Minimally Invasive Approach with Small-Bore Pleural Drainage Catheter (Easydren®) in Malignant Pleural Effusions

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Abstract

Aim: Treatment of malignant pleural effusion is drainage and chemical pleurodesis. Our aim in this study is to investigate the success and complications of the procedure in patients who underwent drainage with an 8F pleural drainage catheter due to malignant pleural effusion, according to the literature.

Methods: The study included 124 patients who underwent 8F pleural drainage catheter (Easydren®) for malignant pleural effusion between August 2020 and October 2022. Clinical, radiological and laboratory findings of all patients were obtained from the hospital automation system and archive files. Age, gender, etiology, number and duration of catheter drainage, complications and length of hospital stay of the patients were recorded.

Results: Of the 124 patients, 67 (54.0%) were female and 57 (45.9%) were male. The mean age was 54 (range, 31-87). A total of 136 pleural drainage catheters were applied to 124 patients. Drainage and complete reexpansion of the lung were successful in 125 (91.9%) of 136 procedures. No acute surgical complications were observed during the application of pleural drainage catheters. The mean drainage time was 4.6 days (range, 3 – 11). The length of hospital stay was 5.7 days (range, 4-12).

Conclusions: Conclusions: We believe that small-bore pleural drainage catheters are as effective as conventional chest tubes for the drainage of malignant pleural effusion with greater patient comfort. Although they rarely have a disadvantage such as obstruction during follow-up, they are less invasive and have fewer complications compared to tube thoracostomy.

Keywords: Malignant pleural effusion, small-bore catheter, drainage

1. Introduction

Malignant pleural effusion is the accumulation of more than normal fluid in the pleural space due to any malignancy. Malignant pleural effusion is thought to occur as a result of direct tumor involvement of the pleura, increased permeability of pleural microvessels and obstruction of lymphatic drainage channels, resulting in decreased reabsorbed fluid[1]. The most common tumors metastasizing to the pleura are lung cancer in men and breast cancer in women. In addition, lymphoma, genitourinary or gastrointestinal system malignancies have an important role in etiology[2]. As in mesothelioma, the cause of pleural effusion may be the malignancy of the pleura itself.

The treatment of malignant pleural effusions is drainage and chemical pleurodesis. Traditionally, 24-28 F large diameter radiopaque drains were used for drainage until recently. This procedure is often painful and has the effect of limiting patient mobilization. In recent years, the use of small diameter drainage catheters has increased. It is argued that the pain and complication risk during placement and follow-up of these catheters are less[3,4]. Our aim in this study is to discuss the success and complications of the procedure in patients who underwent drainage with an 8F pleural drainage catheter for malignant pleural effusion in the light of the literature.

2. Materials and methods

The study included 124 patients who underwent 8F pleural drainage catheter (Easydren®) for malignant pleural effusion between August 2020 and October 2022. The study was planned as a retrospective cohort study. The study protocol was approved by the Institutional Ethics Committee. All patients with malignant effusion who were followed as inpatients in our Thoracic Surgery Clinic or Oncology Clinic were included in the study. Clinical, radiologic and laboratory findings of all patients were obtained from the hospital

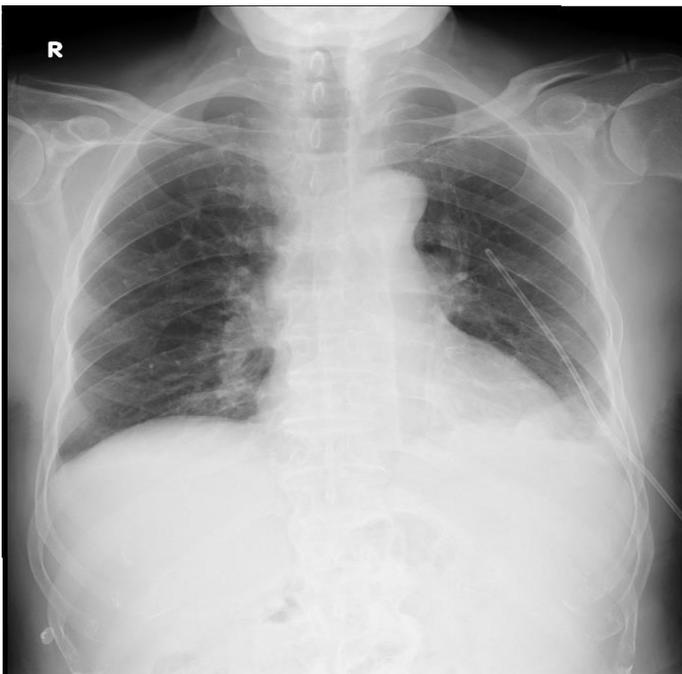Connection of pleural catheter to underwater drainage system in a patient with incompletely expanded lung during drainage

PA chest radiograph in a patient in whom pleural drainage was achieved

automation system and archive files. Direct chest radiography was seen in all patients. Thoracic computed tomography was performed in patients with suspected location and incomplete drainage. Thoracic ultrasonography was performed to determine the amount and localization of effusion in patients in whom thoracentesis failed. Before pleural drainage, thoracentesis was performed to determine the location of the catheter and to determine the nature of the pleural fluid. The pleural drainage catheter was inserted by the Seldinger method after asepsis was ensured and intercostal blockade was performed with local anesthetic. In patients with no location and free pleural fluid, an 8F drainage catheter was placed through the 5th or 6th intercostal space in the mid-axillary line. The pleural catheter was connected to the urine bag. In patients in whom the lung was not fully expanded during drainage, the pleural catheter was connected to an underwater drainage system (Figure 1). Chemical pleurodesis was performed with 4 mg talc in patients with an expanded lung and drainage below 300 ml. Drainage was terminated in patients with a drainage of 200 ml or less (Figure 2). Patients whose pleural catheter was terminated were discharged after chest radiographs 24 hours later showed that the lung was expanded.

3. Results

Of the patients, 67 (54.0%) were female and 57 (45.9%) were male. The mean age was 54 years (31-87). One hundred and twenty-four patients received a total of 136 pleural drainage catheters. Pleural drainage catheters were inserted 3 times in 3 patients, 2 times in 4 patients and bilaterally in 2 patients. The reason for multiple catheter placement was recurrence of pleural effusion or occlusion of the first catheter. Pleural effusion was exudate in 114 patients and transudate in 10 patients. The etiology of malignant pleural effusion was breast cancer in 54 (43.5%), lung cancer in 27 (21.7%), gastrointestinal system cancer in 19 (15.3%), lymphoma in 13 (10.4%), leukemia in 6 (4.8%) and other organ cancers in 5 (4.0%) patients. Cytology was sent for 3 days in patients with a history of primary malignancy. Effusions that were evaluated as malignant or suspected malignant on cytologic examination were accepted as malignant effusions.

No acute major surgical complications were observed during the application of pleural drainage catheters. Precautions against reexpension edema were taken by closing the catheter tap when the drainage volume reached 1500 ml. No reexpansion edema was observed in any of our patients. Drainage and complete lung reexpansion was successful in 125 of 136 procedures (91.9%). Expansion defect due to failure of lung expansion in the costodiaphragmatic sinus was detected in 3 patients. In these patients, the cavity was allowed to fill with fluid after the end of drainage. One patient developed significant pneumothorax after the procedure and underwater drainage was performed by tube thoracostomy with a 28 F radiopaque drain. Videothoracoscopic pleural drainage and decortication were performed in 2 patients aged 34 and 42 years with good general condition in whom septations developed after repeated drainage and drainage was not complete. In 4 patients with complete obstruction of the pleural drainage catheter, the catheter was replaced with a new one and drainage was achieved. In one patient, a portion of the pleural drainage catheter remained in the pleural space due to rupture of the catheter during termination. In this patient, the catheter was removed with the help of a videothoracoscope.

The mean duration of drainage was 4.6 days (3 - 11). During the follow-up of pleural drainage catheters, paracetamol was sufficient as analgesic except for 3 patients. In these patients, the addition of narcotic analgesics was sufficient to control pain if necessary. In addition, catheter obstruction occurred in 7 patients, but in these patients, 50 ml of isotonic fluid was administered through the

catheter via a syringe and flushing was performed. Catheter patency was achieved as a result of the application. No patient developed infection, bleeding or subcutaneous hematoma around the catheter. The mean duration of hospitalization was 5.7 days (4-12).

4. Discussion

Tube thoracostomy has been used as the primary tool for drainage of air or fluid in the pleural space resulting from different causes such as pleural effusion, empyema, hemothorax, chylothorax and pneumothorax. This procedure is performed with blunt dissection technique and usually requires hospitalization, limits patient mobilization and causes severe pain[5-7]. Tube thoracostomy has complications such as hemothorax, pneumothorax, organ perforation, diaphragmatic injury, empyema, pulmonary edema and horner syndrome[8,9]. In recent years, small bore pleural catheters have gained increasing popularity. Their safety and efficacy in managing different pleural pathologies have been the subject of several studies. In this study, we tried to determine the efficacy, advantages and disadvantages of small bore pleural drainage catheters used in patients with malignant pleural effusion.

Several clinical studies comparing large diameter chest tubes with small diameter catheters for malignant pleural effusion have shown that both procedures are equivalent in terms of both drainage and pleurodesis[10-12]. Different studies have measured the pain experienced by patients during the insertion of small diameter pleural catheters for malignant pleural effusion and reported that the pain experienced by patients was very mild and as a result, small diameter drainage catheters were well tolerated by patients[13,14]. In our patients, we found that there was much less pain and less need for analgesia during insertion of 8F catheters used for drainage of malignant pleural effusion compared to traditional tube thoracostomy.

We attributed this to the fact that unlike traditional chest tubes, small diameter catheters do not disrupt the anatomy of the intercostal space and do not compress neurovascular structures. Tube thoracostomy is a procedure that may cause pain in the intercostal space because it is performed with blunt dissection. It causes severe pain especially in obese patients as more dissection is required. Small diameter pleural drainage catheters are placed with the seldinger technique and cause less pain. The risk of diaphragmatic or intra-abdominal organ injury is lower compared to tube thoracostomy. Apart from this advantage, the risk of procedure-related bleeding or subcutaneous hematoma is lower in patients with bone marrow depression due to chemotherapy, coagulopathy due to impaired liver function, or high INR values due to anticoagulant use[2]. None of our patients experienced bleeding or subcutaneous hematoma due to the small diameter catheter.

Small diameter drainage catheters are more costly than radiopaque drains. However, several studies have reported that drainage and pleurodesis of malignant pleural effusion resulted in a shorter hospital stay compared to conventional tubes[15,16]. In addition, it has been reported that in recurrent malignant pleural effusions, small diameter pleural drainage catheters are connected to the urinary bladder and patients are called to outpatient clinic controls with close follow-up[17-19].

Some minor complications such as expansion defect or pneumothorax have been reported in the use of small diameter pleural drainage catheters. We observed lung expansion defect after drainage in three of our patients. We believe that the lung expansion defect was not due to the procedure itself, but to malignant infiltration of the visceral pleura or prolonged effusions causing thickened visceral pleura that prevented lung reexpansion. It is estimated that this complication occurs in 30% of malignant effusion cases[20]. In these patients, catheter drainage is not required for a long time and pleural fluid can be allowed to reaccumulate in the residual space over time[21,22]. Alternatively, as reported by some other authors, drainage can be provided for a longer period of time with the use of an indwelling pleural catheter[23]. In 3 of our patients, an expansive defect was detected in the costodiaphragmatic sinus due to failure of the lung to expand. In these patients, the cavity was allowed to fill with fluid after the catheter was terminated after decreased drainage.

Another common complication of small diameter pleural drainage catheters is frequent occlusion. In 4 of our patients, the catheter was completely occluded and we had to change the catheter for complete drainage. In addition, partial occlusion of the catheter occurred in 7 patients, but in these patients, 50 ml isotonic fluid was administered through the catheter via a syringe and flushing was performed. Catheter patency was achieved as a result of the application. Frequent flushing of the catheters with sterile isotonic may maintain drainage. There are also authors who recommend the use of fibrinolytics to facilitate drainage[24]. Rupture of a small diameter drainage catheter due to its thinness and intrapleural retention is a rare complication as we encountered in 1 patient. Patients should be warned that they should be careful not to get the catheter caught anywhere during mobilization.

5. Conclusions

In conclusion, we believe that small diameter pleural drainage catheters are as effective as conventional chest tubes for drainage of malignant pleural effusion with greater patient comfort. Although it has the disadvantage of rare obstruction during follow-up, it is less invasive and has fewer complications compared to tube thoracostomy.

Statement of ethics

Conflict of interest statement

The authors declare that they have no financial conflict of interest with regard to the content of this report.

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Author contributions

All authors contributed to the study conception and design.
All authors read and approved the final manuscript.

References

1.Rodrîguez-Panadero F. Medical thoracoscopy. Respiration. 2008; 76(4): 363-72.
https://doi.org/10.1159/000158545
2.DiBonito L, Falconieri G, Colautti I, et al. The positive pleural e)usion. A retrospective study of cytopathologic diagnoses with autopsy confirmation. Acta Cytologica 1992; 36: 329-32.
3.Sarıcam M. Comparision of chest tube and intrapleural catheter aplied for benign pleural effusion. Journal of Ankara University Faculty of Medicine. 2018; 71(2): 162-5.
https://doi.org/10.4274/atfm.65375
4.Hamad AM, Alfeky SE. Small-bore catheter is more than an alternative to the ordinary chest tube for pleural drainage. Lung India. 2021; 38: 31-5.
https://doi.org/10.4103/lungindia.lungindia_44_20
5.Light RW. In: Pleural Diseases. 5th ed. Baltimore, MD: Lippincott, Williams

and Wilkins; 2007.

6.Havelock T, Teoh R, Laws D, et al. BTS Pleural Disease Guideline Group. Pleural procedures and thoracic ultrasound: British Thoracic Society Pleural Disease Guideline 2010. Thorax. 2010; 65(2): 61-76.
https://doi.org/10.1136/thx.2010.137026

7.Harris A, O'Driscoll BR, Turkington PM. Survey of major complications of intercostal chest drain insertion in the UK. Postgrad Med J. 2010; 86: 68-72.
https://doi.org/10.1136/pgmj.2009.087759

8.Miller KS, Sahn SA. Chest tubes: indications, technique management and complications. Chest 1987; 91: 258e64.
https://doi.org/10.1378/chest.91.2.258

9.Iberti TJ, Stern PM. Chest tube thoracostomy. Crit Care Chest. 1992; 8: 879e95.
https://doi.org/10.1016/S0749-0704(18)30230-6

10.Thethi I, Ramirez S, Shen W, et al. Effect of chest tube size on pleurodesis efficacy in malignant pleural effusion: A meta-analysis of randomized controlled trials. J Thorac Dis. 2018; 10: 355-62.
https://doi.org/10.21037/jtd.2017.11.134

11.Parulekar W, Di Primio G, Matzinger F, et al. Use of small-bore vs. large-bore chest tubes for treatment of malignant pleural effusions. Chest. 2001; 120: 19-25.
https://doi.org/10.1378/chest.120.1.19

12.Caglayan B, Torun E, Turan D, et al. Efficacy of iodopovidone pleurodesis and comparison of small-bore catheter versus large-bore chest tube. Ann Surg Oncol. 2008; 15: 2594-9.
https://doi.org/10.1245/s10434-008-0004-1

13.Horsley A, Jones L, White J, et al. Efficacy and complications of small-bore, wire-guided chest drains. Chest. 2006; 130: 1857-63.
https://doi.org/10.1378/chest.130.6.1857

14.Cafarotti S, Dall'Armi V, Cusumano G, et al. Small-bore wire-guided chest drains: Safety, tolerability, and effectiveness in pneumothorax, malignant effusions, and pleural empyema. J Thorac Cardiovasc Surg. 2011; 141: 683-7.
https://doi.org/10.1016/j.jtcvs.2010.08.044

15.Yildirim E, Dural K, Yazkan R, et al. Rapid pleurodesis in symptomatic malignant pleural effusion. Eur J Cardiothorac Surg. 2005;27: 19-22.
https://doi.org/10.1016/j.ejcts.2004.08.034

16.Tan C, Sedrakyan A, Browne J, et al. The evidence on the effectiveness of management for malignant pleural effusion: A systematic review. Eur J Cardiothorac Surg. 2006; 29: 829-38.
https://doi.org/10.1016/j.ejcts.2005.12.025

17.Saffran L, Ost DE, Fein AM, et al. Outpatient pleurodesis of malignant pleural effusions using a small-bore pigtail catheter. Chest. 2000; 118: 417-21.
https://doi.org/10.1378/chest.118.2.417

18.Musani AI, Haas AR, Seijo L, et al. Outpatient management of malignant pleural effusions with small-bore, tunneled pleural catheters. Respiration. 2004; 71: 559-66.
https://doi.org/10.1159/000081755

19.Herlihy JP, Loyalka P, Gnananandh J, et al. Pleurx catheter for the management of refractory pleural effusions in congestive heart failure. Tex Heart Inst J. 2009; 36: 38-43.

20.Dresler CM, Olak J, Herndon JE, et al. Cooperative Groups Cancer and Leukemia Group B; Eastern Cooperative Oncology Group; North Central Cooperativ Oncology Group; Radiation Therapy Oncology Group. Phase III intergroup study of talc poudrage vs. talc slurry sclerosis for malignant pleural effusion. Chest. 2005; 127: 909-15.
https://doi.org/10.1378/chest.127.3.909

21.Staes W, Funaki B. "Ex vacuo" pneumothorax. Semin Intervent Radiol. 2009; 26: 82-5.
https://doi.org/10.1055/s-0029-1208386

22.Kim YS, Susanto I, Lazar CA, et al. Pneumothorax exvacuo or "trapped lung" in the setting of hepatic hydrothorax. BMC Pulm Med. 2012; 12: 78.
https://doi.org/10.1186/1471-2466-12-78

23.Kopman DJ, Reddy CB, DeCamp MM, et al. Management of malignant pleural effusions. An Official ATS/STS/STR clinical practice guideline. Am J Respir Crit Care. Med 2018; 198: 839-49.
https://doi.org/10.1164/rccm.201807-1415ST

24.Davies HE, Davies RJ, Davies CW: BTS Pleural Disease Guideline Group. Management of pleural infection in adults: British thoracic society pleural disease guideline 2010. Thorax. 2010; 65: 41-53.
https://doi.org/10.1136/thx.2010.137000