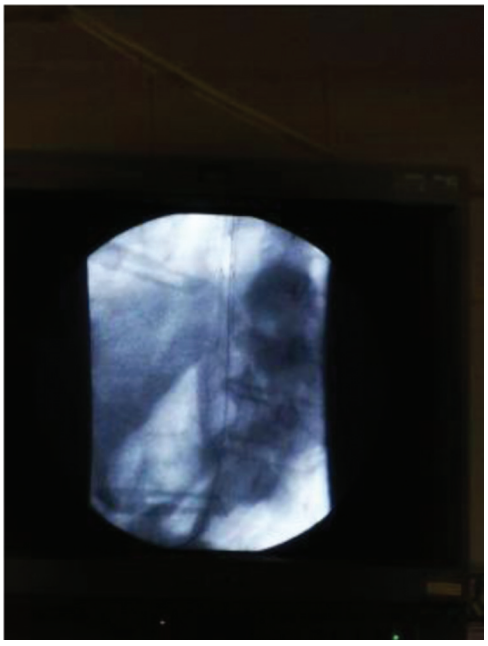
Figure 2

Esophagoscopy entering to chest cavity through the perforation.

Figure 3

Contrast study showing leakage of dye.

Figure 4



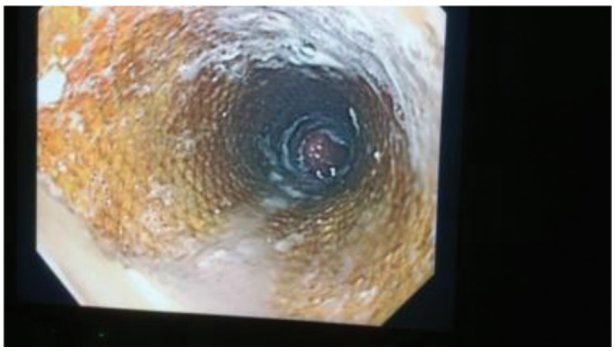
Preparing for stent insertion in proper place.

Among the patients of group A, eight (66.66%) were males and four (33.33%) were females, with the mean age of 43 years (range, 19–63 years), whereas the patients of group B were 11 (61.2%) males and seven (38.8%) females, with the mean age of 46 years (range, 23–59 years) (Table 2).

The mean time elapsed from the initial procedure till the patient's presentation was 16 h (range, 2–23 h) for group A patients and 20 h (range, 9–36 h) for group B patients.

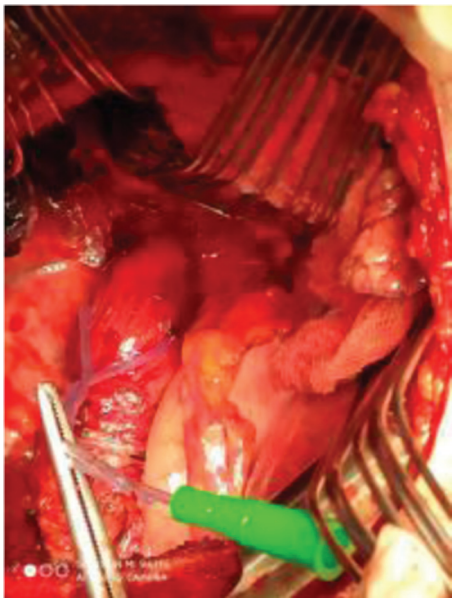
Regarding the initial pathology and the endoscopic procedure that was done, it was dilatation for achalasia

Figure 5



Stent insertion during the initial procedure.

Figure 6



Thoracotomy preparing for primary repair.

Table 2 Demographic characteristics of patients

Variables	Group A (*N*=12)	Group B (*N*=18)	*P* value
Sex (male/female)	8/4	11/7	0.432 (NS)
Mean age (years)	43	46	0.381 (NS)

in three (25%) patients of group A and in four (22.3%) patients of group B, endoscopic stent insertion in two (16.6%) patients of group A and three (16.6%) patients of group B, endoscopic balloon dilatation for postcorrosive stricture in three (25%) patients of group A and five (27.77%) patients of group B, variceal sclerotherapy in two (16.6%) patients of group A and four (22.3%) patients of group B, and endoscopic biopsy in two (16.6%) patients the group A and two (11.1%) patients of group B (Table 3).

The most common presenting symptom in the patients of both groups was pain, which was present in 10 (83.3%) group A patients and 14 (77.8%) group B patients, tachycardia was present in six (50%) group A patients and eight (44.5%) group B patients, dyspnea was present in seven (58%) group A patients and nine (50%) group B patients, hypotension was present in five (41.7%) group A patients and seven (38.9%) group B patients, fever was present in five (41.7%) group A patients and eight (44.5%) group B patients and two (11.1%) group B patients were shocked and were in need for ICU admission for resuscitation before the surgical interference (Table 4).

The diagnosis of the perforation often relied on a combination of clinical suspicion and radiographic evidence. In most cases, the diagnosis was made by the association between the clinical symptoms and chest or abdomen radiographic examination; however, other diagnostic modalities were needed to reach and confirm the definite diagnosis such as contrast study using a water-soluble agent like gastrografin to reveal a contrast leak in most cases of esophageal perforation, where it was helpful in diagnosis of nine (75%) patients of group A and 13 (72.22%) patients of group B. Finally, CT scan of the chest or the abdomen was used to confirm the diagnosis and detect the leakage site and any associated collections, where it was diagnostic in 11 (92%) patients of group A and 18 (100%) patients of group B.

Table 3 The initial procedures done

Procedure	Group A (*N*=12) [*n* (%)]	Group B (*N*=18) [*n* (%)]	*P* value
Dilatation for achalasia	3 (25)	4 (22.3)	0.823 (NS)
Endoscopic stent insertion	2 (16.6)	3 (16.6)	0.0735 (NS)
Endoscopic balloon dilatation for post corrosive stricture	3 (25)	5 (27.77)	0.0642 (NS)
Variceal sclerotherapy	2 (16.6)	4 (22.3)	0.865 (NS)
Endoscopic biopsy	2 (16.6)	2 (11.1)	0.0936 (NS)

Table 4 The clinical presentations of the patients

Variables	Group A (*N*=12) [*n* (%)]	Group B (*N*=18) [*n* (%)]	*P* value
Pain	10 (83.3)	14 (77.8)	0.0943 (NS)
Tachycardia	6 (50)	8 (44.5)	0.0635 (NS)
Dyspnea	7 (58)	9 (50)	0.853 (NS)
Hypotension	5 (41.7)	7 (38.9)	0.0752 (NS)
Fever	5(41.7)	8 (44.5)	0.0736 (NS)
Shock	0	2 (11.1)	0.0436 (S)
The mean time elapsed from the initial procedure (h)	16 (0–23)	20 (9–36)	0.0325 (S)

Regarding the site of the perforation, it was cervical in three (25%) patients of group A and four (22.3%) patients of group B, thoracic in seven (58%) patients of group A and 11 (61.1%) patients of group B, and abdominal in two (16.6%) patients of group A and three (16.6%) patients of group B (Table 5).

Regarding the group A patients, two (16.6%) patients were diagnosed during the initial procedure; both had cervical perforation, and they were managed by an endoscopic stent. Moreover, two (16.6%) patients then deteriorated (one of them had thoracic perforation and other had abdominal perforation), so that they were prepared for surgery and urgent surgical intervention was done where operative drainage with minimal debridement was done in both of them; however, the patient with thoracic perforation later on deteriorated and developed septic shock and later on died. The remaining eight (66.6%) patients were successfully managed with good follow-up; however, one patient later suddenly developed irreversible septic shock and died, whereas the remaining were followed up clinically and radiologically until resolution and sealing of the perforation. So, in general, two (16.6%) patients of group A died, and two (16.6%) patients needed surgical interventions, and one of them died later, so treatment was successful in nine (75%) patients of this group.

Regarding group B patients, the patients with cervical perforations [4] were subjected to primary repair, which was successful in all of them. The patients with thoracic perforations [9] were subjected to primary repair; however, four (22.3%) later developed leakage and were reoperated again, where debridement, wash, and drainage were done, but three of them later developed mediastinitis with septic shock and died later, whereas the patients with the abdominal perforations [3] were subjected to primary repair, but one (5.55%) patient developed leakage later and needed reexploration where debridement and drainage was done; however, the patient later deteriorated and

Table 5 The sensitivity of the diagnostic methods and sites of the perforations

Variables	Group A (*N*=12) [*n* (%)]	Group B (*N*=18) [*n* (%)]	*P* value
Diagnostic modality			
GG contrast study	9 (75)	13 (72.22)	0.0842 (NS)
Computed tomography	11 (92)	18 (100)	
Perforation site			
Cervical	3 (25)	4 (22.3)	
Thoracic	7 (58)	11 (61.1)	0.734 (NS)
Abdominal	2 (16.6)	3 (16.6)	

became shocked and died. So, in general, operative management was successful in 14 (77.7%), and four (22.3%) of the patients died.

The average length of hospital stay was 11 days (range, 8–15 days) for group A patients and 14 days (range, 9–22 days) for group B patients (Tables 6 and 7).

Discussion

Esophageal perforation is a rare and challenging event and always represents a medical emergency. Its diagnosis is dependent on a combination of clinical suspicion and radiological imaging. Our series included 30 patients divided into two groups according to the type of management: group A included 12 patients who had nonoperative management and group B included 18 patients who had surgical intervention.

The decision of the treatment plan was based on the criteria of Altorjay *et al*. [8] for conservative treatment.

Our series was limited to iatrogenic perforations, which is the most common cause of esophageal perforations [10].

A total of 30 patients were evaluated with a mean age of 43 years in group A and 46 years in group B, and the majority of patients in both groups were males.

A recent retrospective study included 21 patients who were treated from iatrogenic esophageal perforation at Oslo University Hospital whose median age was 66 years with male predominance coinciding with our patient's criteria [10].

Regarding the time between the perforation and the diagnosis, there was a significant difference between the two groups, where 16 patients presented before 24 h in group A who were managed by conservative approach, whereas 20 patients were presented later (within 36 h) who needed emergency operative surgery.

A systematic review of case series included 33 studies, where 1452 patients were evaluated, showing that late presentation was more common in 308 patients of iatrogenic perforations, representing 42.6% who were diagnosed after 24 h [11].

In our study, pain was the most prevalent symptom followed by fever and dyspnea which were nonspecific and making early diagnosis more challenging, as stated in the literature [9].

Early diagnosis and prompt management of iatrogenic endoscopic perforations reduce morbidity and mortality rates [12].

CT is irreplaceable as both an adjunct to or an alternative diagnostic modality for contrast esophagography in the diagnosis of iatrogenic esophageal perforation. CT can be used in cases where a patient cannot tolerate contrast esophagography or in the setting of a negative contrast esophagography in a patient with high clinical suspicion [3].

In our study, CT was necessary for establishing the diagnosis in 11 patients in group A and all patients in group B, agreeing with previous evidence.

On our preoperative assessment, we noticed that the thoracic part of the esophagus is the most common site of perforation after therapeutic endoscopic maneuver.

As stated by an interesting retrospective study, conducted in two university institutes over 47 patients, iatrogenic perforations were located at thoracic, distal, and cervical, representing 41, 38, and 21%, respectively [13].

There were no deaths (0%) among patients with cervical perforations in both groups, and five (16.6%) deaths with thoracic perforation among both groups. This finding is supported by Muir *et al*. [14] who stated that the lowest mortality rate was seen in the group of patients who had a cervical perforation (8%).

Table 6 Postmanagement course and patient outcome

Variables	Group A (*N*=12) [*n* (%)]	Group B (*N*=18) [*n* (%)]	*P* value
Management success	9 (75)	14 (77.7)	0.458 (NS)
Conversion from nonoperative to operative management	2 (16.6)	–	–
Reoperation after initial operative management	–	5 (27.77)	–
Mortality	2 (16.6)	4 (22.3)	0.0952 (NS)
Average length of hospital stays (days)	11 (8–15)	14 (9–22)	0.255 (NS)

Table 7 The relation of the mortality rate to the perforation site

The site of the perforation	Group A (*N*=12)	Group B (*N*=18)	*P* value
Cervical	0/3	0/4	NS
Thoracic	2/7 (28.6)	3/11 (27.3)	0.845 (NS)
Abdominal	0/2	1/3	NS

These findings coincide with the findings of an American systematic review stating that among anatomic locations, cervical esophageal perforations have the lowest mortality at 6%, whereas thoracic and abdominal perforations have considerably higher mortality at 27 and 21%, respectively [3].

Conversion from nonoperative plan to operative management occurred in two patients in group A, and these two patients had thoracic esophageal perforations, as it is known to be more aggressive.

Early management within the first 24 h after diagnosis of esophageal perforation is crucial for excellent outcomes.

There is little controversy over the importance of early diagnosis and initiation of optimal treatment of esophageal perforation [15].In our results, the mortality rate was more noticed in group B patients who had a later mean time of presentation (> 24 h), coinciding with several studies in the literature.

The reason for this increase in mortality is owing to the unique anatomical configuration and location of the esophagus, which allows bacteria and digestive enzymes access directly to the mediastinum, leading to the development of severe mediastinitis, empyema, sepsis, and multiple organ dysfunction syndromes [16].

Many studies have indicated that the interval time from perforation to treatment has a significant effect on mortality, with an interval of less than 24 h being associated with a significant reduction in morbidity and mortality [17].

On the contrary, a 27-year Canadian experience addressed this topic and stated that mortality risk was not related to waiting time exceeding 24 h [18].

Regarding the average length of hospital stay in our study, it was 11 days (range, 8–15 days) for the group A patients and 14 days (range, 9–22 days) for the group B patients.

This is similar to as described by a European retrospective review conducted over 81 patients experiencing iatrogenic esophageal perforation stating that the average length of hospital stay was 11 days [19].

Conclusion

Iatrogenic esophageal perforations are rare but represent dangerous and may be lethal conditions. They are treated by either operative or nonoperative techniques. There are no significant differences between both techniques regarding the efficacy, morbidity, and mortality rates; however, the nonoperative management can be applied only in certain circumstances under specific criteria and not suitable in all patients with iatrogenic esophageal perforations, unlike the operative management, which can be used in all patients regardless of the circumstances.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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