Thoracotomy vs. Thoracoscopy For Empyema: A Retrospective Study

Beheshti Monfared M. MD[1], Eshraghi M. MD[2*], Eshagh Hosseini S. J. MD[3], Shamekhi Amiri M. MD[4], Ghasemi Sh. MD[5]

Abstract:

Background and Objective: Empyema is characterized by a pus-filled collection in the thoracic cavity, usually resulting from an infection in the pleural space, often due to bacterial pneumonia. This study aims to compare the complications, pain intensity, length of hospitalization, and outcomes associated with two treatment methods, thoracotomy and thoracoscopy, in patients with stage 2 empyema.

Materials & Methods: This retrospective cohort study included patients hospitalized at Shahid Beheshti Hospital in Qom, Iran, from 2021 to 2023. Sampling was performed using a two-stage stratified random method. Patient information, including medical history, clinical examinations, and demographic data, was recorded. Statistical analyses were conducted using SPSS software, with a significance level set at 0.05.

Results: Baseline demographic and clinical characteristics were comparable between the two groups. Patients who underwent thoracoscopy had significantly lower postoperative pain scores (4.87 ± 1.1 vs. 8.8 ± 0.5; P = 0.001), shorter hospital stay (3.47 ± 0.6 vs. 7.03 ± 0.5 days; P = 0.001), faster surgical site healing (1.14 ± 0.46 vs. 4.43 ± 0.61 weeks; P = 0.001), and a lower 30-day readmission rate (23.2% vs. 45.5%; P = 0.001) compared with the thoracotomy group. Mortality was lower in the thoracoscopy group (0% vs. 2.7%), although the difference was not statistically significant (P = 0.081).

Conclusion: Thoracoscopy is a superior surgical approach compared to thoracotomy for managing empyema, as it results in fewer complications and promotes faster patient recovery.

Keywords: Empyema, Thoracotomy, Thoracoscopy

[1]Department of Surgery, School of Medicine, Shahid Beheshti Hospital, Qom University of Medical Sciences
[2]Associate Professor of Thoracic Surgery, Department of Surgery, School of Medicine, Qom University of Medical Sciences
[3]Associate Professor of Colorectal Surgery, Department of Surgery, School of Medicine, Qom University of Medical Sciences
[4]Assistant Professor, Department of Vascular Surgery and Endovascular Therapy, Faculty of Medicine, Qom University of Medical Sciences, Beheshti Hospital of Qom, Qom, Iran
[5]Assistant Professor of Biostatistics, Department of Biostatistics and Epidemiology, School of Health, Qom University of Medical Sciences
Received: 02//112025
Accepted: 04/04/2026

Corresponding Author: Dr. Mohsen Eshraghi
Tel: 0253136493

E-mail: dr.mohsen.eshraghi@gmail.com

Background and Objective

Empyema is characterized by a pus-filled collection in the thoracic cavity resulting from an infection in the pleural space. It is most commonly caused by bacterial pneumonia, which leads to fluid accumulation (parapneumonic effusion) in that area.[1] Approximately 20% to 40% of patients hospitalized for pneumonia in the United States develop a parapneumonic effusion, and about 5% to 10% of these cases progress to empyema.[2] Each year in the U.S., empyema affects up to 65,000 individuals. Among these patients, roughly 15% do not survive, and 30% require surgical drainage of the pleural space.[3] The management of thoracic empyema depends on the stage of the disease. In the early stages, treatment typically involves antibiotic therapy and pleural drainage. In contrast, advanced stages frequently require surgical intervention. Stage 2 empyema, corresponding to the fibrinopurulent phase, is characterized by fibrin deposition, septation, and loculated pleural collections, and often necessitates surgical debridement and drainage to achieve adequate lung re-expansion. The primary surgical approaches for managing Stage 2 empyema include thoracotomy and video-assisted thoracoscopic surgery (VATS). Thoracotomy, the conventional surgical method, involves a large incision and rib spreading and is associated with increased postoperative pain and a longer recovery period.[4-7] Conversely, VATS is a minimally invasive technique that has demonstrated several advantages, including reduced postoperative pain, shorter hospital stays, fewer perioperative complications, and faster postoperative recovery.[4-7]

Numerous studies have demonstrated superior clinical outcomes with VATS in appropriately selected patients with empyema, including shorter hospital stays, lower pain scores, and earlier return to normal daily activities.[8-10] Nonetheless, thoracotomy may remain the preferred or necessary approach for patients with advanced disease, dense pleural adhesions, or complex pleural anatomy.[11,12] Given the substantial clinical burden of empyema and the significant influence of surgical approach on patient outcomes and healthcare resource utilization, identifying the optimal surgical strategy is of considerable importance. Accordingly, the present study aimed to compare postoperative complications, pain severity, length of hospital stay, and overall clinical outcomes between thoracotomy and VATS in patients with Stage 2 empyema admitted to hospitals in Qom province between 2021 and 2023.

Materials and Methods

This retrospective cohort study included patients diagnosed with stage 2 empyema at Shahid Beheshti Hospital in Qom, Iran, between 2021 and 2023. These patients were hospitalized following pleural fluid aspiration and chest radiography.

Sample Size and Patient Selection

The sample size was calculated as 112 patients per group based on a previous study, assuming a significance level of 0.05 and a statistical power of 80%. Medical records of eligible patients with stage II empyema treated between 2021 and 2023 were stratified according to the surgical approach (thoracotomy or thoracoscopy). A two-stage stratified random sampling method was used to select 112 patients from each group. All surgical procedures were performed by the same thoracic surgeon to minimize inter-operator variability.

Inclusion and Exclusion criteria

Inclusion criteria for this study encompassed all patients hospitalized with stage 2 empyema, confirmed by chest radiography and pleural fluid drainage, whose symptoms persisted for more than one week and who underwent either thoracotomy or thoracoscopy. Exclusion criteria included patients with unstable clinical status; those younger than 15 or older than 60 years; individuals with immunodeficiency; patients with positive pleural fluid cytology for malignancy; those

with underlying malignancy; and cases with incomplete medical records. After obtaining approval for the research proposal and an ethics code from the Research Committee of Qom University of Medical Sciences, the researcher proceeded with data collection.

Data collection

Patient information, including detailed history, clinical examination findings, postoperative outcomes, and demographic data, was recorded on a checklist. A separate checklist was completed for each patient.

Outcome Measures

Postoperative pain severity was assessed using the Visual Analogue Scale (VAS) within the first 24 hours after surgery. For analysis, the highest VAS score recorded during the hospitalization period was used. All patients received postoperative analgesia according to a standardized pain management protocol. Surgical site healing was defined as complete wound closure without clinical evidence of infection, discharge, or wound dehiscence. Healing status was evaluated by the attending surgeon during scheduled follow-up visits. Readmission was defined as any hospital readmission related to surgery-associated complications occurring within 30 days of discharge.

Statistical Analysis

Statistical analyses were performed using SPSS software, version 26. The distribution of quantitative variables was assessed for normality using the Kolmogorov–Smirnov test. Based on the data distribution, comparisons of continuous variables were conducted using either the independent *t*-test or the Mann–Whitney *U* test. Categorical variables were compared using the Chi-square test or Fisher's Exact test, as appropriate. A two-sided *P*-value of less than 0.05 was considered statistically significant.

No adjustments were made for multiple comparisons; therefore, the potential for Type I error should be considered when interpreting the results.

Table 1. Comparison of Clinical Outcomes Between Thoracotomy and Thoracoscopy in Patients with Empyema

Variable	Thoracotomy Mean/Number		Thoracoscopy Standard deviation/Percentage		P value
Age	48.8	6.82	47.4	5.72	0.102
Gender (Man)	66	58.9 %	68	60.7 %	0.785
Gender (Women)	46	41.1 %	44	39.3 %	-
Underlying disease (Yes)	68	60.7 %	70	62.5 %	0.785
VAS	8.8	0.5	4.8	1.1	0.001
Length of hospital stay (Day)	7.03	0.5	3.47	0.6	0.001
Surgical site healing (week)	4.43	0.61	1.41	0.46	0.001
Death	3	2.7 %	0	0 %	0.081
Readmission	51	45.5 %	26	23.2 %	0.001

Probability values were calculated using the chi-square test or independent t-test, as appropriate.

Findings

A total of 224 patients with stage II empyema were included in the study, with 112 patients in each group. Baseline characteristics, including age, sex, and the presence of underlying diseases, were comparable between the thoracotomy and thoracoscopy groups ($P > 0.05$). Patients who underwent thoracoscopy had significantly lower postoperative pain scores (4.87 ± 1.1 vs. 8.8 ± 0.5, $P = 0.001$), shorter hospital stay (3.47 ± 0.60 vs. 7.03 ± 0.50 days, $P = 0.001$), and faster surgical site healing (1.14 ± 0.46 vs. 4.43 ± 0.61 weeks, $P = 0.001$) than those who underwent thoracotomy. The 30-day readmission rate was significantly lower in the thoracoscopy group than in the thoracotomy group (23.2% vs. 45.5%, $P = 0.001$). Although mortality was lower in the thoracoscopy group (0% vs. 2.7%), the difference was not statistically significant ($P = 0.081$).

Discussion and Conclusion

Multiple studies have compared thoracotomy and thoracoscopy in the treatment of empyema, highlighting the advantages of thoracoscopy, especially VATS, over thoracotomy. These studies consistently demonstrate that VATS is associated with shorter hospital stays and fewer postoperative complications. For instance, a study on pediatric empyema found that VATS resulted in earlier discharge and fewer surgical wound infections compared to thoracotomy.[17] VATS is less invasive and results in less postoperative pain, which aligns with findings from other studies that report reduced pain and faster recovery times with thoracoscopic approaches.[18,19]

VATS has shown higher primary treatment success rates and lower mortality compared to non-surgical methods and thoracotomy in managing empyema. In pediatric cases, VATS demonstrated promising results, with fewer complications and no reported mortality.[17]

Thoracoscopy, particularly in the early stages of empyema, is an effective and safe procedure that yields better outcomes than thoracotomy, which is typically reserved for more advanced cases.[20]

Conversely, while thoracoscopy demonstrates clear advantages in recovery metrics, some studies suggest that thoracotomy may still be necessary for complex cases or when anatomical access is limited, highlighting the need for individualized surgical planning.[21,22]

Overall, the findings from our study, along with those from other research, support the preference for thoracoscopy over thoracotomy in managing empyema, especially in its early stages, due to its minimally invasive nature and superior postoperative outcomes.

Limitations

Several limitations of this study should be acknowledged. First, the retrospective design is inherently associated with risks of information bias, incomplete data collection, and limited control over potential confounding factors. Second, treatment allocation was not randomized but was determined by the operating surgeon's clinical judgment, which may have introduced selection bias and confounding by indication. Third, the study was conducted at a single tertiary referral center in Qom, Iran, which may limit the generalizability of the findings to other institutions, healthcare systems, or patient populations. Although having all procedures performed by a single surgeon minimized inter-surgeon variability, this factor may also reduce external validity and restrict the applicability of the results to broader surgical practice. Fourth, a multivariable analysis was not performed to adjust for potential confounders, such as baseline disease severity, comorbid conditions, and pleural characteristics, which could have influenced both treatment selection and outcomes. Fifth, the restricted age range of participants (15–60 years) limits the extrapolation of results to pediatric and elderly populations, in whom disease presentation and surgical tolerance may differ. Furthermore, postoperative pain was assessed exclusively during the initial 24 hours following surgery using the highest recorded VAS score,

precluding a longitudinal evaluation of pain trajectory or long-term functional recovery. Finally, the limited sample size restricted the statistical power to detect differences in rare yet clinically significant outcomes, such as mortality.

Recommendations

Future research should prioritize prospective, multicenter studies utilizing randomized allocation or robustly adjusted analytical designs to minimize bias and confounding. Broader inclusion criteria, encompassing pediatric and elderly populations, along with extended follow-up assessments, are necessary to enhance the generalizability and robustness of the evidence base.

References:

1. Shen KR, Bribriesco A, Crabtree T, Denlinger C, Eby J, Eiken P, et al. The American Association for Thoracic Surgery consensus guidelines for the management of empyema. The Journal of thoracic and cardiovascular surgery. 2017; 153(6): e129-e46.
2. Foley SP, Parrish JS. Pleural space infections. Life. 2023; 13(2): 376.
3. Semenkovich TR, Olsen MA, Puri V, Meyers BF, Kozower BD. Current state of empyema management. The Annals of thoracic surgery. 2018; 105(6): 1589-96.
4. Braimbridge MV. The history of thoracoscopic surgery. The Annals of thoracic surgery. 1993;56(3):610-4.
5. Stellato TA. History of Lap Aroscopic Surgery. Surgical Clinics of North America. 1992; 72(5): 997-1002.
6. Mack MJ, Aronoff RJ, Acuff TE, Douthit MB, Bowman RT, Ryan WH. Present role of thoracoscopy in the diagnosis and treatment of diseases of the chest. The Annals of thoracic surgery. 1992; 54(3): 403-9.
7. Sihoe AD. Video-assisted thoracoscopic surgery as the gold standard for lung cancer surgery. Respirology. 2020; 25: 49-60.
8. Vassallo R, Harari S, Tazi A. Current understanding and management of pulmonary Langerhans cell histiocytosis. Thorax. 2017; 72(10): 937-45.
9. Russell PS. Clinical approach to infection in the compromised host: Springer; 2013.
10. Miller RR, Nelems B, Müller NL, Evans KG, Ostrow DN. Lingular and right middle lobe biopsy in the assessment of diffuse lung disease. The Annals of thoracic surgery. 1987; 44(3): 269-73.
11. Ravaglia C, Bonifazi M, Wells AU, Tomassetti S, Gurioli C, Piciucchi S, et al. Safety and diagnostic yield of transbronchial lung cryobiopsy in diffuse parenchymal lung diseases: a comparative study versus video-assisted thoracoscopic lung biopsy and a systematic review of the literature. Respiration. 2016; 91(3): 215-27.
12. Miller JD, Urschel JD, Cox G, Olak J, Young JEM, Kay JM, et al. A randomized, controlled trial comparing thoracoscopy and limited thoracotomy for lung biopsy in interstitial lung disease. The Annals of thoracic surgery. 2000; 70(5): 1647-50.
13. Hazelrigg SR, Landreneau RJ, Boley TM, Priesmeyer M, Schmaltz RA, Nawarawong W, et al. The effect of muscle-sparing versus standard posterolateral thoracotomy on pulmonary function, muscle strength, and postoperative pain. The Journal of thoracic and cardiovascular surgery. 1991; 101(3): 394-401.
14. Di Mitri M, Thomas E, Capano E, Bisanti C, D'Antonio S, Libri M, et al. The role of the early video-assisted thoracoscopic surgery in children with pleural empyema. Pediatric Surgery International. 2024; 40(1): 134.
15. Mangione P, Vadier F, Senegas J. Thoracoscopy versus thoracotomy in spinal surgery: comparison of 2 paired series. Revue de Chirurgie Orthopedique et Reparatrice de l'Appareil Moteur. 1999;85(6):574-80.
16. Govindasaami V. Medical thoracoscopy: effective, cheap and safe for empyema. Journal of Thoracic Disease. 2023; 15(2): 940.
17. Mohajerzadeh L, Lotfollahzadeh S, Vosoughi A, Harirforoosh I, Parsay S, Amirifar H, et al. Thoracotomy versus video-assisted thoracoscopy in pediatric empyema. The Korean Journal of Thoracic and Cardiovascular Surgery. 2019; 52(3): 125.
18. Coote N, Kay ES. Surgical versus non-surgical management of pleural empyema. Cochrane Database of Systematic Reviews. 2005(4).
19. Redden MD, Chin TY, van Driel ML. Surgical versus non-surgical management for pleural empyema. Cochrane Database of Systematic Reviews. 2017(3).
20. Ravaglia C, Ghirotti C, Puglisi S, Piciucchi S, Gurioli C, Fabbri E, et al. Medical Thoracoscopy and Intrapleural Fibrinolytic Therapy for the Management of Pleural Empyema: A Cohort Study. Respiration. 2023; 102(1): 46-54.
21. Mehrabi S, Shadmehr MB, Irajie C, Barhaghtalab MJY. Primary Spontaneous Pneumothorax: Open Thoracotomy vs. Video-assisted Thoracoscopic Surgery: A Single-center Retrospective Cohort Study. Iranian Journal of Medical Sciences. 2023;48(1):49.
22. Erdogu V, Akin H, Sonmezoglu Y, Kutluk AC, Sezen CB, Dogru MV, et al. Comparison of the video-assisted thoracoscopic lobectomy versus open thoracotomy for primary non-small cell lung cancer: single cohort study with 269 cases. Şişli Etfal Hastanesi Tip Bülteni. 2020; 54(3):291-6.