Central venous access plays an important role in modern medical patient assessment and treatment. The use of central venous access devices has become routine in the oncology setting. Clinical oncology nurses need to know how the devices function, how to provide proper care, and how to manage potential side effects. The focus of this article will be on the navigation of implanted, skin-tunneled ports.

In the oncology setting, central venous access devices (CVADs) most often are used to administer chemotherapy. CVADs also are used for blood draws; hydration; administration of blood products, total parenteral nutrition (TPN), or medications (long-term, intermittent, and continuous); peripheral access; hemodynamic monitoring; and simultaneous administration of multiple complex fluids.

**Types of Devices and Their Usage**

**Nontunneled CVADs** are made of polyurethane, have three to five lumens, and come in various diameters and lengths (Hamilton, 2006). Typical use is for short periods of time (5–10 days), and the internal jugular, subclavian, or femoral veins are used as insertion sites.

**Skin-tunneled CVADs** also are placed in the jugular and subclavian veins. The femoral vein is used less frequently. The catheters come in varying diameters and have multiple lumens. A Dacron® (Invista, Inc.) cuff stabilizes the catheter by creating fibrosis with the subcutaneous tissues. The cuff also provides an antimicrobial barrier between the skin and the vascular system, allowing the catheter to remain in place for months or even years.

**Peripherally inserted central catheters (PICCs)** have peripheral insertion sites in the basilic, median, cubital, or cephalic veins. The catheters are considered CVADs because their tips terminate in the lower third of the superior vena cava (Hamilton, 2006). PICCs may be used for months.

For long-term oncology use, skin-tunneled, implanted, subcutaneous CVADS are recommended. The devices are placed surgically in the subcutaneous tissue of the chest, arm, or abdominal wall (see Figure 1). They should be considered only for patients requiring long-term IV therapy. The implanted port consists of a self-sealing septum covering a metal or plastic reservoir (the body) and a catheter.

**Figure 1. Surgeons Placing an Implanted Port**

*Note. Surgeons are placing a port chamber for chemotherapy infusion. The port chamber is placed in a subcutaneous pocket, which is closed with sutures. The white silastic (silicone) catheter attached to the port chamber will feed into the superior vena cava over a guidewire.*

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1. To reduce the risk of infection, wash hands well with soap and water or use an alcohol-based hand cleaner.
2. Have the patient turn away from the port; have the patient wear a mask if he or she has a cough.
3. Observe the port site for signs of infection such as redness, discoloration, edema, drainage, or pain; also look for signs of bleeding or ecchymosis. Report any abnormalities to the physician.
4. Use sterile gloves, set up a sterile field, and prime a noncoring needle and extension set with a 10 ml syringe of normal saline solution; purge out all of the air to reduce the risk of air embolism.
5. Drape the patient and prepare the site by cleansing according to institutional protocol. Alcohol and chlorhexidine glucanate or alcohol and betadine commonly are used to clean the site; chlorhexidine is recommended over betadine. Chlorhexidine glucanate is applied with a scrubbing motion back and forth to create friction with the skin for at least 30 seconds; let the cleansing agents air-dry thoroughly. Do not allow the patient to blow or wave the site dry, and do not blot dry.
6. With your nondominant hand, palpate the edges of the port and apply slight pressure to stretch the skin across the septum to stabilize the port and assist in proper needle placement; insert the Huber needle through the skin at the port center until the needle hits the back wall.
7. Unclamp the extension set, aspirate for blood return to verify proper needle placement, flush with 10 ml of normal saline solution, and reclement.
8. Place a folded 2” x 2” piece of gauze under the Huber needle wings to support the needle in a 90° position. A gripper-style device should lay flush with the skin.
9. Apply a transparent dressing. If the dressing remains occlusive, it can stay in place for up to seven days. A sterile occlusive gauze dressing may be used for a patient with tape allergies; gauze dressings should be changed every two days and as needed. Some facility protocols call for skin protectant use: Apply to the skin around the port, not the access site, and allow to dry prior to application of the dressing.
10. The port is ready for use: Place an injection cap on the end of the extension set and flush with 10 ml of normal saline solution. Attach continuous IV fluids at this time. If an open-ended catheter is being used, flush with 20 ml normal saline and then 5 ml 100 unit/ml heparin (only once), clamping as the last few milliliters are pushed.

Figure 2. Port Access Procedure

Note. Based on information from Hadaway, 2002; Larovere, 1999a, 1999b; Masoorli, 2005; O’Grady et al., 2002.

Connecting it to a central vein. Implanted ports are available in single- and dual-lumen designs (Hamilton, 2006). The dual-lumen port has two separate reservoirs, each with its own catheter and septum in a single port body. Port catheters may be open ended or close ended. Open-ended port catheters require flushing with heparinized saline to prevent clotting. Closed-ended or valved port catheters should be flushed with normal saline for infusion. The closed end does not require a heparinized flush. Nurses must verify the type of catheter with patients, medical records, or port placement teams because the type is impossible to determine just by looking. If they are unable to verify, nurses should treat a port as open-ended and flush it with heparinized saline.

An advantage to an implanted port is that, when not in use, it is under the skin, allowing patients to participate in activities of daily living, including showering, and other normal activities without restriction. Because implanted CVADs allow for patient portability, the port is ideal for administration of long-term, intermittent therapies, such as chemotherapy.

Implanted ports are placed in the operating room or during interventional radiology as an outpatient procedure. Before they are used, all CVAD placements should be confirmed by x-ray. For proper placement, the catheter tip should rest in the lower third of the superior vena cava. Right atrium placement is not acceptable. Improper placement can trigger arrhythmias or result in pericardial effusion and cardiac tamponade (Hamilton, 2006).

Complications associated with the insertion of CVADs include (Hamilton, 2006):
- Pneumothorax
- Cardiac tamponade
- Arterial rupture
- Hemorrhage
- Hemothorax
- Hydrothorax
- Air embolus
- Brachial nerve plexus injury
- Thoracic duct injury
- Misplacement
- Infection

Complications during the use of CVADs are (Hamilton, 2006):
- Infection or sepsis
- Thrombosis or deep vein thrombosis

1. To reduce the risk of infection transmission, wash hands, cleanse cap with alcohol, attach a 10 ml syringe of normal saline, and gently withdraw to check for blood return.
2. Flush the port with 20 ml of normal saline. If an open-ended catheter is being used, flush with 20 ml normal saline and then 5 ml 100 unit/ml heparin (only once), clamping as the last few milliliters are pushed. A close-ended catheter requires the use of only normal saline; positive pressure during instillation of the final 0.5 ml will prevent back flow of blood into the catheter.
3. Notify the physician if resistance is met during instillation.
4. Using clean gloves, remove the dressing and examine the port site.
5. Discard gloves, wash hands, and apply sterile gloves.
6. Palpate the port edges with your nondominant hand and stabilize the port with your thumb and index finger.
7. Have the patient perform the Valsalva maneuver, then gently but firmly remove the Huber needle with a continuous upward pull, being careful of needle sticks.
8. Examine the needle for intactness or signs of occlusions or clots; discard in sharps container.
9. Apply gauze dressing to site.
10. Document procedure with (a) date and time of deaccess, (b) gauge and length of needle, (c) needle intactness, (d) presence of blood return, (e) any resistance met when flushing, and (f) skin condition at port site.

Figure 3. Port Deaccess Procedure

Note. Based on information from Hadaway, 2002; Larovere, 1999a, 1999b; Masoorli, 2005; O’Grady et al., 2002.
<table>
<thead>
<tr>
<th>TYPE OF PORT COMPLICATION</th>
<th>SIGNS AND SYMPTOMS</th>
<th>POSSIBLE CAUSE(S)</th>
<th>INTERVENTION</th>
<th>PREVENTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection or sepsis</td>
<td>Fever, redness, pain, or edema</td>
<td>Contamination of insertion site</td>
<td>Draw aerobic and anaerobic blood cultures, culture any site drainage, and treat with antibiotics. Port may need to be removed.</td>
<td>Good sterile technique; timely dressing, needle, and tubing changes</td>
</tr>
<tr>
<td>Thrombus or deep vein thrombosis</td>
<td>Catheter occlusion, lack of blood return, resistance present when flushing line, swelling, or symptoms of superior vena cava syndrome</td>
<td>Long dwell times; precipitate buildup from blood, lipids, or drugs; or lack of proper line flush</td>
<td>Check to see if tubing is kinked or clamped. When flushing, do not force if resistance is met; notify the physician because fibrinolytic drug instillation may be needed.</td>
<td>Flush regularly; flush catheter between IV medications with normal saline. If an open-ended catheter is being used, flush with 20 ml normal saline and then 5 ml 100 unit/ml heparin (only once), clamping as the last few milliliters are pushed.</td>
</tr>
<tr>
<td>Skin breakdown</td>
<td>Compromised skin over septum site</td>
<td>Insertion incision directly over the port that does not heal, port accessed in same place each time, or substantial patient weight loss</td>
<td>Port may need to be removed.</td>
<td>Good skin care, improved patient nutrition</td>
</tr>
<tr>
<td>Infiltration or extravasation</td>
<td>Pain or burning at port site, with or without use; leaking; skin color changes; edema; induration at site</td>
<td>Needle dislodgement; improper needle length, especially in a patient who is obese; catheter separation, fracture, or rupture; fibrin sheath formation; thrombus; vein pressure from lymphedema or enlarged axillary nodes; or vessel narrowing from scarring caused by surgery or radiation</td>
<td>Stop infusion immediately. Notify the physician, and follow facility protocol for infiltration or extravasation care. A cathetergram may be ordered to evaluate whether fluid flows properly.</td>
<td>Provide patient education, monitor the site frequently, and check for blood return.</td>
</tr>
<tr>
<td>180º rotation of implanted port</td>
<td>Resistance met when accessing port</td>
<td>Port not adequately sutured to fascia during insertion, substantial patient weight loss, or persistent vomiting or coughing breaks sutures</td>
<td>Try to access again with a new sterile needle. Do not turn port back over because it may cause a twisted catheter, separate the catheter from the port, or rupture the catheter. Notify the physician immediately. Port repositioning is performed in interventional radiology or the operating room.</td>
<td>–</td>
</tr>
<tr>
<td>Catheter migration or fracture</td>
<td>Symptoms of fracture are shoulder pain, burning at site, and inability to obtain good blood return; right atrium migration symptoms are arrhythmias, chest pain, and dyspnea; and symptoms of jugular vein migration are an earache on the port side and bubbling heard when the catheter is flushed.</td>
<td>The catheter was flushed with high gradient pressure or it severed from the port.</td>
<td>Stop and notify the physician. Fluoroscopy is used to verify catheter tip position.</td>
<td>Do not flush port with a syringe smaller than 10 ml.</td>
</tr>
<tr>
<td>Fibrin sheath formation</td>
<td>Lack of blood return with aspiration; resistance may be met with flushing.</td>
<td>Long dwell times or precipitate buildup from blood, lipids, or drugs</td>
<td>Check to see if tubing is kinked or clamped. When flushing, do not force flush if resistance is met; if line flushes easily without blood return, have the patient change position, raise his or her arms, or turn his or her head to the other side and cough. Notify the physician because fibrinolytic drug instillation may be needed.</td>
<td>Flush regularly; flush catheter between IV medications with normal saline. Clamp tubing as the last 0.5 ml is instilled to create a positive pressure; positive pressure prevents back flow of blood into the catheter.</td>
</tr>
</tbody>
</table>

*Note. Based on information from Camp-Sorrell, 2001, 2004; Hadaway, 2000; Kuter, 2004; Masoorli & Angeles, 2002; Moureau, 2001; Rosenthal, 2006.*
• Skin breakdown at the site
• Infiltration or chemotherapy extravasation
• 180° rotation of an implanted port
• Catheter migration or fracture
• Fibrin sheath formation.

Implanted port access is a sterile procedure. Topical anesthetics can be used to decrease patient discomfort. Each lumen should be accessed and flushed at least once a month if used intermittently. See Figure 2 for the port access procedure and Figure 3 for the deaccess procedure. During continuous use, access needles should be changed every seven days, with caps and tubing changed every two days, except with TPN. When TPN is infused, tubing is changed every 24 hours because of the high glucose content and potential for bacterial growth (Mattlow et al., 1999).

Complications

Some complications from CVAD are rare, whereas others are more common. See Table 1 for a summary of port complications and how oncology nurses navigate them through prevention, identification, and intervention.

Proper care and maintenance of ports decrease the potential for complications. Routine flushing is important to reduce fibrin sheath or clot formation. The mnemonic device “SASH” can help when flushing most catheters: saline, administer the medication, saline, and heparin (Hadaway, 2003). Routine port flushing with heparinized saline is the most common practice to maintain patency. However, flushing with heparinized saline is inadequate to prevent blood vessel thrombus. Systemic prophyaxis using anticoagulation has been evaluated. The benefit of systemic prophylaxis with low-molecular-weight heparin or warfarin has not been well established; therefore, it is not recommended for routine practice (Kuter, 2004).

Because catheter occlusions can affect patient care, the staff nurses in the James Care Dublin Unit at Ohio State University questioned whether the use of a single-lumen or dual-lumen port affected the rate of catheter occlusion. The nurses underwent a quality control project to evaluate the question. During a two-month period, all patients with implanted ports that presented to the chemotherapy unit for treatment were monitored. All patients received the same maintenance care. Maintenance care consisted of a monthly port flush with normal saline followed by heparinized saline. A total of 43 visits were recorded. Of those seen, 17 patients had double-lumen ports and 26 had single-lumen ports. Nine occlusions were identified during the two-month period, all in patients with double-lumen ports.

Based on these results, single-lumen ports now are requested unless otherwise medically indicated. Further evaluation is indicated to validate the results of this limited, quality-assurance project.

Patient Education

Nursing knowledge of port types and proper care are only a part of successful port navigation. Patient education is vital for the success of all ports. Initially, nurses should explain the placement procedure and recovery process. Postoperatively, education should be provided pertaining to site care and the importance of routine flushing using only a noncoring needle with sterile technique during access. Patients with ports must be aware of potential complications and should understand when they should notify their health-care providers. Arming patients with this knowledge helps to ensure a successful and uncomplicated port experience.

Use of implanted ports in the oncology setting makes long-term, intermittent IV treatments more patient friendly by helping to maintain patients’ quality of daily living. Oncology nurses knowledgeable in port navigation can ensure that patients in their care have clear sailing.

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