Managing Pleural Effusions:
Nursing Care of Patients With a Tenckhoff Catheter

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Malignant pleural effusions result from advanced metastatic disease and can have a devastating effect on patients and their families. The insertion of a tunneled pleural catheter, such as a Tenckhoff catheter, is a treatment option for this patient population. Nurses play a significant role during the patient's journey with the disease process, providing the skills necessary to promote self-care and autonomy, resulting in improved quality of life. In this article, the authors discuss the nursing care of patients who have a Tenckhoff catheter.

Nursing plays a significant role in the management of pleural effusions, supporting patients and their families throughout their journey. A malignant pleural effusion is an accumulation of fluid in the pleural space with malignant cells within it. Although congestive heart failure or infection can cause benign pleural effusions, the most common underlying etiological causes of malignant pleural effusions include carcinoma of the lung, mesothelioma, breast cancer, gastrointestinal tract carcinomas, lymphomas, and ovarian cancer (Brubacher & Holmes Gobel, 2003; Musani, Haas, Seijo, Wilby, & Sterman, 2004). The annual incidence of malignant pleural effusion is 200,000 in the United States (Porcel & Light, 2006). Malignant pleural effusion is a frequent and morbid result of advanced metastatic disease that can cause severe dyspnea, chest tightness, pleuritic pain, and cough. Such symptoms can result in a tremendous amount of emotional distress and anxiety for the patient and their family.

Treatment options for recurrent pleural effusions include repeated thoracentesis, chemical sclerosis/talc pleurodesis, chemotherapy, radiation, and placement of a long-term indwelling pleural catheter, such as Tenckhoff or Pleurx® (Denver Biomedical) catheters (Robinson, Fullerton, Albert, Sorensen, & Johnston, 1994). Multiple factors must be taken into consideration when determining which treatment option is appropriate for patients. According to Shuey and Payne (2005), the treatment considerations include patients' performance status, type of malignancy and its response to previous treatments, and prognosis.

Two membranes, known as the pleura, lie within the chest cavity. The two types are the visceral pleura, which covers the lung, and the parietal pleura, which lines the inner chest wall. The space between these two pleura is known as the pleural space (see Figure 1). Normally 5–20 ml of fluid is present in the pleural space, which acts as a lubricant allowing the two pleura to slide across each other without resistance during respiration (Held-Warmkessel & Schiech, 2008; Pearson et al., 2002; Shuey & Payne, 2005; Taubert, 2001). The fluid is diffused through the parietal pleural capillaries and is reabsorbed through the visceral pleura. A pleural effusion results if more fluid is produced than can be absorbed from the pleural space (Held-Warmkessel & Schiech, 2008). Peritoneal fluid also may accumulate within the pleural space as it leaks through pores in the diaphragm in patients with abdominal ascites (Pearson et al., 2002; Shuey & Payne, 2005). As much as 0.5–1 L of fluid may move through the pleural space in a 24-hour period (Shuey & Payne, 2005; Taubert, 2001).

With the current advances in treatment methodologies with malignant disease, patients, in general, are living longer. However, by the time they develop a malignant pleural effusion, their life expectancy usually is severely limited. The healthcare team's goal should be to work with the patient and their family to try to

At a Glance

- Nurses can play a significant role in assisting patients and their families with the devastating effect of malignant pleural effusions.
- Nurses require advanced educational preparation to safely care for patients with a Tenckhoff catheter.
- The ultimate goal of managing a Tenckhoff catheter is to allow patients autonomy in their care, thereby contributing to improved quality of life.

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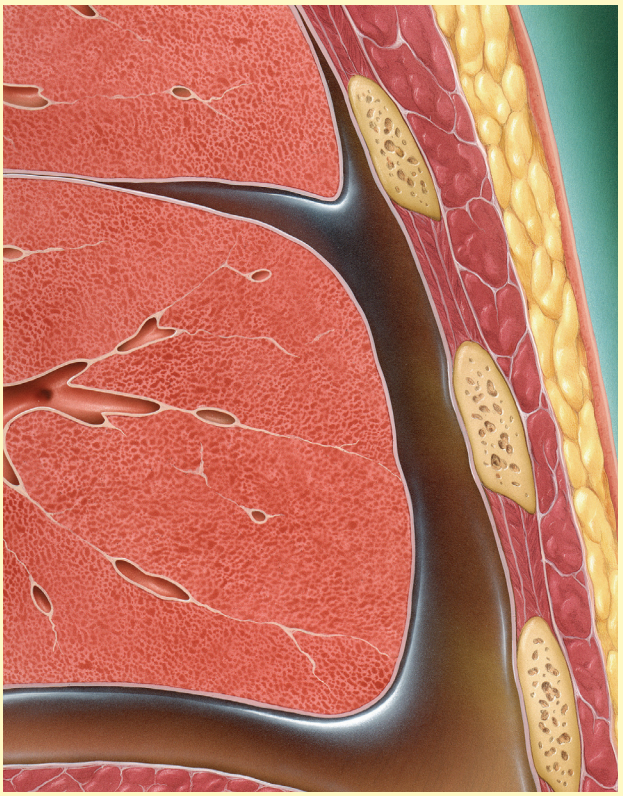

Figure 1. Pleural Effusion

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ease symptoms and provide a better quality of life (QOL). As reported by Warren, Kalimi, Khodadadian, and Kim (2008), use of a Pleurx catheter to drain pleural fluid improves patient symptoms. The authors' experience has demonstrated that the insertion of a Tenckhoff catheter can improve patients' QOL by allowing them the freedom to drain pleural fluid whenever they are symptomatic by using an indwelling tunneled pleural catheter. Patients and family members can be taught how to drain the Tenckhoff catheter so that they are not totally reliant on health professionals, giving them greater autonomy through self-care skills while offering them some control over symptoms related to their disease. For the purpose of this article, the tunneled pleural catheter the authors' refer to is the Tenckhoff catheter, which is widely used in their institution, University Health Network (UHN), and the surrounding community. This article will outline nursing care of a Tenckhoff catheter, including the drainage procedure, flushing, how to change the adapter, and dressing changes. A care guide is included (see Table 1).

Background History

Tenckhoff and Schechter originally designed the Tenckhoff catheter in 1968 for drainage of the peritoneal cavity in acute renal failure (Twardowski, 2006). Robinson et al. (1994) described the placement of an externally draining Tenckhoff catheter into the pleural space to drain malignant pleural effusions. Since then, Tenckhoff catheters have been used for drainage of recurrent pleural effusions. Other centers use similar indwelling tunneled pleural catheters, such as the Pleurx catheter, which has been used in the United States since 1997 (Tremblay & Michaud, 2006; Warren et al., 2008).

Definition

A Tenckhoff catheter is a soft translucent silicone rubber tube with multiple drainage holes, a radiopaque stripe down its length, and a Dacron cuff. The catheter is implanted in the pleural space, tunneled through the subcutaneous tissue, and brought out through a skin exit wound. A plastic luer lock adapter (included in the sterile Tenckhoff catheter package) is inserted into the end of the Tenckhoff catheter. Then a MaxPlus® Tru-Swab Positive Displacement Connector (Maximus Medical) or equivalent is locked onto this adapter. The IV tubing, attached to an empty sterile IV bag, is then luer locked onto the end of the MaxPlus. Once implanted, the body produces fibrin, which grows onto the Dacron cuff, securing the Tenckhoff catheter in place while providing a barrier between the outside of the chest cavity and the pleural space (see Figure 2).

A similar drainage system used in other centers is the Pleurx catheter. This system has a polyester cuff and also uses a one-way valve at the end of the catheter; drainage is achieved with the use of vacuum bottles instead of gravity into an empty IV bag, as with the Tenckhoff catheter system (Warren et al., 2008). The authors of this article do not have any experience with use of the Pleurx system. Both the Tenckhoff and Pleurx catheter systems work equally well with similar positive patient outcomes. Although the Pleurx catheter system may be widely used at other institutions, an equipment cost analysis found that the Tenckhoff catheter system is considerably more economical (about 25% the cost). Because patient outcomes are similar between systems, the authors continue to use the Tenckhoff catheter system at their institution.

A Tenckhoff catheter can be placed under local anesthetic for patients who are high risk for anaesthetic (Johnston et al., 2000). All patients who have a Tenckhoff catheter placed require community nursing care when discharged. If this nursing care can be arranged in advance, a Tenckhoff catheter placement procedure often can be done on an outpatient basis. At the authors' institution, if no complications arise, the length of stay for patients requiring admission to hospital for this procedure is overnight, similar to the findings of Johnston et al. (2000). Thorough patient education must be completed prior to the patient being discharged from hospital and a written instruction package is sent home with the patient.

According to Tremblay and Michaud (2006), although tunneled pleural catheters are being used more frequently, a limited amount of literature on the subject has been published. The authors' literature search supported this finding and revealed little nursing documentation surrounding care of patients with a Tenckhoff catheter in situ. Therefore, guidelines were developed based on Johnston et al. (2000). The authors studied 122 patients ($\bar{X}$ age = 63 years) with a total of 134 Tenckhoff catheters placed from 1993–1999. The majority of the patients either had lung or breast primary carcinomas and Tenckhoff catheters remained in situ for a mean of 89 days (range 8–377).

The guidelines have evolved over time and are used by nurses to provide care to patients with a Tenckhoff catheter. To support

patients across the continuum of care, educational sessions were held with community nurses and the guidelines have now been adopted by community care nursing agencies in the Toronto, Canada, region to help guide their practice. They use the same educational instruction package that is supplied to the patient to ensure consistency. Once educated, community care nurses have been able to provide all necessary care with regard to the Tenckhoff catheter. Resource contact numbers for experts at the authors' institution (available 24 hours per day) are provided to the community care nurses on the medical referral form and in the educational package.

All care of a Tenckhoff catheter must be undertaken using aseptic technique. The authors recommend the use of a needleless system whenever possible.

Table 1. Care Guide for Tenckhoff Catheters

DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8+
Ensure that the catheter is taped securely to the patient's chest.	→	→	→	→	→	→	→
Connect catheter to straight drainage for 72 hours.	→	Disconnect IV tubing at end of day if insertion site is dry and intact. If insertion site becomes wet with pleural fluid at any time, reconnect catheter and drain for 48–72 hours.	Reconnect new IV tubing and bag daily for drainage procedure and disconnect at end of procedure if the site is dry and intact.	→	→	→	Drain following frequency guidelines.
Change IV bag and tubing on a daily basis.	→	→	Use new IV bag and tubing with each drainage procedure.	→	→	→	→
Change MaxPlus® adaptor every seven days and as needed.	→	→	→	→	→	Change MaxPlus adaptor.	→
Do not change initial dressings if the dressings remain dry and intact.	→	Change initial dressings, then continue changing dressings every two days and as needed beginning on day 5.	Do not change dressings if the dressings remain dry and intact.	Change dressings every two days and as needed.	Do not change dressings if the dressings remain dry and intact.	Change dressings every two days and as needed.	Change dressings every two days and as needed. Then, after two weeks, change dressings weekly and as needed.
Apply waterproof dressing for shower for initial two weeks or anytime swimming in a pool.	→	→	→	→	→	→	→
Monitor catheter exit site suture.	→	→	→	→	→	If exit site is well healed, remove suture.	→
Culture any suspicious drainage from the insertion site.	→	→	→	→	→	→	→
Expel any air from the drainage bag as needed.	→	→	→	→	→	→	→
Monitor and record the amount of drainage.	→	→	→	→	→	→	If no drainage for three weeks, contact surgeon about possible catheter removal.

Note. Arrows indicate that the action should be continued or repeated on those days.

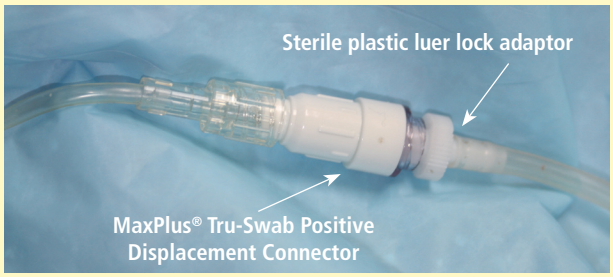

Figure 2. Tenckhoff Catheter and Connections

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Drainage Procedure

The ultimate goal is autonomy and independence by the patient and/or family in caring for the Tenckhoff catheter. Daily community nursing visits are arranged initially to provide the care, support, and daily education to the patient and/or family. Once the community nurse assesses that the patient and/or family member is ready to learn and can safely care for the Tenckhoff catheter, they will be educated on the required care procedures. Being able to care for this catheter independently within their own home and not having to be connected to a drainage bag continuously provides the patient with a sense of control and autonomy (Held-Warmkessel & Schiech, 2008). The community care nurses always are available to the patient and/or family should questions or concerns arise. In the authors' experience, most patients or family members have been able to successfully care for the Tenckhoff catheter independently after a few days. If patients live alone with no personal support or have physical and/or psychological limitations that prevent them from safely being able to care for the Tenckhoff catheter independently, the community nurse will continue to provide all necessary care.

Required equipment for a drainage procedure includes an empty sterile IV solution bag (initial size of 1 L), sterile secondary IV tubing, MaxPlus or equivalent adapter, alcohol or chlorhexidine swabs, sterile normal saline, a 10 cc syringe, clean gloves, and dressing supplies. Pleural fluid should drain freely. Using gravity, place the drainage bag lower than the patient's chest and allow continuous drainage for the first 72 hours after insertion. Monitor the insertion site for drainage and change the dressing daily and as needed. The empty sterile IV bag will serve as the drainage collection bag and must be changed along with the IV tubing every 24 hours and as needed. If a bag fills completely during a drainage session, a new bag must be attached but the same IV tubing may be used.

After the initial 72 hours, the Tenckhoff catheter should be accessed daily for one week then as per the drainage guidelines or if the patient becomes symptomatic. Drainage guidelines are listed in Table 2. Drainage may take anywhere from 15–90 minutes, so ensure that the patient is comfortable prior to initiating the procedure if they are not ambulatory. Once all the fluid has drained, dispose of the tubing and bag observing body substance precautions as per organizational policy. Thorough documentation of the amount, color, and consistency of the pleural fluid as well as any other observations is essential.

To prepare for the drainage procedure, attach the secondary IV tubing to the empty IV bag. Cleanse the MaxPlus thoroughly with chlorhexidine (or equivalent) and allow it to dry for 30 seconds. Luer lock the IV tubing into the MaxPlus. Ensure the roller clamp is open on the IV tubing and, using gravity, drain the pleural fluid. Once the flow of pleural fluid has stopped, wait five minutes, close the roller clamp on the IV tubing, and disconnect from the MaxPlus (see Figure 3).

Lung re-expansion following Tenckhoff catheter insertion may cause coughing, pain, pulmonary edema, and/or oxygen desaturation. Removing a large amount of fluid too quickly also may result in hypotension or circulatory collapse; therefore, careful monitoring of vital signs (heart rate, blood pressure, and oxygen saturation) and respiratory status is essential if symptoms occur (Held-Warmkessel & Schiech, 2008). If pulmonary edema and its associated oxygen desaturation were to occur, this would happen within a few hours of the insertion procedure while the patient is still in the hospital. Symptoms of chest discomfort and/or coughing as the pleural space is drained are not uncommon.

The lung will not always fully expand following evacuation of a large amount of pleural fluid during the insertion procedure. This can create a large empty space within the pleural cavity with only the catheter in place to drain it. This may result in the drainage bag filling up with air. As the MaxPlus is not a one-way valve, the air cannot escape freely and must be manually released or it could result in an inability of the fluid to drain and/or subcutaneous emphysema. Subcutaneous emphysema may develop at the insertion site and spread up the patient's chest, possibly causing the patient some discomfort. However, it is not considered a danger to the patient and will reabsorb over time. When the air is released from the bag, any additional spread of the subcutaneous emphysema is prevented. Prior to discharge from hospital, the patient education provided should demonstrate this procedure to the patient and family members. Visiting nurses to the home also review the process. In the authors' experience, patients and family members are able to manage this procedure independently.

Changing the MaxPlus Adaptor

Because research to support the frequency of MaxPlus changes when used for malignant pleural effusions was not available, the authors' institution recommends a change schedule of every seven days and as needed (i.e., if blocked). The patient should be educated on keeping a written record of MaxPlus adaptor changes. If nurses are using an alternate adapter, follow that manufacturer's recommendations for a change schedule. When changing the MaxPlus, once the area is thoroughly cleansed, occlude the

Table 2. Drainage Guidelines

AMOUNT OF DRAINAGE	DRAINAGE FREQUENCY PROTOCOL
More than 300 cc	Drain every day.
100–300 cc	Drain every other day.
Less than 100 cc	Drain twice a week for two weeks, then reduce to once weekly and as needed.

Tenckhoff catheter manually by kinking the catheter tubing over with your hands. Never use any kind of clamp on the Tenckhoff catheter because the soft silicone is ruptured easily. Remove the MaxPlus, cleanse the end of the luer lock adapter, attach a new sterile MaxPlus, and unkink the Tenckhoff catheter.

Care of Incision and Dressing Changes

Two incisions require dressing changes. If they remain dry and intact, change the initial dressing after the first 72 hours. The posterior incision has dissolvable sutures. Cleanse the incision and cover with a dry dressing as needed until healed. The anterior incision is the exit site from which the Tenckhoff catheter protrudes. A nondissolvable suture may be present in situ, which can be removed by the visiting community nurse 7–10 days after insertion. The site must be monitored for leakage of pleural fluid, bleeding, and signs of inflammation or infection. A culture should be sent and analyzed if any suspicious drainage, such as purulence or foul odor, is noted. Cleanse the site and cover with a sterile 2 inch by 2 inch gauze and a clear film dressing (such as Opsite® [Smith & Nephew) or Tegaderm® [3M]) every two days and as needed for the first two weeks. Once healed, apply a clear film dressing directly over the site (without gauze) weekly and as needed to allow for easy observation of the site. Taping the Tenckhoff catheter securely to the skin below the dressing will avoid undue tension.

The patient must be instructed to keep the dressings dry for the first two weeks after insertion. Showers may be taken with a waterproof dressing in place. Once the exit site has healed, the patient may take a shower with the dressing off and then redress the site. Soaking in a bathtub is not recommended. Do not to expose the Tenckhoff catheter to chemicals, such as chlorine, which may cause catheter breakdown. Patients who wish to swim in a pool must cover the insertion site and Tenckhoff catheter completely to keep it dry.

Removal of Tenckhoff Catheter and Follow-Up

If the pleural effusion resolves and no drainage occurs for a minimum of three weeks, the surgeon may remove the Tenckhoff catheter in the outpatient clinic. Using local anesthetic, a small incision is made above the Dacron cuff, any adhesions are released, and the Tenckhoff catheter is removed and the incision sutured. If nondissolvable sutures are used, the patient will be asked to see his or her family physician within two weeks for removal. For possible complications and troubleshooting tips, see Table 3.

An initial follow-up visit is booked with the surgeon for two to four weeks following insertion of the Tenckhoff catheter. Additional routine follow-up visits are not usually booked unless warranted by the patient's specific medical needs and/or for catheter removal.

Conclusion

Malignant pleural effusions often develop with advanced metastatic disease, significantly affecting the lives of patients and their families. Tunneled pleural catheters can offer these patients some autonomy and control of their symptoms as their disease progresses. Although other healthcare institutions may use a different type of tunneled pleural catheter, the authors' have had great success in their institution using Tenckhoff catheters with few complications. This has contributed to improved QOL and independence for patients dealing with a poor prognosis. Nurses make a significant impact on this patient population through teaching the patient and their family the necessary self-care skills to manage the Tenckhoff catheter independently while supporting them on their journey from hospital to home.

Note. IV tubing, roller clamp, and IV bag using gravity to drain pleural fluid are pictured at top left; a full setup from patient to drainage bag is pictured at top right; and dressing, Tenckhoff catheter, luer lock adaptor to MaxPlus® Tru-Swab Positive Displacement Connector, and IV tubing with roller clamp are in the bottom photo.

Figure 3. Catheter Settings and Placement

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Table 3. Catheter-Related Complications and Troubleshooting

POTENTIAL COMPLICATION	SOLUTIONS
The pleural fluid does not flow freely when the Tenckhoff catheter is initially connected.	Instruct the patient to breath deeply, cough, or walk around if ambulatory. Repositioning of the patient two or three times may be required. If no drainage occurs once connected and the patient is asymptomatic, discontinue drainage until the next scheduled session.
Symptoms of chest discomfort or coughing occur as the pleural fluid is drained.	Reduce the flow rate or stop for 15–30 minutes. If the discomfort continues but the patient is not short of breath, discontinue drainage for this session and drain at a slower rate next time. If discomfort exists and the patient is symptomatic, stop the drainage procedure and notify the physician.
The drainage bag fills with air or the patient develops subcutaneous emphysema.	The air must be released. To release the air, close the roller clamp on the IV tubing to prevent air from entering the patient's chest. Next, while maintaining sterile technique, detach the bag from the tubing, gently squeeze the air out, and then reattach the bag. Ensure the roller clamp is opened once this procedure is complete.
An infection develops and does not resolve with antibiotic treatment.	Removal of the Tenckhoff catheter may be necessary.
The Tenckhoff catheter exit site may leak pleural fluid, either continuously or once disconnected from the drainage bag.	If a moist environment exists, fibrin will not form around the Dacron cuff. If the Tenckhoff catheter is patent but leaking at the insertion site, leave it to continuous drainage for an additional 48–72 hours, changing the bag and tubing daily and as needed. After this time period, disconnect again and monitor the site. If the leakage persists, reattach to continuous drainage and notify the patient's physician.
The Tenckhoff catheter is not draining but is leaking at the exit site.	Assess the Tenckhoff catheter and MaxPlus® for visible blockage, which may present itself as blood strands or fibrin. If a blockage is noted in the MaxPlus, the adapter must be changed. If no blockage is visible, attempt to flush the catheter by cleansing the end of the MaxPlus, let it dry for 30 seconds, then slowly inject 10 cc of normal saline through the MaxPlus. The Tenckhoff catheter is *never* routinely flushed—this procedure must only be performed in the case of a blockage. If resistance occurs, reposition the patient and attempt to flush again. If resistance still occurs, stop and contact the patient's physician. If the Tenckhoff catheter flushes with ease, attach the tubing and bag and proceed with the drainage. If minimal or no drainage occurs and the patient remains asymptomatic, detach until the next scheduled session.
Fibrin or blood clots occasionally block the Tenckhoff catheter.	Neither flushing nor changing the MaxPlus will resolve the issue. Contact the patient's physician as a clot-busting agent, such as streptokinase, may need to be injected into the Tenckhoff catheter.

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