ORIGINAL ARTICLE

Double-Lumen vs Small-Bore Pigtail Catheter for Pleural Effusion: Which is Superior?

Novi Siagian[1], Noni Novisari Soeroso[1*], Syamsul Bihar[1], Taufik Ashar[2]
[1]Department of Pulmonology and Respiratory Medicine, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia.
[2]Department of Environmental Health, Faculty of Public Health, Universitas Sumatera Utara, Medan, Indonesia.

ARTICLE INFO

Article history:
Received 31 October 2024
Received in revised form
11 December 2024
Accepted 15 January 2025
Available online 30 January 2025

Keywords:
Cancer,
Double-lumen,
Pigtail,
Pleural effusion.

Cite this as:
Siagian N, Soeroso NN, Bihar S, *et al*. Double-Lumen vs Small-Bore Pigtail Catheter for Pleural Effusion: Which is Superior? *J Respi* 2025; 11: 39-46.

ABSTRACT

Introduction: Pleural effusion is associated with a high mortality rate. Tube thoracostomy remains the standard treatment. Despite this, double-lumen catheters, typically used for central venous access, are infrequently employed for pleural drainage. This study compared the characteristics of patients undergoing double-lumen catheter versus pigtail catheter placements for pleural effusion.
Methods: A retrospective cross-sectional study was conducted on adult patients at Prof. Dr. Chairuddin Panusunan Lubis Universitas Sumatera Utara Hospital, Haji Adam Malik General Hospital, and St. Elisabeth Hospital, Medan, from September 2022 to April 2024. This study analyzed patient demographics and clinical presentations for those receiving either catheter type.
Results: The mean age of patients with double-lumen catheters was 58.21 years old, while those with pigtail catheters averaged 54.9 years old. Patients with double-lumen catheters frequently presented with a combination of shortness of breath, cough, and chest pain, while those with pigtail catheters primarily reported shortness of breath. Both groups predominantly exhibited exudative pleural effusions. Radiological evaluations indicated moderate pleural effusion was most common in both groups, with thoracic ultrasound revealing fluid volumes between 500 and 2,000 cc.
Conclusion: Double-lumen catheters are more frequently utilized for moderate to massive pleural effusion, whereas pigtail catheters are typically reserved for moderate cases. The choice of catheter depends on the patient's condition, the underlying cause of the effusion, and radiological findings.

INTRODUCTION

According to the World Health Organization (WHO), it was estimated that in industrialized countries, per 100,000 people, 320 people suffer from pleural effusion.[1] The incidence of pleural effusion in the United States (US) was reported to be 1.3 million people each year, caused by congestive heart failure (CHF), malignancy, pulmonary embolism, and pneumonia.[1] According to the Ministry of Health of the Republic of Indonesia, cases of pleural effusion reached 2.7%, with males around 57.42% and females around 42.75%, while most cases are tuberculous pleuritis (TB).[1]

In Indonesia, several hospitals have conducted studies on pleural effusion. Results of medical records at Dr. Kariadi General Hospital, Semarang, in 2011 showed that the prevalence of pleural effusion in females was around 66.7%, and in males around 33.3%.[2] Another study conducted at Haji Adam Malik General Hospital, Medan, in 2011 with a total of 136 cases showed that the prevalence in females was around 34.6%, while in males, around 65.4% suffered from pleural effusion.[2] According to the medical records of Dr. Harjono Regional Hospital, Ponorogo, in 2016, from January to October, there were 68 cases of pleural effusion, with the average being males and females over 45 years old.[2]

Many patients with pleural effusion die within 30 days of hospitalization, and almost ⅓ die within one year. A previous study showed that the mortality rate of pleural effusion is quite high, with malignancy being the most common cause of death.[3] Other than malignancy, if ascites and liver cirrhosis are accompanied by bilateral pleural effusion, it is most likely caused by hepatic hydrothorax, which also causes high mortality.[4–7] Recurrent or refractory pleural effusions (RPE) were managed with repeat thoracentesis. However, this procedure was associated with greater pain and

*Corresponding author: noni@usu.ac.id

Jurnal Respirasi (Journal of Respirology), p-ISSN: 2407-0831; e-ISSN: 2621-8372.
Accredited No. 79/E/KPT/2023; Available at https://e-journal.unair.ac.id/JR. DOI: 10.20473/jr.v11-I.1.2025.39-46

discomfort, poor quality of life, and a high risk of complications.[8,9] Tube thoracostomy remains the standard for treating pneumothorax and simple effusion in most hospitals. Placement of a large bore chest tube was an invasive procedure with potential morbidity and complications, and therefore, the use of a small bore pigtail catheter might be desirable.[10] Liu, *et al*. (2010) reported a success rate of 64.0–81.6% in patients with different etiologies of pleural effusion.[11] Of 276 patients who used pigtail catheters (size 10-16 Fr), only 10 patients (3.0%) experienced complications due to the procedure, including infection (1.2%), dislodgement (1.2%), bleeding from a puncture site, hemothorax complications (0.3%), and lung puncture (0.3%).[11]

A double-lumen catheter is more commonly used for therapeutic or diagnostic purposes of central venous catheterization, making its use for pleural drainage relatively uncommon in clinical practice. On the other hand, pigtail catheters have been reported to require a smaller incision for insertion into the pleural cavity, which is associated with lower insertion site pain due to the relatively less invasive nature of the procedure. This study aimed to overview the characteristics of patients installed with double-lumen catheters or pigtail catheters for indications of pleural effusion.

METHODS

This was a descriptive study of the clinical characteristics of patients who received double-lumen and pigtail catheter placement procedures for indications of pleural effusion with a retrospective cross-sectional design. Data sources were obtained from the researchers' findings during a predetermined period regarding several characteristics of the variables to be evaluated. The sample was all adult patients who received double-lumen and pigtail catheter placement procedures for indications of pleural effusion based on medical record data at Prof. Dr. Chairuddin Panusunan Lubis Universitas Sumatera Utara Hospital, Haji Adam Malik General Hospital, and St. Elisabeth Hospital, Medan, from September 2022 to April 2024 using the consecutive sampling method. This study had passed an ethical review by the Health Research Ethics Committee of Universitas Sumatera Utara, Medan.

The inclusion criteria of this study were patients with pleural effusion based on medical record data who received double-lumen catheter size 12 Fr (Figure 1) and pigtail catheter size 8 Fr, 10 Fr, and 12 Fr insertion procedures at 18-75 years old. Patients who had complete medical data regarding the chronological history of the underlying pathology resulting in fluid accumulation in the patient's pleural cavity were also included in this study. The exclusion criteria in this study were patients with pigtail catheters and double-lumen catheters installed by departments other than the Department of Pulmonology and Respiratory Medicine and patients who did not have complete medical data on the history of the underlying disease that led to the formation of fluid accumulation in the patient's pleural cavity.

The assessment variables included age, sex, clinical symptoms such as coughing, chest pain, shortness of breath, and type of pleural effusion (exudative or transudative). The etiology of pleural effusion, including ascites, hypoalbuminemia, cardiovascular, metabolic, and renal disorders, as well as cancer, was also evaluated. The degree of pleural effusion, classified as minimal, moderate, and massive, was assessed through radiopaque images showing fluid accumulation occupying the costophrenic angle or hemithorax on radiology.

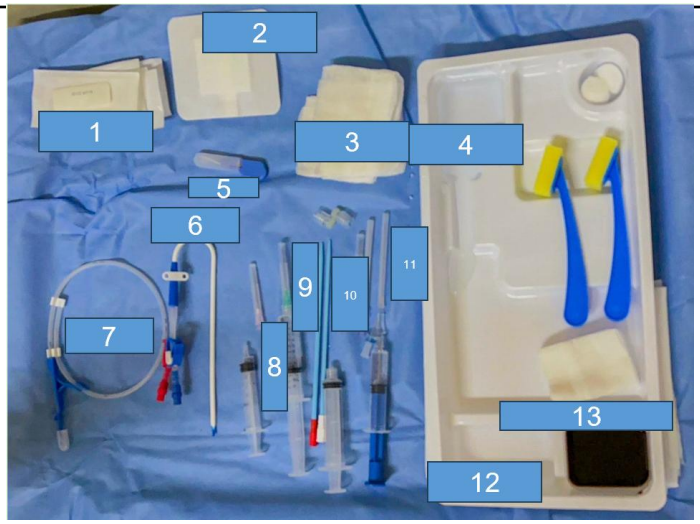

Figure 1. Central venous double lumen catheter set: (1) Nald hecting and silk; (2) Dressing; (3) Sterile gauze; (4) Sodium chloride (NaCl) 0.9%; (5) Surgical blade; (6) Double lumen catheter size 12 Fr; (7) Guide wire; (8) Lidocaine; (9) and (10) Dilator; (11) IV cannula; (12) Alcohol; (13) Povidone-iodine

RESULTS

The results of this study related to demographic characteristics, clinical features, etiology, type of pleural effusion fluid, and radiological findings in patients undergoing double-lumen and pigtail catheter placement procedures (Table 1). These findings were expected to provide a deeper understanding of the effectiveness of each type of catheter in treating pleural effusion and support clinical decision-making in choosing the most appropriate procedure for the patient.

Table 1. Frequency distribution of demographic characteristics

Demographic Characteristics	Types of Catheters	
	Double Lumen (n=29)	Pigtail (n=40)
Gender, n (%)		
Male	11 (37.9)	22 (55)
Female	18 (62.1)	18 (45)
Age, years old		
Mean (standard deviation)	58.21 (9.62)	54.9 (15.09)
Median (min-max)	61 (33-73)	58.5 (22-75)
Clinical Features		
Shortness of breath	7 (24.1)	12 (30)
Cough	0	2 (5)
Chest pain	0	9 (22.5)
Shortness of breath, cough, and chest pain	14 (48.3)	4 (10)
Shortness of breath and cough	4 (13.8)	2 (5)
Shortness of breath and chest pain	4 (13.8)	9 (22.5)
Cough and chest pain	0	2 (5)
Etiology		
Lung malignancy	9 (31)	13 (32.5)
Lung malignancy with comorbidities*	7 (24.1)	6 (15.0)
Lung infection	1 (3.4)	5 (12.5)
Lung infection with comorbidities**	2 (6.9)	7 (17.5)
Other malignancies (e.g., ovarian, cervical cancer)	5 (17.2)	1 (2.5)
Extrapulmonary conditions (e.g., congestive heart failure, tuberculosis)	2 (6.9)	3 (7.5)

*Includes lung malignancy with complications (e.g., from breast carcinoma, ascites, hypoalbuminemia)
**Includes lung infections with congestive heart failure, chronic kidney disease, or hypoalbuminemia

Based on gender, most patients who underwent double-lumen catheter insertion were females, totaling 18 people (62.1%). Meanwhile, patients who underwent pigtail catheter insertion were mostly males, totaling 22 people (55%). Patients using double-lumen catheters were 58.21 years old on average, with the youngest being 33 years old and the oldest being 73 years old. Meanwhile, patients using pigtail catheters had a mean age of 54.9 years old, with the youngest of 22 years old and the oldest of 75 years old. In patients using double-lumen catheters, the most common symptoms were shortness of breath, cough, and chest pain, which occurred in 14 patients (48.3), followed by symptoms of shortness of breath in 7 people (24.1%). Both shortness of breath and cough and shortness of breath and chest pain symptoms were reported by 4 patients (13.8%),

respectively. The most common symptom in patients using pigtail catheters was shortness of breath, which was complained of by 12 patients (30%). Followed by complaints of chest pain and shortness of breath and chest pain each by 9 patients (22.5%). Next, shortness of breath, cough, and chest pain were complained by 4 patients (10%) (Figure 2).

Based on the etiology, most patients who use catheters double lumen were patients with lung malignancy, totaling 9 people (31%), followed by patients with lung malignancy spread from breast malignancy, totaling 7 patients (24.1%). The next most common etiology was lung malignancy accompanied by CHF with hypoalbuminemia and lung malignancy accompanied by malnutrition with hypoalbuminemia in 2 people (6.9%), respectively. Meanwhile, in patients with pigtail catheters installed, the most common cause was lung malignancy in 13 people (32.5%), followed by lung infection in 5 people (12.5%). The etiology of lung malignancy was accompanied by a lung infection and hypoalbuminemia in 3 people (7.5%) (Figure 2).

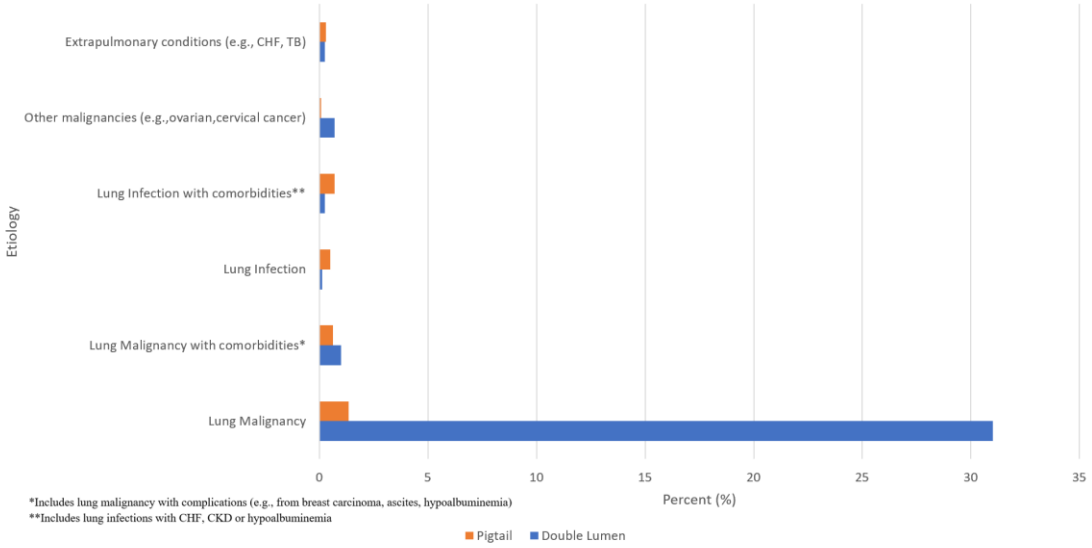

Figure 2. Bar chart of the proportion of pleural effusion etiology of patients

The most common type of effusion fluid in the catheterized patient group double lumen was exudated in 26 people (89.7%), while in patients who had pigtail catheters installed, fluid was also exudated in 37 people (92.5%) (Figure 3).

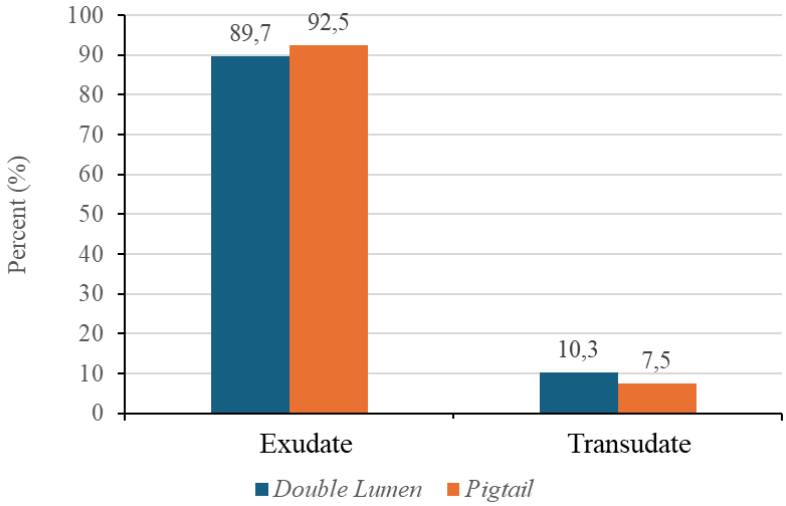

Figure 3. Bar chart of the proportion of pleural effusion fluid types from patients

The most common radiological findings in patients with double-lumen catheters were moderate pleural effusion in 16 patients (55.2%) and massive pleural effusion in 13 patients (44.8%). The most common finding in patients with pigtail catheters was moderate pleural effusion in 19 patients (47.5%) (Figure 4).

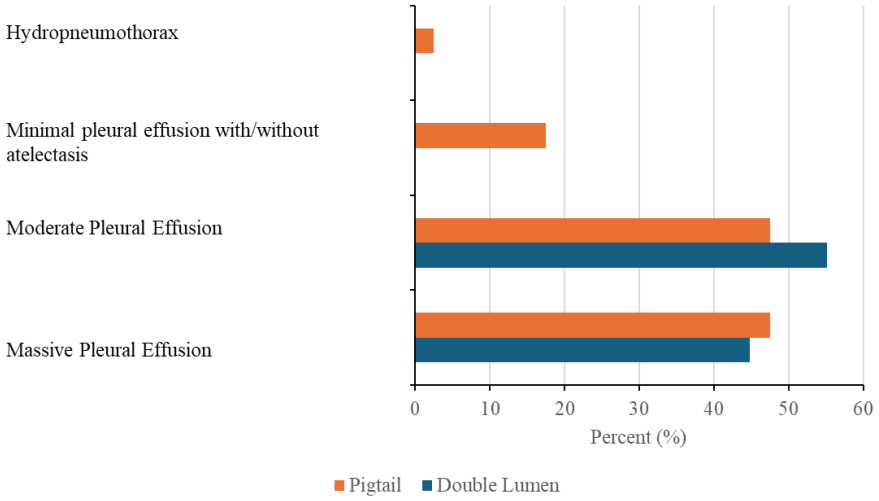

Figure 4. Bar chart of the proportion of radiological findings from patients

According to thorax ultrasonography (USG), most of the two study groups had effusion fluid of 500–2,000 cc. This included up to 22 patients (75.7%) with double-lumen catheters and 31 patients (77.5%) with pigtail catheters. Six patients (20.7%) in the double-lumen catheter group had an effusion production volume >2,000 cc. No pigtail catheter patients had a production volume of>2,000 cc (Figure 5).

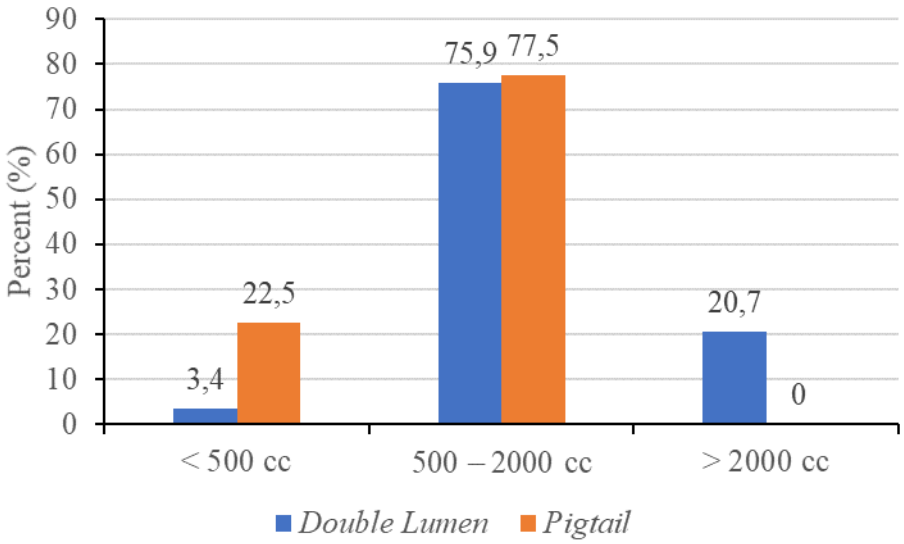

Figure 5. Bar chart of the proportion of pleural effusion production volume estimation through thoracic ultrasound in patients

DISCUSSION

Demographic Characteristics of Subjects

Pleural effusion is a common clinical finding, with an estimated incidence of 320 to 400 cases per 100,000 individuals per year, and approximately 1.5 million patients are estimated to have pleural effusions each year in the US.[12–14] A large study in the People's Republic of China showed that 62.9% of patients with pleural effusions were males, with a mean age of 61.6 years old (±16.9 years old).[12] The leading causes of pleural effusions in this study were parapneumonic effusion and empyema (25.1%), malignant neoplasm (23.7%), and TB (12.3%).[12] A study by Rizana, *et al*. (2017) showed the average age of pigtail insertion in pleural effusion was 48.06 years old, consisting of 7 males (21.8%) and 9 females (28.1%), with the largest age group being 51-60 years old, accounting for 31.2%.[15] The mean age of patients with double-lumen catheters in this study was 58.21 years old, compared

with 54.9 years old for patients with pigtail catheters. A study by Abdelghany, *et al*. (2022) showed that the mean age of patients with double-lumen catheters was 59.63 (±13.54) years old.[16] Meanwhile, according to El-Shabrawy, *et al*. (2019), it was found that the mean age of patients with pleural effusion with pigtail catheters was 58.4 (±13.1) years old.[17] The demographic characteristics of the catheter groups in pleural effusion were consistent with the overall demographic pattern observed in pleural effusion patients. The demographic data of this study showed that more females were using double-lumen catheters (62.1%) and more males using pigtail catheters (55%). The variation in gender distribution between these two mechanisms for treating pleural effusion showed that gender was not directly related to the indication for catheterization but was more related to the etiology of the disease experienced.

Etiology of Pleural Effusion in Patients Undergoing Double-Lumen and Pigtail Catheters

The study by Rizana, *et al*. (2017) identified lung cancer as the most common etiology of pleural effusion, affecting 50% of patients, followed by pulmonary TB (25%), malignancies other than lung cancer (18.7%), and pneumonia and CHF, each accounting for 3.1%.[15] The most common etiology of patients with double-lumen catheters was lung malignancy (31%), followed by lung malignancy spread from breast cancer (24.1%). This was in line with the study by Abdelghany, *et al*. (2022), which showed that 87.5% of subjects involved with double-lumen catheters had lung adenocarcinoma, followed by 8.3% who had mesothelioma.[16] This study associated these results with the most common pleural effusion etiology, lung malignancy, breast malignancy, and lymphoma.[16] Meanwhile, the most common etiology of patients with pigtail catheters was lung malignancy (32.5%), followed by lung infection (12.5%) and lung malignancy accompanied by lung infection and extrapulmonary problems (7.5%). This was similar to the study by El-Shabrawy, *et al*. (2019), which showed that the most common etiology of pleural effusion as an indication for the use of pigtail catheters was malignancy, followed by mesothelioma, TB, empyema, and non-specific pleural inflammation.[17] This was the same with previous studies that used pigtail catheters in various pleural effusions, including those caused by malignancy and infection.[10,18]

Types of Pleural Effusion Fluid in Patients Undergoing Double-Lumen and Pigtail Catheters

Exudate was the most common type of effusion fluid in both patient groups, with 89.7% in double-lumen catheters and 92.5% in pigtail catheters. A previous study indicated that double-lumen catheters were used for cases of large and uncomplicated exudative pleural effusions.[19] Similarly, pigtail catheters were also used for exudative pleural effusions and were proven effective in treating these cases.[18]

Radiographic Findings in Patients Undergoing Double-Lumen and Pigtail Catheters

The most common radiological findings in patients with double-lumen catheters were moderate (55.2%) and massive (44.8%) pleural effusion. This was in line with a study by Abdelghany, *et al*. (2022), which showed that the use of double-lumen catheters in moderate pleural effusion was 20.8% and massive 79.2%.[16] Although the results between these studies did not show a similar sequence to this study, this proves that double-lumen catheters were previously found to be effective in emptying large pleural effusions, by the findings of massive and moderate pleural effusions in patients.[8,16,19] Meanwhile, the most common finding in patients with pigtail catheters was moderate pleural effusion (47.5%). This was similar to previous studies showing that pigtail catheters could be used for various levels of pleural effusion, including moderate.[10,20] El-Shabrawy, *et al.* (2019) showed that pigtail catheters could be used in various stages of pleural effusion, ranging from mild to moderate to severe, accompanied by various accompanying clinical manifestations.[17]

Most subjects in both study groups had effusion fluid of 500-2,000 cc. There were 6 patients (20.7%) with a production volume >2,000 cc in the double-lumen catheter group, but no patients with a production volume >2,000 cc in the pigtail catheter group. A previous study found the use of double-lumen catheters to drain large pleural effusions, which explains the finding of volumes >2000 cc.[19] Meanwhile, the use of pigtail catheters was generally in smaller pleural effusions, consistent with the findings of this study where there were no patients with volumes >2,000 cc.[18] This was in line with a study by El-Shabrawy, *et al.* (2019), which showed that in patients with pleural effusions drained with pigtail catheters, the most common fluid volume found was less than 1,500 mL (30%).[17] This suggests that pigtail catheters are preferred in smaller amounts of pleural effusion.

There are some limitations in this study. One of them was the small and limited sample size. This was related to the single-center nature of the study. Therefore, a larger and more diverse sample was needed to see demographic characteristics in a multi-center setting. This study was also only descriptive, explaining the difference between double-lumen catheters and pigtails, which, although well-informed, did not illustrate how the use of double-lumen catheters compared to pigtails in pleural effusion cases. In this

regard, various aspects could be assessed, including effectiveness, safety, and cost and benefit. This provides a chance for further study on applying pigtail and double-lumen catheters in case of pleural effusion.

CONCLUSION

The results showed that the selection of catheter type depends on several factors. Double-lumen catheters are more suitable for patients with massive and malignant pleural effusion, moderate and massive pleural effusion findings, and production volume >2,000 cc. Pigtail catheters are more suitable for patients with moderate and non-malignant pleural effusion, with findings of moderate pleural effusion and production volume ≤2,000 cc. Double-lumen catheters are more commonly used in patients with moderate and massive pleural effusion, while pigtail catheters are more commonly used in patients with moderate pleural effusion. This study showed that double-lumen and pigtail catheters were effective options for drainage of exudative pleural effusion fluid. The appropriate catheter type selection depends on patient characteristics, the etiology of the pleural effusion, and radiological findings. This study was conducted by collecting data from medical records. Therefore, the researchers did not intervene in selecting double-lumen catheters or pigtail catheters for patients.

This study can provide helpful information for clinicians in the future in choosing the right type of catheter for patients with pleural effusion. There are still several areas in this study that can be improved, such as the necessity of research with a bigger and more varied sample size to support the findings. Additionally, future research is needed to compare the long-term efficacy of pigtail and dual-lumen catheters. Assessing the advantages and disadvantages of using pigtail and dual-lumen catheters is also needed.

Acknowledgments

The authors would like to thank the Department of Medical Records, Prof. Dr. Chairuddin Panusunan Lubis Universitas Sumatera Utara Hospital, Medan, Haji Adam Malik General Hospital, Medan, St. Elisabeth Hospital, Medan, and the parties involved in conducting this study through patient medical records.

Conflict of Interest

The authors declared there is no conflict of interest.

Funding

This study did not receive any funding.

Authors' Contributions

Conducting research design, drafting proposal, collecting data, analyzing data result, and drafting proposal: NS. Supervising proposal designing and data processing, guiding statistical analysis data, providing relevant research references, and reviewing manuscript: NNS, SB, TA.

REFERENCES

1. Wulandari S, Syahrani F, Rahmaini A, *et al*. Pleura Fluid Leukocyte Levels Test in Establish of Pleura Tuberculosis Effusion in Exudative Pleural Effusion Patients at H. Adam Malik General Hospital Medan in 2018. *J Respirologi Indones* 2021; 41: 156–160. [Journal]
2. Akbar MI. *Asuhan Keperawatan pada Pasien Efusi Pleura dengan Masalah Keperawatan Ketidakefektifan Pola Napas di Ruang Asoka RSUD Dr. Harjono Ponorogo*. Universitas Muhammadiyah Ponorogo, http://eprints.umpo.ac.id/5343/ (2019).
3. Sidiq MF, Agustina H, Kulsum ID. Profil Klinis, Gambaran Makroskopis dan Mikroskopis Cairan Efusi Pleura pada Pasien Rawat Inap di Departemen Ilmu Penyakit Dalam RSUP Dr. Hasan Sadikin Bandung Periode Januari 2016-Desember 2018. *Indones J CHEST Crit Emerg Med* 2020; 7: 1–10. [Journal]
4. Boka K. Pleural Effusion. *Medscape*, https://emedicine.medscape.com/article/299959-overview (2024, accessed 1 March 2024).
5. Rial MB, Pallarés JP, Viedma EC, *et al*. Diagnosis and Treatment of Pleural Effusion. Recommendations of the Spanish Society of Pulmonology and Thoracic Surgery. Update 2022. *Arch Bronconeumol* 2023; 59: 27–35. [ScienceDirect]
6. Jany B, Welte T. Pleural Effusion in Adults-Etiology, Diagnosis, and Treatment. *Dtsch Arztebl Int* 2019; 116: 377–386. [PubMed]
7. Shen-Wagner J, Gamble C, MacGilvray P. Pleural Effusion: Diagnostic Approach in Adults. *Am Fam Physician* 2023; 108: 464–475. [PubMed]
8. Kolikof J, Peterson K, Baker AM. Central Venous Catheter. Treasure Island (FL), 2025. [PubMed]
9. Zisis C, Tsirgogianni K, Lazaridis G, *et al*. Chest Drainage Systems in Use. *Ann Transl Med*; 3. Epub ahead of print 2015. [Journal]
10. Bediwy AS, Amer HG. Pigtail Catheter Use for Draining Pleural Effusions of Various Etiologies. *Int Sch Res Not* 2012; 2012: 143295. [Journal]
11. Liu YH, Lin YC, Liang SJ, *et al*. Ultrasound-Guided Pigtail Catheters for Drainage of Various Pleural Diseases. *Am J Emerg Med* 2010; 28: 915–921. [PubMed]
12. Ferreiro L, San José ME, Valdés L. Management of Parapneumonic Pleural Effusion in Adults. *Arch Bronconeumol (English Ed* 2015; 51: 637–646. [ScienceDirect]

13. Krishna R, Antoine MH, Alahmadi MH, *et al*. Pleural Effusion. Treasure Island (FL), 2025. [PubMed]
14. Mummadi SR, Stoller JK, Lopez R, *et al*. Epidemiology of Adult Pleural Disease in the United States. *Chest* 2021; 160: 1534–1551. [ScienceDirect]
15. Rizana S, Widirahardjo, Soeroso N, *et al*. Komplikasi Penggunaan *Small Bore Catheter* (Kateter Pigtail) dibandingkan *Large Bore Cathether* untuk Drainase Efusi Pleura. *J Respirologi Indones* 2017; 37: 91–95. [Journal]
16. Abdelghany MF, Essmat K, El-Karn AF, *et al*. Modified Indwelling Pleural Catheter versus Silver Nitrate Pleurodesis for the Management of Malignant Pleural Effusion. *Egypt J Chest Dis Tuberc*; 71, https://journals.lww.com/ecdt/fulltext/2022/71020/modified_indwelling_pleural_catheter_versus_silver.17.aspx (2022).
17. El- Shabrawy M, Elhawary A. Preparation for Minithoracoscopy by Percutaneous Pigtail Catheter Insertion for Difficult Pleural Effusion Cases. *Egypt J Chest Dis Tuberc*; 68, https://journals.lww.com/ecdt/fulltext/2019/68030/preparation_for_minithoracoscopy_by_percutaneous.19.aspx (2019).
18. Jayakrishnan B, Kashoob M, Al-Sukaiti R, *et al*. Percutaneous Ultrasound-Guided Pigtail Catheter for Pleural Effusions: Efficacy and Safety. *Oman Med J* 2021; 36: e248. [PubMed]
19. Shwaihet N, Ingram G. Use of Double Lumen Central Venous Catheters for the Drainage of Pleural Effusion in Pediatrics: A Prospective Observational Study. *Int J Nurs* 2014; 2: 30–35. [Journal]
20. Khare R, Anand K, Agrawal P, *et al*. Comparative Analysis of Pigtail Catheter versus Intercostal Tube Drainage for Pleural Effusion: A Tertiary Centre Study. *Int Surg J* 2022; 10: 105–109. [Journal]