

Endoscopic Treatment versus Surgical Repair of Esophageal Perforation: A Systematic Review

Mena Saad Allah Lokas Yosab, MBBCh; Ahmed M. Farrag, MD; Hisham El-Akkad, MD; Tarek Abouzeid Osman, MD

Department of General Surgery, Faculty of Medicine, Ain Shams University, Egypt

Introduction: Esophageal perforation (EP) is considered a potentially fatal condition. The main causes are iatrogenic, spontaneous, foreign body (FB) ingestion, traumatic, and malignant. Treatment of choice is conventional due to different modalities available conservative treatment, surgical repair, and endoscopic treatment. While surgical repair has traditionally been the recommended treatment for EP, endoscopic treatment is becoming on the rise.

Aim of work: To provide cumulative data about the efficacy and safety of endoscopic treatment versus surgical repair of EP.

Patients and methods: This systematic review with meta-analysis was conducted at the Upper GIT Surgery Department, Faculty of medicine, Ain Shams University. This is a systematic review of literatures published in the recent ten years and prepared carefully to follow the Cochrane Handbook for Systematic Reviews of Interventions.

Results: Ten studies met the inclusion criteria with a total of 1452 patients (707 men, 728 women; mean age 66.5 years). The most common etiology was spontaneous (36.8%), followed by iatrogenic cause (21%), and the most common location was middle part (47%). Endoscopic treatment and surgical repair were done in 871, 581 patients respectively. The overall mean age was 66.5 years. There was a statistically significant higher complication ($P=0.015$) and longer length of hospital stay ($P=0.008$) in the surgical repair. Regarding mortality rate and failure of treatment, there was statistically insignificant difference among two groups ($P=0.042$) and ($P=0.45$).

Conclusion: Surgical repair of EP was associated with more complications and longer hospital stay than the endoscopic treatment. Neither is superior, in lowering the mortality rate and treatment failure.

Key words: Endoscopic treatment, surgical repair, esophageal perforation, Boerhaave syndrome.

Introduction

EP is considered a potentially fatal disease, with a mortality rate ranging from 10% to 40%. Delay in diagnosis due to nonspecific symptoms, and hence delayed initiation of treatment, as well as the absence of clear management guidelines, contribute to the rising mortality rate which is already high.¹

The etiologies of EP include iatrogenic, spontaneous, foreign bodies and trauma. These different etiologies make treatment difficult and challenging. Treatment of EP varies from aggressive surgical therapy to conservative management, according to the signs and symptoms at first presentation.²

The treatment is based on a number of factors, such as the cause, time of diagnosis, perforation site, level of abdominal and mediastinal contamination, comorbidities of the patient, and functional state. Management choice is based largely on the experience and available resources of the clinical team.³

Historically, aggressive surgical treatment was the main treatment for EP; however, with recent advancements in endoscopic techniques, the incidence of EP is fast growing with a change in etiologies.⁴

Surgical management includes drainage alone, primary closure, T-tube placement, esophageal

resection, and diversion techniques. The selection of the surgical approach based on the location of the perforation.⁵

Endoscopic treatment includes through-the-scope clips (TTSCs), over-the-scope clips (OTSCs), stents, suturing, and endoscopic vacuum suction therapy.⁶

We aimed to spot the light on EP comparing between the surgical and endoscopic line of treatment regarding safety and efficacy.

Patients and methods

This systematic review with meta-analysis was conducted at the Upper GIT Surgery Department, Faculty of medicine, Ain Shams University.

Search Strategy

An initial search for English literature was carried out using the PubMed, Cochrane library Ovid, Scopus & Google scholar using the following keywords: Endoscopic, surgical repair, EP, and Boerhaave's syndrome. This review was done using the standard methodology outlined in the Cochrane Handbook for Systematic Reviews of Interventions, version 6.2, 2021.⁷

Inclusion criteria

Studies that included adult patients were diagnosed with EP and were managed either by endoscopic

treatment or surgical repair in the last ten years.

Exclusion criteria

The exclusion criteria were as follows: Studies written in non-English languages, cadaver studies, animal studies, conference abstracts, and any short articles with incomplete data.

Data extraction

Data were fed to the computer and analyzed from the included studies using Review Manager (RevMan version 5.4.1, The Nordic Cochrane Center, the Cochrane Collaboration, Copenhagen, Denmark, 2021).

Study outcomes

Length of hospital stay, mortality rate, complication rate, and treatment failure.

Statistical analysis

A formal meta-analysis was conducted for all

outcomes if the data were sufficient. Pooled dichotomous data were expressed as risk ratios (RR) with 95% confidence intervals (95% CI), while pooled continuous effect measures were expressed as the mean difference (MD) with 95% CI. We explored and quantified between-study statistical heterogeneity using the I^2 test. By default, we used the fixed-effect model in all analyses. If heterogeneity was statistically significant ($p < 0.05$) or I^2 was $> 50\%$, we used the Der Simonian and Laird random-effects model instead.⁸

Results

A total of 3154 studies were identified through the main electronic databases. Of these, 135 studies were assessed for eligibility, and after excluding 125 studies, potential articles were selected for further screening. Among this total, ten studies (Nine retrospective studies,⁹⁻¹⁷ and one prospective study,¹⁸) met all the inclusion criteria and were included (**Fig. 1**). Characteristics of patients.

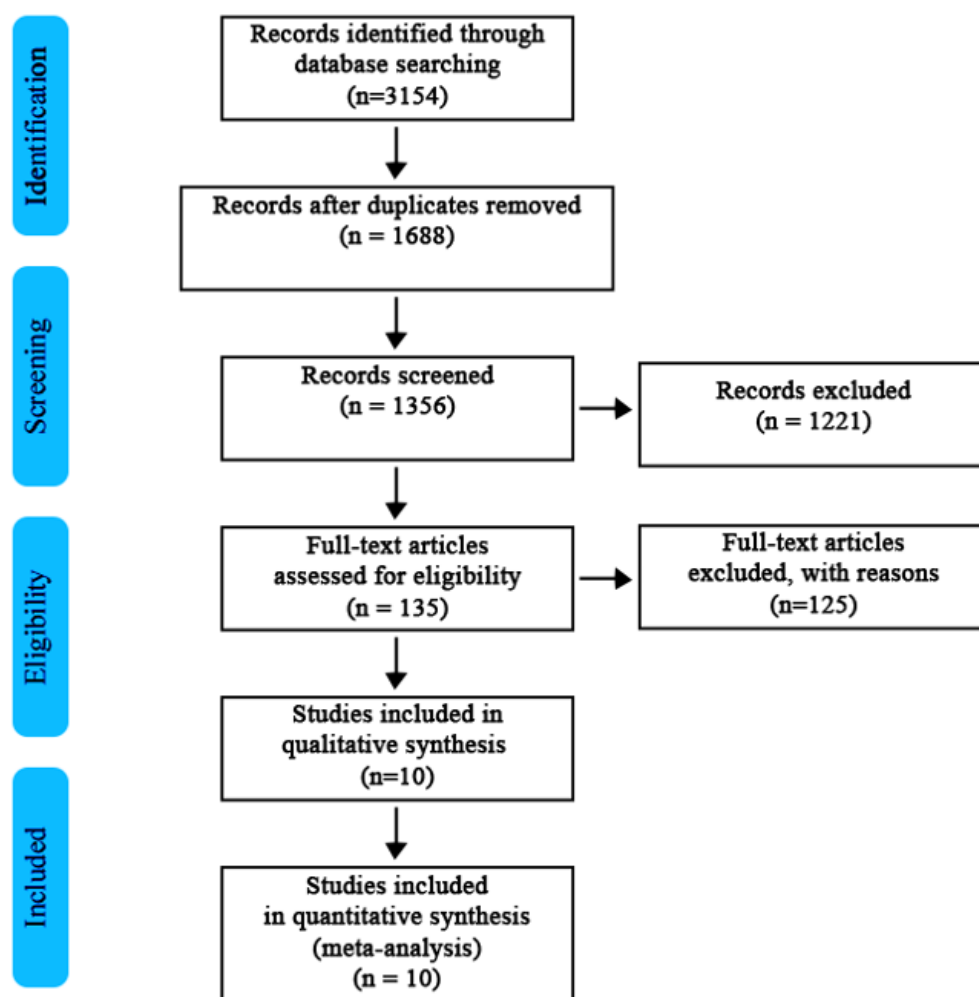


Fig 1: Flow chart showing the selection of studies in this pooled analysis.

Total number of 1452 patients were included with mean age 66.5 years and male\female ratio was 707\ 728.

Etiology and site of perforation

Regarding the etiology of perforation, the most common cause of EP was spontaneous perforation (63.8%), also known as Boerhaave syndrome, followed by iatrogenic causes (21%), malignancy (9.3%), FB ingestion (5.5%), and others (0.4%). The most common location was the middle third (47%), followed by the distal third (35.8%), the gastroesophageal junction (GEJ) (11.2%), and the proximal third (6%).

Type of treatment

Endoscopic treatment was done in 871 cases and surgical repair in 581 cases (**Table 1**).

Outcomes

The mean duration of hospital stay was significantly longer in the surgical group compared to the endoscopic group (21.29 days vs 13.67 days; $P=0.008$) (**Table 2**). Five studies assessed the difference between the two groups regarding events of complications (135 in the endoscopic group vs 315 in the surgical group). There was a statistically significant higher rate in the surgical group ($P=0.03$) (**Table 3**).

Six studies were conducted to assess the failure of treatment (29 cases in the endoscopic group vs 28 cases in the surgical group), with insignificant differences between the two groups ($P=0.54$), as illustrated in (**Table 4**). The mean mortality rate was 34.2% in the endoscopic group vs 19.3% in the surgical group, with insignificant differences between the two groups ($P=0.42$) (**Table 5**).

Table 1: Type of treatment

Author	Treatment	
	Surgery	Endoscopy
Axtell et al., 2021	109	33
Dickinson et al., 2016	8	8
Freeman et al., 2015	30	30
Jiang et al., 2012	7	35
Lindenmann et al., 2013	66	37
Markar et al., 2015	299	600
Schweigert et al., 2013	23	13
Søreide et al., 2012	21	26
Zhang et al., 2021	7	20
Zimmermann et al., 2017	40	40

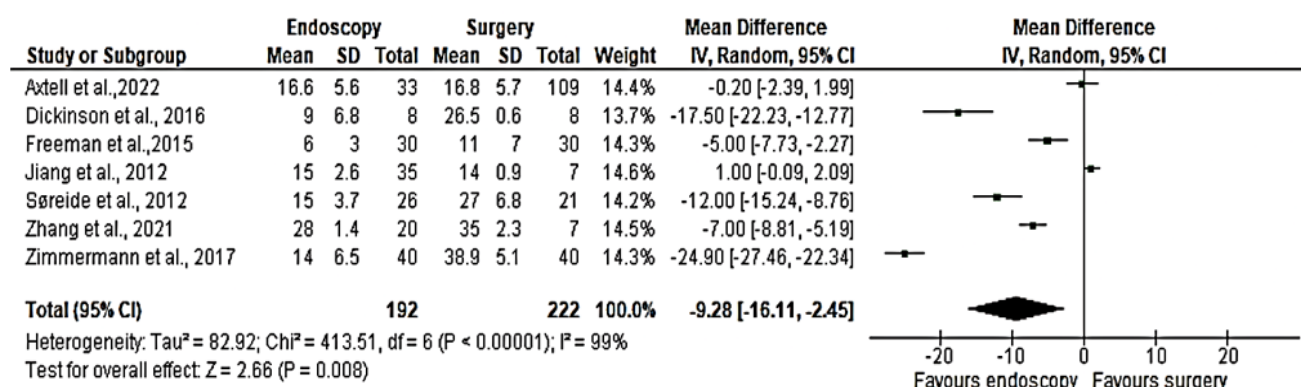


Table 2: Meta-analysis for hospitalization length\day.

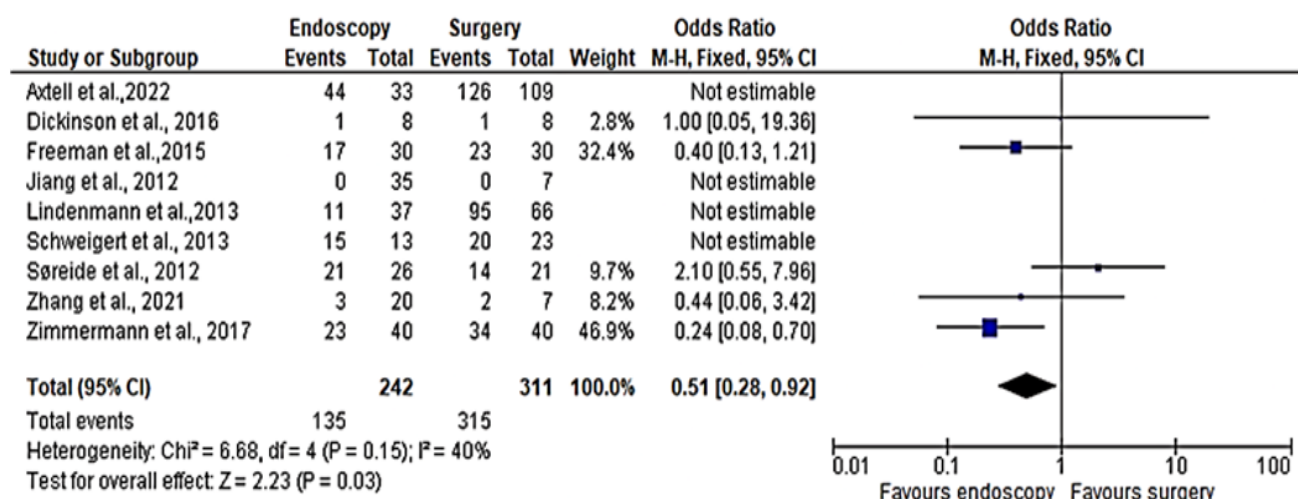


Table 3: Meta-analysis for complication.

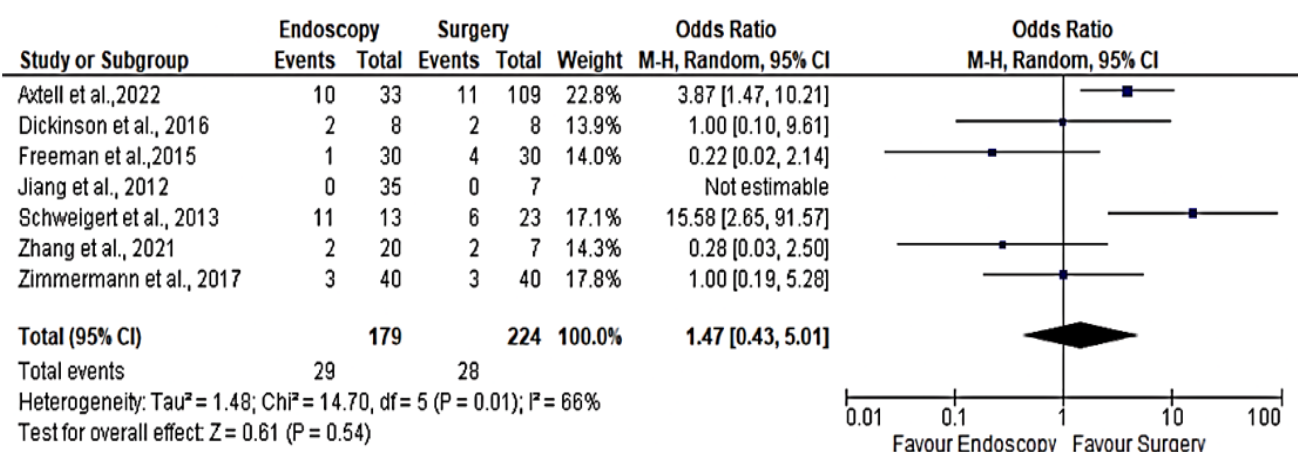


Table 4: Meta-analysis for failure of treatment.

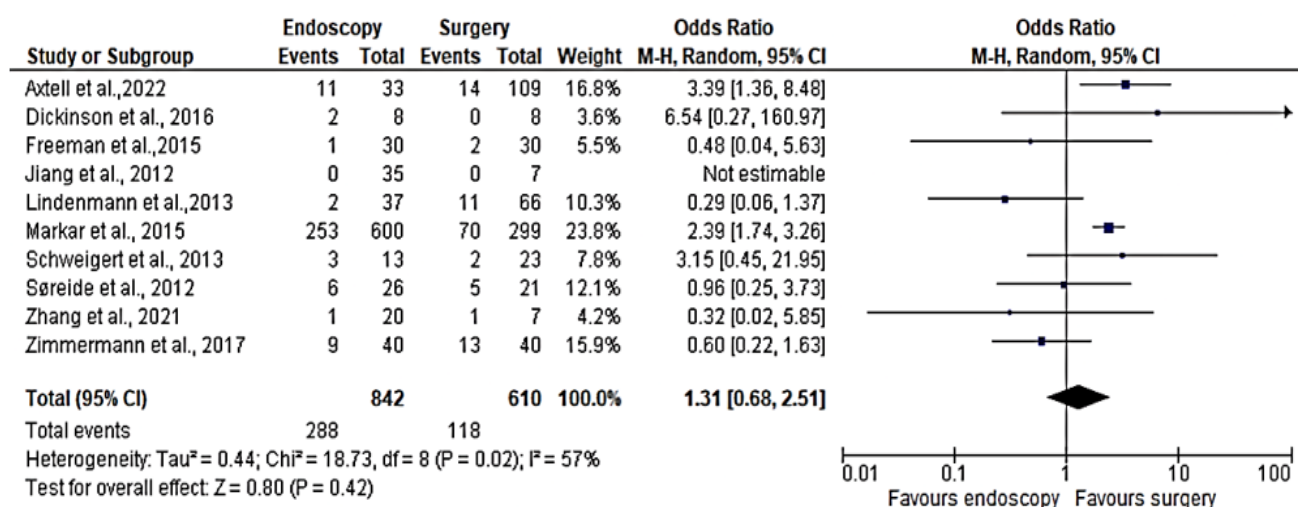


Table 5: Meta-analysis for mortality.

Discussion

EP is a highly fatal and morbid condition and remains an important therapeutic challenge with a variety of treatment modalities, including surgical, endoscopic, and medical therapies.⁹

Endoscopic therapy for esophageal leaks and perforations includes TTSCs and OTSCs, endoscopic suturing, endoscopic stenting, or a combination of these.¹⁹

Operative exposure provides a clear visualization of the perforation, allowing an assessment of surrounding tissue damage as well as permitting definitive repair of the defect, tissue debridement, and wide local drainage of contaminated spaces. This is particularly true if done during the first 24 hours from the injury.³

A total number of 1452 cases were included with a mean age of 66.5 years, and the male/female was 707/728, indicating a slightly higher prevalence in females.

The most common cause in this study was spontaneous perforation (63.8%) followed by iatrogenic causes (21%). Similar data were concluded by Schweigert et al.²⁰ who reported the commonest cause was spontaneous (Boerhaave; n=119), iatrogenic (Instrumentation; n=85), and coexisting esophageal cancer (n=43). In another study, Kuppusamy et al.²¹ stated that etiology of perforation involved iatrogenic (n=51; 63%), spontaneous Boerhaave syndrome (n=24; 30%), spontaneous (n=4; 5%), and FB induced (n=2; 2%).

The commonest location was the middle third (47%), followed by distal third (35.8%). Similarly, Ali et al.²² reported the commonest location was thoracic part (n=124; 62.3%) and thoracoabdominal (n=62; 31.2%). In contrary, Liao et al.²³ reported that a total of 61.2% of the perforations were in the cervical esophagus.

Our study showed that the mean length of hospital stay was longer in the surgical group than in the endoscopic group (31.85 days vs 16.5 days; $P = 0.008$). Similarly, Puertaviente et al.²⁴ reported longer hospital stays in the surgical group than in the endoscopic group (36.30 days vs 15.63 days; $P=0.029$).

Regarding treatment failure, our result stated that insignificant differences between the endoscopic group and surgical group (29 vs 28 cases; $P=0.54$). The mean mortality rate in our study showed insignificant differences between the two groups (34.2% vs 19.3%; $P=0.42$). The study of Deng et al.²⁵ of 45 studies reported that the mortality and complication rates in their center were 4.55% and 31.82%, respectively. Surgical treatments had

mortality rate of 10.01%, compared to 6.49% for conservative treatments.

However, Sweil et al.²⁶ reported successful management of endoscopic therapy. Endoscopic interventions (n=14; 61%), surgical repair (n=3; 13%), and conservative management (n=6; 26%). Twenty-four patients (87%) were discharged from the hospital, one patient (4.3%) pursued hospital care, and one patient (4.3%) died.

Regarding complications in our study, the total events in the endoscopic group vs the surgical group were (135 vs 315; $P=0.03$). Fattahi Masoom et al.² reported no significant relationship between complications on follow-up and time of presentation, cause of perforation, or type of treatment.

Conclusion

Management by surgical repair of EP was associated with more complications and longer hospital stay than the endoscopic treatment. Both are not superior to each other regarding reduction of treatment failure and mortality rate.

References

1. Huu VV, Viet DQ, Van KN: Surgical management of esophageal perforation: Role of primary closure. *Asian Cardiovascular and Thoracic Annals*. 2019; 27(3): 192-198.
2. Fattahi MS, Nouri DM, Fattahi A, Hajebi KS: Surgical management of early and late esophageal perforation. *Asian Cardiovascular and Thoracic Annals*. 2018; 26(9): 685-689.
3. Sepesi B, Raymond D, Peters J: Esophageal perforation: Surgical, endoscopic and medical management strategies. *Current Opinion in Gastroenterology*. 2010; 26(4): 379-383.
4. Sudarshan M, Elharram M, Spicer J, Mulder D, Ferri L: Management of esophageal perforation in the endoscopic era: Is operative repair still relevant? *Surgery*. 2016; 160(4): 1104-1110.
5. Lampridis S, Mitsos S, Hayward M, Lawrence D, Panagiotopoulos N: The insidious presentation and challenging management of esophageal perforation following diagnostic and therapeutic interventions. *J Thorac Dis*. 2020; 12(5): 2724-2734.
6. Gurwara S, Clayton S: Esophageal perforations: An endoscopic approach to management. *Current Gastroenterology Reports*. 2019; 21(11): 1-6.
7. Higgins J, Thomas J, Chandler J, Cumpston M, Li T, Page M, et al: Cochrane handbook for systematic reviews of interventions chichester (UK: John Wiley & Sons). 2021.

8. DerSimonian R, Laird N: Meta-analysis in clinical trials. *Controlled Clinical Trials*. 1986; 7(3): 177-188.
9. Axtell A, Gaissert H, Morse C, Premkumar A, Schumacher L, Muniappan A, et al: Management and outcomes of esophageal perforation. *Diseases of the Esophagus*. 2021; 35(1): 39.
10. Freeman R, Ascoti A, Dake M, Mahidhara R: An assessment of the optimal time for removal of esophageal stents used in the treatment of an esophageal anastomotic leak or perforation. *The Annals of Thoracic Surgery*. 2015; 100(2): 422-428.
11. Jiang J, Yu T, Zhang Y, Li J, Yang L: Treatment of cervical esophageal perforation caused by foreign bodies. *Diseases of the Esophagus*. 2012; 25(7): 590-594.
12. Lindenmann J, Matzi V, Neuboeck N, Anegg U, Maier A, Smolle J, et al: Management of esophageal perforation in 120 consecutive patients: clinical impact of a structured treatment algorithm. *Journal of Gastrointestinal Surgery*. 2013; 17(6): 1036-1043.
13. Søreide J, Konradsson A, Sandvik O, Øvrebø K, Viste A: Esophageal perforation: Clinical patterns and outcomes from a patient cohort of Western Norway. *Digestive Surgery*. 2012; 29(6): 494-502.
14. Markar S, Mackenzie H, Wiggins T, Askari A, Faiz O, Zaninotto G, et al: Management and outcomes of esophageal perforation: A national study of 2,564 patients in England. *Official Journal of the American College of Gastroenterology | ACG*. 2015; 110(11): 1559-1566.
15. Zhang C, Nienhüser H, Rupp C, Koschny R, Schmidt T, Müller-Stich B, et al: Endoscopic vacuum therapy for spontaneous and iatrogenic esophageal perforations: A retrospective study. *Clinics in Surgery*. 2021; 6: 1-7.
16. Zimmermann M, Hoffmann M, Jungbluth T, Bruch H, Keck T, Schloercke E: Predictors of morbidity and mortality in esophageal perforation: Retrospective study of 80 patients. *Scandinavian Journal of Surgery*. 2017; 106(2): 126-132.
17. Schweigert M, Beattie R, Solymosi N, Booth K, Dubecz A, Muir A, et al: Endoscopic stent insertion versus primary operative management for spontaneous rupture of the esophagus (Boerhaave syndrome): An international study comparing the outcome. *The American Surgeon™*. 2013; 79(6): 634-640.
18. Dickinson K, Buttar N, Wong Kee Song L, Gostout C, Cassivi S, Allen M, et al: Utility of endoscopic therapy in the management of Boerhaave syndrome. *Endoscopy International Open*. 2016; 4(11): 1146-1150.
19. Dickinson K, Blackmon S: Endoscopic techniques for the management of esophageal perforation. *Operative Techniques in Thoracic and Cardiovascular Surgery*. 2015; 20(3): 251-278.
20. Schweigert M, Sousa H, Solymosi N, Yankulov A, Fernández M, Beattie R, et al: Spotlight on esophageal perforation: A multinational study using the Pittsburgh esophageal perforation severity scoring system. *The Journal of Thoracic and Cardiovascular Surgery*. 2016; 151(4): 1002-1011.
21. Kuppusamy M, Hubka M, Felisky C, Carrott P, Kline E, Koehler R, et al: Evolving management strategies in esophageal perforation: Surgeons using nonoperative techniques to improve outcomes. *Journal of the American College of Surgeons*. 2011; 213(1): 164-71.
22. Ali JT, Rice RD, David EA, Spicer JD, Dubose JJ, Bonavina L, et al: Perforated esophageal intervention focus (PERF) study: A multi-center examination of contemporary treatment. *Dis Esophagus*. 2017; 30(11): 1-8.
23. Liao F, Zhu Z, Pan X, Li B, Zhu Y, Chen Y, et al: Safety and efficacy of nonoperative treatment in esophageal perforation caused by foreign bodies. *Clinical and Translational Gastroenterology*. 2022; 13(1).
24. Puertavicente A, Jiménez P, López M, Nisa F, Velasco G, Álvarez J, et al: Management of esophageal perforation: 28-Year Experience in a major referral center. *The American Surgeon*. 2018; 84(5): 684-689.
25. Deng Y, Hou L, Qin D, Huang T, Yuan T: Current treatment and outcome of esophageal perforation: A single-center experience and a pooled analysis. *Medicine*. 2021; 100(16): 25600.
26. Swei E, Heller J, Attwell A: Tu1089 iatrogenic esophageal perforation: A case series. *Gastrointestinal Endoscopy*. 2020; 91(6): 539-540.