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**RESEARCH ARTICLE**
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# COMPARISON OF EFFICACY AND SAFETY BETWEEN SMALL BORE VS. LARGE BORE CHEST TUBES FOR THERAPEUTIC PLEURAL DRAINAGE

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## ABSTRACT

**Background:** Therapeutic pleural drainage involves the insertion of a chest tube to evacuate fluid or air from the pleural space, often utilized in the management of conditions such as pleural effusion or pneumothorax.

**Objectives:** To compare the efficacy and safety between small bore versus large bore chest tubes for therapeutic pleural drainage.

**Study Design:** Cross Randomized Controlled Trial (RCT).

**Settings:** The study was conducted at the Department of Pulmonology Services Hospital Lahore from January 2024 to June 2024.

**Methods:** A total of 110 patients, comprising 55 individuals in each group, were enrolled in this prospective comparative study. Patients presenting with pneumothorax, empyema, para-pneumonic effusion, or malignant effusion requiring therapeutic evacuation of the pleural space were included. Allocation to either the small bore (<20 F size) or large bore (>20 F size) chest tube group was randomized using a lottery method. Therapeutic drainage procedures were performed by experienced clinicians following standard protocols. Data including patient demographics, indications for drainage, tube insertion technique, duration of drainage, volume of fluid removed, and clinical outcomes were recorded. Collected data were processed and analyzed using IBM SPSS, version 27.0.

**Results:** The study comprised 73 (66.4%) males and 37 (33.6%) females. The mean age of participants was 48.49 ± 13.17 years for the small-bore chest tube group and 46 ± 12.72 years for the large-bore chest tube group. The small-bore chest tube group drained a higher proportion of effusions less than 1000 ml compared to the large-bore chest tube group (47.3% vs. 23.6%, $p = 0.033$). Furthermore, the small-bore chest tube group had significantly shorter dwell times (3.38 days vs. 7.95 days, $p < 0.001$) and shorter durations of hospital stay (3.95 days vs. 8.69 days, $p < 0.001$) compared to the large-bore chest tube group. The small-bore chest tube group demonstrated

a higher rate of lung re-expansion compared to the large-bore chest tube group (70.9% vs. 54.5%, p = 0.076).
**Conclusion:** Small-bore chest tubes demonstrated significant advantages in patient comfort, shorter hospital stays, and fewer complications, while large-bore tubes were more effective for larger effusions. Tailoring the choice of chest tube to the clinical scenario can enhance patient outcomes

**Keywords:** Chest tubes, Drainage, Efficacy, Large bore, Pleural, Safety, Small bore

## INTRODUCTION

Therapeutic pleural drainage is a common medical procedure performed to manage conditions such as pleural effusions, pneumothorax, and empyema. This intervention aims to relieve respiratory distress, improve lung function, and facilitate patient recovery.[1,2] Chest tubes, also known as thoracostomy tubes, are the primary instruments used for this purpose. They are categorized based on their diameter into small-bore (10–14 French) and large-bore (20–36 French) tubes. The choice of chest tube size is often determined by the clinical indication, physician preference, and institutional protocols.[3,4]

Large-bore chest tubes have been traditionally favored in clinical practice due to their capacity to effectively evacuate thick, viscous, or large-volume pleural collections. They are often recommended for cases of hemothorax, empyema, or significant malignant pleural effusions, where rapid drainage is essential.[5] Large-bore tubes are considered effective in minimizing complications such as tube occlusion and incomplete drainage, which can lead to recurrent effusions or infections. However, their use is associated with significant patient discomfort and procedural complications, including pain at the insertion site, bleeding, and risk of soft tissue injury.[6]

In contrast, small-bore chest tubes have gained increasing popularity due to their minimally invasive nature and improved patient tolerance. Typically inserted under ultrasound or radiologic guidance, these tubes are associated with reduced pain, shorter hospital stays, and fewer insertion-related complications. They are particularly advantageous in the management of less complex cases, such as uncomplicated pneumothorax or small, non-viscous pleural effusions.[7] Despite these advantages, concerns regarding their efficacy in evacuating large or thick pleural collections remain. Inadequate drainage with small-bore tubes may lead to prolonged hospitalization, increased need for tube repositioning, or secondary procedures such as thoracoscopy or surgical decortication.[8]

The safety profiles of small-bore and large-bore chest tubes are another critical consideration in therapeutic pleural drainage. The insertion of either type carries inherent risks, including infection, pneumothorax, and organ injury.[9] However, large-bore tubes, given their size and rigidity, are more likely to cause tissue trauma during insertion. Small-bore tubes, while safer in this regard, may pose a higher risk of blockage, leading to suboptimal outcomes. Understanding these safety concerns is essential for tailoring interventions to individual patient needs and minimizing adverse events.[10]

Over the years, several studies have explored the comparative efficacy and safety of small-bore and large-bore chest tubes in various clinical settings. While some research supports the equivalence of small-bore tubes in terms of drainage efficiency for specific indications, other studies highlight the superiority of large-bore tubes in managing complex cases. This variability in findings reflects the influence of patient factors, underlying pathology, and procedural expertise on outcomes. By evaluating the efficacy and safety profiles of small-bore versus large-bore chest tubes, clinicians can make informed decisions that balance therapeutic effectiveness with patient comfort and safety. Moreover, identifying the optimal choice of chest tube size can help standardize practices, reduce healthcare costs, and enhance the overall quality of care.

## MATERIALS AND METHODS

This study was a comparative analysis. The study was conducted at the Department of Pulmonology Services Hospital Lahore from January 2024 to June 2024. A total of 110 participants were recruited and evenly distributed into two groups. Participants in one group were managed with small-bore chest tubes (10–14 French), while the other group received large-bore chest tubes (20–36 French). Participants were included based on clinical indications for therapeutic pleural drainage, such as empyema, malignant effusion, para-pneumonic effusion, pneumothorax, or hemothorax. Patients with contraindications to chest tube insertion, such as coagulopathy or refusal to consent, were excluded.

Chest tubes were inserted under aseptic conditions by trained personnel. The selection of tube size was based on clinical judgment and institutional protocols. The insertion site was determined according to standard guidelines, and tubes were secured to prevent dislodgement. Imaging was used to confirm tube placement and evaluate lung re-expansion. Baseline demographic and clinical data, including age, gender, indication for drainage, and site of effusion, were recorded. The volume of effusion drained was categorized as less than 1000 ml, between 1000–2000 ml, or greater than 2000 ml. Procedural outcomes, such as dwell time, duration of hospital stay, pain scores, and bleeding during the procedure, were documented.

Primary outcomes included the efficiency of drainage, complications such as blockage, dislodgement, malposition, wound infection, and the need for further interventions, including surgery or thrombolytic therapy. Secondary outcomes included lung re-expansion rates, procedural bleeding, pain scores, and duration of hospital stay. Data were processed and analyzed using IBM SPSS, version 27.0. Categorical variables were expressed as frequencies and percentages and compared using the Chi-square test or Fisher exact test, as appropriate. Continuous variables were expressed as means with standard deviations (SD) and compared using the Mann-Whitney U test. Normality of data distribution was assessed using the Shapiro-Wilk test. The level of significance was set at 5%, and p-values less than 0.05 were considered statistically significant. Results were visualized using bar charts where applicable for easier interpretation.

## STUDY RESULTS

A total of 110 participants were evenly distributed into two groups for the study. In one group small bore chest drains were inserted while in other group large bore drains were inserted. The study comprised 73 (66.4%) males and 37 (33.6%) females. Age distribution analysis indicated that the majority of participants (77, 70%) fell within the 31-60 years age range, with a mean age of 48.49 ± 13.17 years for the small-bore chest tube group and 46 ± 12.72 years for the large-bore chest tube group [Table 1].

**Table 1:** Age and gender distribution of study participants

| | **Small bore Chest tube** | | **Large bore Chest tube** | |
|---|---|---|---|---|
| | **n** | **%** | **n** | **%** |
| **Gender** | | | | |
| Female | 20 | 36.4% | 17 | 30.9% |
| Male | 35 | 63.6% | 38 | 69.1% |
| **Age groups (years)** | | | | |
| ≤ 30 | 6 | 10.9% | 8 | 14.5% |
| 31-45 | 16 | 29.1% | 15 | 27.3% |
| 46-60 | 21 | 38.2% | 25 | 45.5% |
| > 60 | 12 | 21.8% | 7 | 12.7% |
| **Age (years),** Mean ± SD | 48.49 ± 13.17 | | 46.00 ± 12.72 | |

In the comparison of indications for therapeutic pleural drainage between the small bore and large bore chest tube groups, no statistically significant differences were observed. The small-bore chest tube group demonstrated similar proportions of participants diagnosed with empyema (41.8%), malignant effusion (10.9%), para-pneumonic effusion (12.7%), pneumothorax (32.7) and hemothorax (1.8%) compared to the large bore chest tube group, where corresponding percentages were 36.4%, 9.1%, 7.3%, 41.8% and 5.5%, respectively [Table 2].

The distribution of effusion sites (left, right, bilateral) did not show statistically significant differences between the small bore and large bore chest tube groups ($p > 0.05$). The volume of effusion drained differed significantly between the two groups. The small-bore chest tube group drained a higher proportion of effusions less than 1000 ml compared to the large bore chest tube group (47.3% vs. 23.6%, $p = 0.033$). However, there were no significant differences in the drainage of effusions with volumes between 1000-2000 ml or more than 2000 ml [Table 2].

**Table 2:** Comparison of indications, effusion distribution, and drainage volume between two study groups

| | **Small bore Chest tube** | | **Large bore Chest tube** | | **p value** |
|---|---|---|---|---|---|
| | **n** | **%** | **n** | **%** | |
| **Indication** | | | | | |
| Empyema | 23 | 41.8% | 20 | 36.4% | 0.604 [a] |
| Hemothorax | 1 | 1.8% | 3 | 5.5% | |
| Malignant effusion | 6 | 10.9% | 5 | 9.1% | |
| Para-pneumonic effusion | 7 | 12.7% | 4 | 7.3% | |
| Pneumothorax | 18 | 32.7% | 23 | 41.8% | |
| **Sites of effusion** | | | | | |
| Left | 24 | 43.6% | 25 | 45.5% | 0.633 [b] |
| Right | 30 | 54.5% | 27 | 49.1% | |
| Bilateral | 1 | 1.8% | 3 | 5.5% | |
| **Volume of drainage** | | | | | |
| < 1000 ml | 26 | 47.3% | 13 | 23.6% | 0.033 [a] |
| 1000-2000 ml | 16 | 29.1% | 25 | 45.5% | |
| > 2000 ml | 13 | 23.6% | 17 | 30.9% | |

[a] Chi-square test; [b] Fisher exact test.

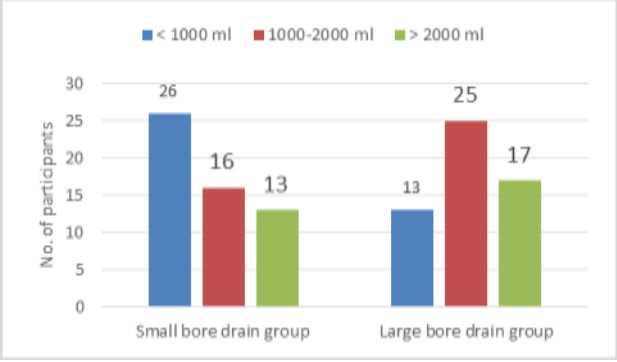


**Figure 1:** Volume of effusion drained in both groups.

Significant differences in procedural outcomes were observed between the small bore and large bore chest tube groups. Participants in the small-bore chest tube group had significantly shorter dwell times (3.38 days vs. 7.95 days, $p < 0.001$) and shorter durations of hospital stay (3.95 days vs. 8.69 days, $p < 0.001$) compared to those in the large bore chest tube group. Additionally, participants in the small-bore chest tube group reported lower pain scores (1.13 vs. 5.91, $p < 0.001$) and experienced less bleeding during the procedure (1.01 ml vs. 11.53 ml, $p < 0.001$) compared to the large bore chest tube group [Table 3].

**Table 3:** Comparison of procedural outcomes between two study groups

| | **Small bore Chest tube** | | **Large bore Chest tube** | | **p value** [a] |
|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | |
| Dwell time (days) | 3.38 | 1.57 | 7.95 | 3.69 | < 0.001 |
| Duration of hospital stay (days) | 3.95 | 1.79 | 8.69 | 4.17 | < 0.001 |
| Pain score | 1.13 | 0.72 | 5.91 | 1.38 | < 0.001 |
| Bleeding during procedure (ml) | 1.01 | 0.28 | 11.53 | 6.86 | < 0.001 |

[a] Mann-Whitney U test.

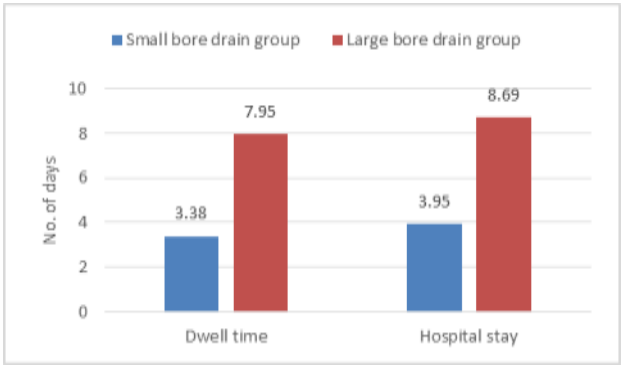


**Figure 2:** Mean hospital stay and dwell time in both groups.

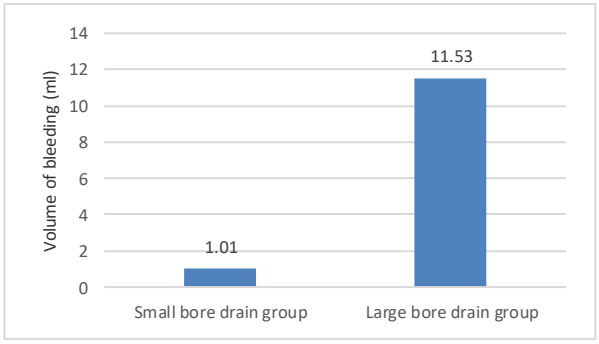


**Figure 3:** Mean bleeding during procedure in both groups.

The incidence of complications differed significantly between the two groups. Participants in the small-bore chest tube group experienced fewer complications such as blockage, dislodgement, and wound infection compared to those in the large bore chest tube group ($p < 0.001$ for all). However, there were no significant differences in the need for a second intervention, the need for surgery, or the use of thrombolytics between the two groups ($p > 0.05$ for all). While not statistically significant, the small-bore chest tube group demonstrated a higher rate of lung re-expansion compared to the large bore chest tube group (70.9% vs. 54.5%, $p = 0.076$) as shown in Table 4.

**Table 4:** Comparison of complications and further management between two study groups.

| | **Small bore Chest tube** | | **Large bore Chest tube** | | **p value** |
|---|---|---|---|---|---|
| | **n** | **%** | **n** | **%** | |
| **Complications** | | | | | |
| Blockage | 8 | 14.5% | 0 | 0.0% | < 0.001 [b] |
| Dislodgement | 6 | 10.9% | 1 | 1.8% | |
| Hemorrhage | 0 | 0% | 3 | 5.5% | |
| Malposition | 1 | 1.8% | 6 | 10.9% | |
| Surgical emphysema | 2 | 3.6% | 7 | 12.7% | |
| Wound infection | 8 | 14.5% | 0 | 0.0% | |
| **Further Management** | | | | | |
| Need for 2nd intervention | 3 | 5.5% | 5 | 9.1% | 0.716 [b] |
| Need for surgery | 2 | 3.6% | 7 | 12.7% | 0.161 [b] |
| Thrombolytics | 1 | 1.8% | 0 | 0.0% | 1.000 [b] |
| **Re-expansion of lung** | 39 | 70.9% | 30 | 54.5% | 0.076 [a] |

[a] Chi-square test; [b] Fisher exact test.

## DISCUSSION

Therapeutic pleural drainage is a critical procedure for managing pleural effusions, pneumothorax, and other pleural conditions. The choice between small-bore (10–14 French) and large-bore (20–36 French) chest tubes remains a subject of clinical debate. Large-bore tubes are traditionally preferred for thick or large-volume effusions due to their superior drainage capacity but are often associated with significant pain and procedural complications.[13] Conversely, small-bore tubes offer a less invasive alternative with improved patient comfort, though concerns about their efficacy in complex cases persist. Comparing these two options is essential to optimize clinical outcomes while balancing efficacy, safety, and patient experience.[14,15] This study evaluates the efficacy and safety of small-bore versus large-bore chest tubes, providing evidence-based insights to guide clinical decision-making. Our results showed that the duration of chest tube placement was significantly shorter in the SB group (3.38 ± 1.57 days) compared to the LB group (7.95 ± 3.69 days, $p < 0.001$). This aligns closely with findings by Ramzan et al. (2021), who reported a mean dwell time of 3.0 ± 1.6 days for SB drains versus 7.9 ± 3.8 days for LB drains ($p < 0.001$).[16] Similarly, Mehra et al. (2020) demonstrated shorter dwell times in the SB group (5 ± 4 days) compared to the LB group (8 ± 6 days). These results suggest that SB tubes are associated with faster recovery and shorter hospital stays, a trend corroborated by our data showing significantly shorter hospital stays in the SB group (3.95 ± 1.79 days) versus the LB group (8.69 ± 4.17 days, $p < 0.001$).[17]

Pain scores were significantly lower in the SB group (1.13 ± 0.72) compared to the LB group (5.91 ± 1.38, $p < 0.001$), consistent with findings from Ramzan et al., who reported pain scores of 1.07 ± 0.81 in the SB group versus 5.67 ± 1.68 in the LB group. This reinforces the notion that SB tubes

are better tolerated by patients, as also highlighted by Mehra et al., who found SB tubes to be associated with less pain and improved patient comfort.[17] Bleeding during the procedure was significantly higher in the LB group (11.53 ± 6.86 ml) compared to the SB group (1.01 ± 0.28 ml, $p < 0.001$). This is similar to Ramzan et al., who reported mean bleeding volumes of 11.9 ± 7.8 ml for LB tubes versus 0.1 ± 0.2 ml for SB tubes ($p < 0.001$). Our study also found that complications such as wound infections were more prevalent in the LB group (0% in the SB group versus 14.5% in the LB group, $p < 0.001$), consistent with Ramzan et al.'s findings of significantly higher wound infection rates in the LB group. Regarding lung re-expansion, our results demonstrated slightly higher rates in the SB group (70.9%) compared to the LB group (54.5%, $p = 0.076$), although this difference was not statistically significant. This is comparable to findings by Thethi et al. (2018), where no significant differences in successful pleurodesis were observed between the SB and LB groups (73.8% vs. 82%, $p = 0.19$).[20]

Orlando et al. (2020) also reported similar initial drainage volumes and complication rates between SB and LB tubes, which aligns with our findings that no significant differences were observed in the drainage of effusions between 1000–2000 ml or >2000 ml. However, SB tubes drained a higher proportion of effusions <1000 ml (47.3% vs. 23.6%, $p = 0.033$).[18] Our findings align with Parulekar et al. (2001), who demonstrated no significant difference in effusion recurrence rates between SB and LB tubes, further emphasizing that tube size does not necessarily influence long-term outcomes like effusion recurrence or pleurodesis success.[19]

This study provides a comprehensive comparison of small-bore and large-bore chest tubes using robust statistical methods, offering valuable clinical insights. It is strengthened by its balanced participant groups and systematic data collection. However, its generalizability may be limited by the single-center design and lack of long-term follow-up. Additionally, procedural variations could influence the outcomes.

## CONCLUSION

Small-bore chest tubes demonstrated significant advantages in patient comfort, shorter hospital stays, and fewer complications, while large-bore tubes were more effective for larger effusions. Tailoring the choice of chest tube to the clinical scenario can enhance patient outcomes. These findings highlight the need for individualized approaches in therapeutic pleural drainage.

## REFERENCES

1. Sundaralingam A, Banka R, Rahman NM. Management of pleural infection. Pulmonary therapy. 2021 Jun;7:59-74.
2. Sorino C, Feller-Kopman D, Mei F, Mondoni M, Agati S, Marchetti G, Rahman NM. Chest Tubes and Pleural Drainage: History and Current Status in Pleural Disease Management. Journal of Clinical Medicine. 2024 Oct 23;13(21):6331.
3. Congedo MT, Ferretti GM, Nachira D, Pennisi MA. Management of pleural effusions in the emergency department. Reviews on Recent Clinical Trials. 2020 Dec 1;15(4):258-68.
4. Elsheikh A, Bhatnagar M, Rahman NM. Diagnosis and management of pleural infection. Breathe. 2024 Jan 16;19(4).
5. Williams JG, Lerner AD. Managing complications of pleural procedures. Journal of Thoracic Disease. 2021 Aug;13(8):5242.
6. Kulandaisamy PC, Kulandaisamy S, Kramer D, Mcgrath C. Malignant pleural effusions—a review of current guidelines and practices. Journal of clinical medicine. 2021 Nov 26;10(23):5535.
7. Asciak R, Bedawi EO, Bhatnagar R, Clive AO, Hassan M, Lloyd H, Reddy R, Roberts H, Rahman NM. British thoracic Society Clinical Statement on pleural procedures. Thorax. 2023 Jul 1;78(Suppl 3):s43-68.

8. Stüben BO, Plitzko GA, Reeh M, Melling N, Izbicki JR, Bachmann K, Tachezy M. Intrathoracic vacuum therapy for the therapy of pleural empyema—A systematic review and analysis of the literature. Journal of Thoracic Disease. 2023 Feb 2;15(2):780.
9. Stüben BO, Plitzko GA, Reeh M, Melling N, Izbicki JR, Bachmann K, Tachezy M. Intrathoracic vacuum therapy for the therapy of pleural empyema—A systematic review and analysis of the literature. Journal of Thoracic Disease. 2023 Feb 2;15(2):780.
10. Roberts ME, Rahman NM, Maskell NA, Bibby AC, Blyth KG, Corcoran JP, Edey A, Evison M, de Fonseka D, Hallifax R, Harden S. British Thoracic Society guideline for pleural disease. Thorax. 2023 Jul 1;78(Suppl 3):s1-42.
11. Alayande BT. Management of Empyema Thoracis in low-resource settings. Global Thoracic Surgery, An Issue of Thoracic Surgery Clinics, E-Book: Global Thoracic Surgery, An Issue of Thoracic Surgery Clinics, E-Book. 2022 Aug 17;32(3):361-72.
12. Nicholson MJ, Manley C, Ahmad D. Thoracentesis for the diagnosis and management of pleural effusions: the current state of a centuries-old procedure. Journal of Respiration. 2023 Dec 8;3(4):208-22.
13. Bhalla AS, Jana M, Naranje P, Singh SK, Banday I. Challenges in Image-Guided Drainage of Infected Pleural Collections: A Review. Journal of Clinical Interventional Radiology ISVIR. 2022 Aug;6(02):131-40.
14. Abdulelah M, Abu Hishmeh M. Infective Pleural Effusions—A Comprehensive Narrative Review Article. Clinics and Practice. 2024 May 16;14(3):870-81.
15. Hassan M, Gadallah M, Mercer RM, Harriss E, Rahman NM. Predictors of outcome of pleurodesis in patients with malignant pleural effusion: a systematic review and meta-analysis. Expert review of respiratory medicine. 2020 Jun 2;14(6):645-54.
16. Ramzan M, Mahmud T, Saqib M, Khan AS, Saboor QA, Mirza AR. A Comparative Study Between-Small Bore and Large Bore Tubes for Therapeutic Pleural Drainage. InProceedings 2021 Apr 21 (Vol. 35, No. 2, pp. 68-72).
17. Mehra S, Heraganahally S, Sajkov D, Morton S, Bowden J. The effectiveness of small-bore intercostal catheters versus large-bore chest tubes in the management of pleural disease with the systematic review of literature. Lung India. 2020 May 1;37(3):198-203.
18. Orlando A, Cordero J, Carrick MM, Tanner AH, Banton K, Vogel R, Lieser M, Acuna D, Bar-Or D. Comparing complications of small-bore chest tubes to large-bore chest tubes in the setting of delayed hemothorax: a retrospective multicenter cohort study. Scandinavian journal of trauma, resuscitation and emergency medicine. 2020 Dec;28:1-8.
19. Parulekar W, Di Primio G, Matzinger F, Dennie C, Bociek G. Use of small-bore vs large-bore chest tubes for treatment of malignant pleural effusions. Chest. 2001 Jul 1;120(1):19-25.
20. Thethi I, Ramirez S, Shen W, Zhang D, Mohamad M, Kaphle U, Kheir F. Effect of chest tube size on pleurodesis efficacy in malignant pleural effusion: a meta-analysis of randomized controlled trials. Journal of thoracic disease. 2018 Jan;10(1):355.