

# Managing central venous access devices in cancer patients: A practice guideline

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## Abstract

*In cancer care, central venous access devices (CVADs) are used to safely manage patients undergoing long-term systemic treatment. CVADs are also used to ensure the safe delivery of other agents, biotherapy and supportive therapies. Nursing practice is often driven by policies and procedures that may or may not be evidence-based. Prevention of catheter-related intraluminal thrombosis is essential for quality care. Therefore, there is a need for evidence-based standardized protocols across the system. To address the issue, our group conducted a systematic review of the existing literature, which addressed the following questions:*

- 1. To prevent catheter-related intraluminal thrombosis and local or systemic catheter-related infection, minimize the need to replace devices, and enhance quality of life of adults with cancer:*
  - Should CVADs be locked with heparin or saline?*
  - What volume and strength of solution should be used to lock CVADs?*
  - How frequently should CVADs be locked or flushed?*
  - What type of catheter should be used?*
- 2. In patients who require systemic therapy for cancer, what indicators impact the decision to insert a central venous access device (CVAD)?*

*The MEDLINE, CINAHL, EMBASE and Cochrane Library databases were systematically searched for relevant guidelines and studies. Evidence was selected and reviewed by the Central Venous Access Devices Guideline Working Panel of Cancer Care Ontario's Program in Evidence-based Care (PEBC). Recommendations were formed through a review of the evidence, including best practice guidelines and, where the evidence was lacking, the expert opinion and the consensus process was used. External review of the recommendations by Ontario practitioners was obtained through a mailed survey. The recommendations were then revised by the CVAD Working Panel. Final approval of the systematic review and recommendations was obtained from the PEBC Report Approval Panel. The systematic review revealed a lack of standardized protocols for the choice and management of CVADs. It is hoped this paper will influence standardized protocol across institutions in order to: increase patient confidence in nursing care as patients move from institution to institution, simplify nursing education, and develop research that can lead to evidence to inform decision-making on the issues identified.*

*In the oncology setting, CVADs are used to ensure the safe delivery of agents such as chemotherapy, biotherapy and supportive therapy. CVADs support the long-term systemic therapy protocols requiring multiple agents, locally irritating agents that need to be injected into larger veins, and administration of larger volume or viscous fluids, such as blood and blood products. The devices reduce the frequency with which a patient's peripheral veins are accessed. In addition to supporting inpatient venous access requirements, CVADs*

have enhanced the care of oncology patients by allowing patients to be safely managed on an outpatient basis for a portion of their course of treatment, either receiving chemotherapy at an outpatient clinic or receiving their medication at home with the use of an ambulatory infusion pump.

In addition, CVADs support complex inpatient protocols and supportive therapies, such as antibiotics, hydration, or blood and blood product administration. CVADs require meticulous ongoing care and maintenance. Patients and family members must be motivated and willing to learn how to care for the device through focused patient education programs and support.

Due to the many types of access devices available and in widespread use, professionals are able to deliver complex treatment plans aimed at increasing patient survival and quality of life. However, a proportion of patients experience CVAD-related complications, such as intraluminal catheter-related thrombosis, defined as a blood clot in the lumen of the CVAD, or catheter-related infection, or extraluminal venous thromboembolism. The development of thrombotic intraluminal CVAD occlusion is a concern for cancer patients because there is a four- to six-fold increased risk of thromboembolism for cancer patients compared to non-cancer patients, perhaps related to the mechanisms of the disease itself or extrinsic factors such as chemotherapy and surgery (Heit et al., 2002). The loss of CVAD use as a result of intraluminal occlusion can cause: a delay in treatment, patient stress and dissatisfaction, and extra cost to the health system (i.e., such as the use of alteplase and line replacement, etc.).

Several manufacturer and nursing practice strategies have been implemented in an attempt to reduce the risk of CVAD-related complications that include locking devices with heparin between use, reducing the frequency of accessing the line for locking purposes, and improving CVAD design. Hospitals, ambulatory centres, and community care agencies have policies and procedures that, to some extent, are based on nurse, physician, and patient preferences. Cost and organizational issues may also influence policies. As new CVADs have been introduced, so have new procedures and policies regarding their care and maintenance, most often based on manufacturers' recommendations. However, evidence from clinical studies to support those recommendations is scant or nonexistent. The result of all of those factors is a wide variation in oncology nursing practice among cancer programs in Ontario. As patients move from hospital to community care, the difference in protocols and procedures highlights the variation in clinical practice and creates confusion and concern among patients and their family caregivers. The differences in procedures can also create problems for nursing care. As patients move from one setting to another (e.g., from an ambulatory centre to a hospital, or from a hospital to home care), nurses must adjust CVAD care to accommodate maintenance procedures used at other institutions. This has led to variation in care between patients in the same institution.

Because of the wide variety of devices, the economic impact of a particular protocol cannot be overlooked. Different devices have their own associated equipment costs and nursing educational and training requirements. The choice of a CVAD maintenance protocol can have significant monetary implications.

To examine the literature and determine recommendations, the Central Venous Line Guideline Panel selected two key questions as the basis for the review. These are:

1. To prevent catheter-related intraluminal thrombosis and local or systemic catheter-related infection, minimize the need to replace devices, and enhance quality of life among adults with cancer:
  - Should central venous access devices (CVADs) be locked with heparin or saline?
  - What volume and strength of solution should be used to lock CVADs?

- How frequently should CVADs be locked or flushed?
  - What type of catheter should be used?
2. In patients who require systemic therapy for cancer, what are the indicators (e.g., functional or quantitative neutropenia, age, diagnosis, therapy, immune status, or patient convenience) that have an impact on the decision to insert a CVAD?

## Methods

This practice guideline was developed by Cancer Care Ontario's Program in Evidence-Based Care (PEBC). Evidence was originally screened by the research methodologist, and further screening and selection was conducted by the entire panel.

This systematic review is a convenient and up-to-date source of the best available evidence on managing CVADs in cancer patients. That evidence forms the basis of a clinical practice guideline developed by the Central Venous Access Device Guideline Panel. The systematic review and companion practice guideline are intended to promote evidence-based practice in Ontario. The PEBC is editorially independent of Cancer Care Ontario and the Provincial Ministry of Health and Long-Term Care. Please visit the PEBC website for the full evidence-based series and subsequent updates at: <http://www.cancercare.on.ca>.

The Central Venous Access Device Guideline Panel: 1) formulated a set of guideline questions relevant to cancer care in Ontario, 2) reviewed the available evidence on the effectiveness of locking solutions, volumes, and frequency, and various types of CVADs, 3) considered the quantity, quality, consistency, completeness, and relevance of the evidence, and 4) drafted recommendations based on the available evidence, panel members' expert opinions, and guidelines from other groups. Patient safety, convenience, and quality of life were considered in formulating recommendations.

A systematic search for clinical practice guidelines, systematic reviews, and clinical trials was conducted in November 2004. When no comprehensive evidence-based guidelines or systematic reviews were found, MEDLINE (1980-November 2004), EMBASE (1980-November 2004), CINAHL (1982-2004), and the Cochrane Central Register of Controlled Trials (3rd quarter, 2004) were searched through OVID to find reports of relevant clinical trials. Search strategies and terms used are fully described in the systematic review at <http://www.cancercare.on.ca>.

External review of the recommendations by practitioners was obtained through a mailed survey. The recommendations were then revised by the CVAD Working Panel. Final approval of the systematic review and recommendations was obtained from the PEBC Report Approval Panel.

## Results

### Literature available for review

The literature search found six practice guidelines published in the last five years related to managing CVAD (Camp-Sorrell, 2004; The Canadian Intravenous Nurses Association, 1999; Centres for Disease Control and Prevention, 2002; Intravenous Nurses Society, 2000; Registered Nurses Association of Ontario, 2004; Pellowe et al., 2003; Pratt et al., 2001). The guideline panel reviewed the recommendations related to the guideline questions listed above and took note of the evidence used to support each recommendation as discussed below. The panel concluded that none of those guidelines covered the full range of questions posed by the panel for adult cancer patients. For this reason, the panel chose to develop an Ontario guideline for use in cancer care rather than adopt any of the existing guidelines.

Seventeen primary studies on preventing catheter-related venous thrombosis or infection in cancer patients published in full between 1988 and 2004 were found and are listed in Table One.

### **Should CVADs be locked with heparin or saline?**

There isn't any evidence available to determine if saline or heparin should be used to lock cancer patients' CVADs when not in use. In addition, control and experimental manoeuvres differed not only in the lock solution used, but also in the volume and frequency of locking, hampering any interpretation of which of those factors affected the outcome. Heparin is the most common cause of immune-mediated thrombocytopenia related to drugs. One to three per cent of patients who receive therapeutic intravenous doses of heparin develop this complication (Schmitt & Adelman, 1993). Most patients develop heparin-induced thrombocytopenia (HIT) after receiving intravenous or subcutaneous heparin therapy for a thrombotic event or for prophylaxis. However, the amount of heparin required to cause HIT can be quite small. Occasional patients have developed this disorder after exposure to as little as 250 units from a heparin flush (Heeger & Backstrom, 1986). Only a limited number of cases have been described in the literature and the true incidence is unknown (Kadidal, Mayo & Horne, 1999).

As well, heparin locking is obviously inappropriate in patients with pre-existing heparin-induced thrombocytopenia (Kelton, 2005). Evidence from other products (e.g., arterial catheters) may be worthy of consideration by practitioners and institutions when developing procedures. Devices that use mechanical methods to lock catheters such as closed ended CVADs (e.g., Groshong™) make the question of locking solution moot, but the use of those devices may have other implications that must be considered, such as the possibility of more frequent malfunction (Biffi et al., 2001). Finally, technological innovation may provide clearer solutions to this question in the future.

### **What volume and strength of solution should be used to lock CVADs?**

There is insufficient evidence to determine the volume and strength of solution that should be used to lock CVADs in cancer patients. Evidence is available from one study only, a non-randomized comparative cohort study that compared a group of 145 patients whose catheters were flushed with 5 mL daily of 10 U/mL heparin (50 units total) and 51 with 10 mL daily of 100 U/mL heparin (1000 units total) (Brown-Smith, Stoner, & Barley, 1990). Single-lumen open-ended tunnelled catheters were used and 93% of participants received chemotherapy. Catheter-related thrombosis occurred in 17% of the group receiving 50 units of heparin daily and 14% those on 1000 units ( $p=0.63$ ). Both the volume and strength of solution differed between the two comparison groups, with neither flushing protocol reflecting current practice. It is essential that patient safety, as well as efficacy be considered when determining the appropriate solution strength of heparin.

### **How frequently should CVADs be locked?**

One study examined the frequency of locking central venous catheters (CVCs) in cancer patients. Kelly, Dumenko, McGregor, and McHutchinson (1992) determined catheter-related-infection rates for 82 adult outpatients receiving chemotherapy at a single centre from 1987 to 1989. Most patients had a double-lumen catheter. Lines were flushed weekly with 5 mL of 10 U/mL heparinized saline. Nineteen per cent of lines became infected, but no lines were removed because of loss of patency. The study authors compared the infection rate to published rates, which ranged from 6% to 56% and decided to adopt the weekly flushing routine as standard practice.

There is insufficient evidence to determine how often CVADs should be locked between use in cancer patients. Current practice depends on the type of device used. When deciding on one frequency over another, patient convenience and costs to patients, families, and institutions should be considered.

### **What type of catheter should be used?**

Six randomized trials and nine cohort studies that compared different types of catheters (e.g., implanted devices versus tunnelled catheters) are summarized in Table Two. The highest level of evidence comes from the randomized trials. Two additional randomized or quasi-randomized trials were terminated prematurely due to severe local bleeding experienced by five patients with ports, compared to none in the control group (Johansson et al., 2004) or because of an excess of complications in the Groshong™ group (Warner, Haygood, Davies, & Hennies, 1996). The patient's risk for complications such as infection or thrombosis can influence the choice of catheter type. This evidence on risk is also detailed in Table Two.

There is evidence from four randomized trials of implanted devices versus tunnelled catheters in adults. Although rates of infection were often higher in the tunnelled catheters, the trials did not detect statistically significant differences in outcome.

There is limited evidence on tunnelled versus conventional non-tunnelled CVADs, specifically, Groshong™ valved closed-ended versus open-ended catheters and single-lumen versus double-lumen catheters in cancer patients. None of the relevant studies detected statistically significant differences between treatment groups. CVADs with double lumens may pose a greater risk of infection and mechanical dysfunction because an extra lumen may lead to greater exposure to the patient through increased catheter manipulation.

The evidence from one randomized trial of catheters demonstrated that the addition of a silver-impregnated cuff to the standard central catheter did not identify a significant difference in catheter-related

| <b>Table One. Evidence available from primary studies on preventing catheter-related venous thrombosis or infection</b> |                                                                                                                                              |                                                                                                                                                                                                                              |                                     |
|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>Question</b>                                                                                                         | <b>Randomized Controlled Trials</b>                                                                                                          | <b>Comparative cohort</b>                                                                                                                                                                                                    | <b>Comparison to published data</b> |
| <b>Volume of solution</b>                                                                                               | —                                                                                                                                            | Brown-Smith et al., 1990                                                                                                                                                                                                     | —                                   |
| <b>Frequency</b>                                                                                                        | —                                                                                                                                            | —                                                                                                                                                                                                                            | Kelly et al., 1992                  |
| <b>Type of catheter</b>                                                                                                 | Johansson et al., 2004<br>Biffi et al., 2001<br>Bow et al., 1999<br>Mueller et al., 1992<br>Carde et al., 1989<br>Kappers-Klunne et al. 1989 | Cortelezzi, A. et al., 2003<br>Minassian et al., 2000<br>Warner et al., 1996<br>Eastridge & Lefor, 1995<br>Gleeson et al., 1993<br>Groeger et al., 1993<br>Raad et al., 1993<br>Pegues et al., 1992<br>Pasquale et al., 1992 | —                                   |
| <b>Impregnated catheters</b>                                                                                            | Groeger et al, 1993                                                                                                                          | —                                                                                                                                                                                                                            | —                                   |

infection. While there is evidence that catheters treated with chlorhexidine-silver sulfadiazine was effective, reducing blood stream infection rates in short-term non-tunnelled venous access devices, the benefit is restricted to the first eight days, and does not continue when the average insertion time exceeds eight days (Walder, Pittet, & Tramer, 2002). For that reason, catheters impregnated with antimicrobial or antiseptic agents are not likely to be useful in cancer patients undergoing chemotherapy that may require a CVAD to be in place for months.

### Indications

In a narrative review published in 2003, Shelton stated that, in patients with leukemia, “indwelling intravenous lines are most likely to become infected if inserted after the onset of neutropenia” and recommended against the use of permanent or semi-permanent venous access devices in patients who are functionally or quantitatively neutropenic (Shelton, 2003). Unfortunately, Shelton did not present any supporting evidence for those conclusions. High platelet count at the time of catheter insertion, coagulation abnormalities associated with some types of cancer, and chemotherapy-related activation of the coagulation

cascade have been suggested as patient characteristics that may be indicators for CVAD-related venous thrombosis (Verso & Agnelli, 2003).

Our literature search did not find any clinical studies that directly addressed the guideline question. Evidence on indicators for catheter-related infection or intraluminal thrombosis in cancer patients that may help to inform a decision about when to insert a venous access device or choice of device is available from 12 clinical studies and is summarized in Table Three.

In an additional study, multivariate analysis by Nightingale et al. (1997) found that patient age, malignancy, chemotherapy regimen, platelet count, and leukocyte count did not predict the probability of catheter removal due to complications. Some studies may have had insufficient sample sizes and, hence, insufficient power to detect statistically significant differences in risk profile.

There are fewer studies that examined indicators for intraluminal catheter-related thrombosis. Because intraluminal thrombosis is often asymptomatic or associated with non-specific symptoms, reported incidence rates and related relative risks may vary by detection method (Tesselaar, Ouwerkerk, Nooy, Rosendaal, &

**Table Two. Evidence on relationship between catheter type and catheter-related infection/thrombosis**

| Trial                                                                                                    | Patients                  | Diagnosis                                   | Treatment groups (experimental vs. control)                                                                                 | Intraluminal catheter-related thrombosis | Catheter-related infection | Removal because of infection or occlusion |
|----------------------------------------------------------------------------------------------------------|---------------------------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------|----------------------------|-------------------------------------------|
| <i>Randomized trials</i>                                                                                 |                           |                                             |                                                                                                                             |                                          |                            |                                           |
| Bow et al., 1999                                                                                         | 120 adults                | solid tumours, lymphoma (77% gynecological) | implanted device (Port-A-Cath™) vs. standard peripheral venous access                                                       | 2%<br>2%                                 | 0<br>0                     | not reported                              |
| Mueller et al., 1992                                                                                     | 92 adults and children >5 | leukemia, lymphoma, solid tumour            | implanted device (Port-A-Cath™) vs. tunnelled catheter (Hickman™)                                                           | 2%<br>9%                                 | 15%<br>28%                 | 9%<br>11%                                 |
| Carde et al., 1989                                                                                       | 96 adults                 | solid tumours, lymphoma (40% breast)        | implanted device (Port-A-Cath™) vs. tunnelled catheter (Hickman™)                                                           | not reported                             | not reported               | 4%<br>13%                                 |
| Kappers-Klunne et al., 1989                                                                              | 43 adults                 | leukemia, lymphoma                          | implanted device (Port-A-Cath™) vs. tunnelled catheter (Hickman™)                                                           | 10%<br>0%                                | 15%<br>30%                 | 20%<br>30%                                |
| Biffi et al., 2001                                                                                       | 302 adults                | solid tumours (48% breast)                  | implanted device (Dome Port™) attached to valved catheter vs. implanted device (Dome Port™) attached to open-ended catheter | not reported                             | 0.7%<br>2%                 | 3%<br>3%                                  |
| <i>Comparative Cohort: Choice of catheter made by patient or physician (prospective data collection)</i> |                           |                                             |                                                                                                                             |                                          |                            |                                           |
| Groeger et al., 1993                                                                                     | 1430 adults & children    | leukemia, lymphoma, solid tumour            | implanted port vs. tunnelled catheter                                                                                       | not reported                             | 8%*<br>43%                 | 3%*<br>20%                                |
| Raad et al., 1993                                                                                        | 340 adults                | not reported                                | peripherally inserted central catheter vs. non-tunnelled Silastic central venous catheter                                   | not reported                             | 16%<br>11%                 | not reported                              |

*continued on page 5...*

Osanto, 2004). There is insufficient evidence to determine specific indicators for intraluminal catheter-related thrombosis among cancer patients. Additional research is required to better influence recommendations.

**Convenience and quality of life**

Bow, Kilpatrick, and Clinch (1999) found no significant difference in quality of life measures (using the Functional Living Index–Cancer) between standard peripheral venous access and implantable venous access port systems. However, there were significant differences in reported anxiety and pain between port system and standard peripheral groups. Port system participants experienced less access-related anxiety (p=0.003) and pain (p=0.01) than the standard peripheral group experienced with intravenous starts.

**Consensus**

The CVAD Guideline Panel is comprised of oncology nurses and advanced practice oncology nurses from across Ontario specializing in adult and pediatric oncology care. The recommendations for the adult population were based on a combination of the evidence presented, existing recommendations from institutions (regional cancer centres, regional cancer programs and community hospitals) across the province and manufacturers’ recommendations. When evidence was lacking, expert opinion and panel consensus were incorporated into the recommendations. As well, the panel used the practitioner feedback as further evaluation of the recommendations.

**Should CVADs be locked with heparin or saline?**

The use of either saline or heparin in catheters is based on the manufacturers’ recommendations, institutional protocols and the panel’s expertise. Saline is recommended by the manufacturers of closed-ended catheters and positive pressure injection/lock adaptors because these valves prevent blood backflow into the lumen of the catheter and, therefore, should reduce or eliminate the risk of intraluminal thrombus occlusion. The panel would like to emphasize that with the use of saline in these devices, the proper procedure must be followed as outlined by the manufacturers to prevent blood backflow as an improper flushing procedure and backflow of blood can cause a thrombus or occlusion.

Heparin is used to prevent thrombus development if blood should enter the lumen of the catheter and is, therefore, used with open-ended catheters. Open- or closed-ended catheters with or without positive pressure devices and external extensions (e.g., Hickman) can become kinked or bent exerting enough pressure to push small amounts of heparin or saline into the vein. This can generate negative pressure when compression is released and blood is drawn back into the lumen of a catheter, allowing for thrombus development.

Implanted ports are not visible and there is no way of knowing the type of catheter being used or type/size of port unless the patient has some way to verify this, such as a card identifying the type and length of catheter. For this reason, heparin is used to be safe in reducing the risk of thrombus occlusion.

As frontline care providers, nurses must take a leadership role in emphasizing the importance of CVAD care for their patients and families. CVADs are considered a patient’s lifeline and, as such, patients should be empowered with the knowledge and skill required

|                                                                                                            |            |                                   |                                                                                                                          |              |                               |              |
|------------------------------------------------------------------------------------------------------------|------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------|-------------------------------|--------------|
| <i>continued from page 4...</i>                                                                            |            |                                   |                                                                                                                          |              |                               |              |
| <b>Comparative Cohort: Choice of catheter made by patient or physician (retrospective data collection)</b> |            |                                   |                                                                                                                          |              |                               |              |
| Minassian et al., 2000                                                                                     | 268 adults | gynecologic cancer                | implanted device (Port-A-Cath™) vs. peripherally inserted implanted device (PAS™ port) vs. tunnelled catheter (Hickman™) | not reported | 11%<br>9%<br>19%              | not reported |
| Eastridge & Lefor, 1995                                                                                    | 274 adults | not reported                      | implanted device vs. tunnelled catheter (Hickman™)                                                                       | 6%<br>10%    | 5%<br>13%                     | 12%<br>23%   |
| Gleeson et al., 1993                                                                                       | 97 adults  | gynecologic cancer                | implanted device (Hickman™ port) vs. tunnelled catheter (Groshong™) (single-lumen) (double-lumen)                        | not reported | 16%*<br>32%<br>(35%)<br>(32%) | 12%<br>5%    |
| Pegues et al., 1992                                                                                        | 141 adults | solid tumours (34% colorectal)    | implanted device vs. tunnelled catheter                                                                                  | 2%<br>9%     | 11%<br>15%                    | 7%<br>9%     |
| Cortelezzi, A. et al., 2003                                                                                | 126 adults | hematologic malignancy            | non-tunnelled catheter (few tunnelled) vs. peripherally inserted central catheter                                        | 10%*<br>26%  | not reported                  | not reported |
| Pasquale et al., 1992                                                                                      | 106 adults | solid tumours, leukemia, lymphoma | Groshong™ catheter vs. Hickman™ catheter                                                                                 | not reported | 13%<br>11%                    |              |
| Abbreviations: CVAD, Central Venous Access Device; PORT, totally implanted port system; vs. versus         |            |                                   |                                                                                                                          |              |                               |              |
| * p<0.05 on difference between experimental and control rate                                               |            |                                   |                                                                                                                          |              |                               |              |

to assess and care for their lines. The health care team should be notified if the patient's medical condition changes, dressings become non-occlusive or there is evidence of fever, pain, redness or swelling. Patients presenting with intraluminal thrombosis may be completely asymptomatic.

**What volume and strength of solution should be used to lock CVADs?**

The volume of solution to be used in a CVAD depends on the catheter length, the internal diameter of the tubing, the reservoirs and extensions, and the need to ensure that all surface areas receive adequate turbulence and flushing. Manufacturer documents state that the volume of the flush solution should be equal to at least twice the volume capacity of the catheter and add-on devices. The panel used the manufacturers' recommendations and expert opinion to arrive at the volume of solution recommendations.

There was no evidence to support one concentration of heparin over another, and the manufacturers' recommendation was the use of institutional protocols. The consensus of the group was to recommend a heparin concentration of 100 units /ml since it is the most common concentration of heparin used in most institutions in Ontario.

**How frequently should CVADs be locked?**

Although patient convenience and costs to patients, families, and institutions may be considered when deciding on the frequency of flushing, the panel used expertise, manufacturers' recommendations and common practice to generate recommendations for the flush frequency for each device. The implanted port does not have any external adaptor that requires changing (i.e., injection caps) unless it is accessed. If a port or catheter is accessed, the recommendations are once weekly, the non-coring needle and extension/injection cap/adaptor are changed and the line flushed. Injection caps require

| <b>Table Three. Evidence on indicators for catheter-related infection or thrombosis</b>                                                                                                             |                                                         |                   |          |           |                    |         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|-------------------|----------|-----------|--------------------|---------|
| <b>Catheter-related infection</b>                                                                                                                                                                   |                                                         |                   |          |           |                    |         |
| <b>Study</b>                                                                                                                                                                                        | <b>Patients</b>                                         | <b>Indicators</b> |          |           |                    |         |
|                                                                                                                                                                                                     |                                                         | Neutropenia       | Age      | Diagnosis | Treatment Protocol | BMT     |
| <i>Multivariate analysis</i>                                                                                                                                                                        |                                                         |                   |          |           |                    |         |
| Craft et al., 1996                                                                                                                                                                                  | 122 adults with solid tumour (48%) or HEM               | —                 | —        | p=0.036   | —                  | —       |
| Howell et al., 1995                                                                                                                                                                                 | 71 adults with HEM (65%) or solid tumour                | p=0.018           | NS       | —         | NS                 | NS      |
| Keung et al., 1994                                                                                                                                                                                  | 104 adults with cancer                                  | —                 | p=0.0004 | —         | —                  | —       |
| Groeger et al., 1993                                                                                                                                                                                | 1430 adults & children with cancer; 55% solid tumours   | —                 | p=0.014  | p=0.005   | —                  | —       |
| Kelly et al., 1992                                                                                                                                                                                  | 82 adults receiving CT; 66% leukemia/lymphoma           | —                 | NS       | NS        | —                  | p=0.014 |
| <i>Univariate analysis</i>                                                                                                                                                                          |                                                         |                   |          |           |                    |         |
| Walshe et al., 2002                                                                                                                                                                                 | 351 adults; 92% with cancer: 80% solid tumours, 12% HEM | —                 | NS       | p=0.03    | NS                 | NS      |
| Sotir et al., 1999                                                                                                                                                                                  | 51 adults with solid tumours or HEM                     | —                 | —        | 0.06      | —                  | —       |
| Raad et al., 1993                                                                                                                                                                                   | 340 adults with cancer                                  | NS                | —        | p<0.04    | —                  | NS      |
| <b>Catheter-related thrombosis</b>                                                                                                                                                                  |                                                         |                   |          |           |                    |         |
| <b>Study</b>                                                                                                                                                                                        | <b>Patients</b>                                         | <b>Indicators</b> |          |           |                    |         |
|                                                                                                                                                                                                     |                                                         | Platelet count    | Age      | Diagnosis | Treatment Protocol | BMT     |
| <i>Multivariate analysis</i>                                                                                                                                                                        |                                                         |                   |          |           |                    |         |
| Cortezzi et al., 2003                                                                                                                                                                               | 126 adults with HEM                                     | NS                | p=0.049  | NS        | NS                 | —       |
| Craft et al., 1996                                                                                                                                                                                  | 122 adults with HEM or solid tumours (48%)              | —                 | —        | NS        | —                  | —       |
| <i>Univariate analysis</i>                                                                                                                                                                          |                                                         |                   |          |           |                    |         |
| Tesselaar et al., 2004                                                                                                                                                                              | 243 adults with solid tumours                           | NS                | NS       | p<0.05    | NS                 | —       |
| De Cicco M. et al., 1997                                                                                                                                                                            | 95 adults with cancer: 79% solid tumours, 21% HEM       | NS                | NS       | NS        | —                  | —       |
| BMT, Bone Marrow Transplant; NS, no statistically significant association between indicator and thrombosis (p>0.05); HEM, hematologic malignancy; CT, chemotherapy; —, not examined as an indicator |                                                         |                   |          |           |                    |         |

changing a minimum of every week or as needed. For this reason, the lines are flushed as a minimum with each cap change since flushing and locking are part of this process with injection cap/adaptor changes.

**What type of catheter should be used and what indicators influence the choice?**

Consensus was not reached for which indicators had an impact on the decision of inserting a CVAD, due to lack of evidence. It was determined that, in the absence of evidence, other factors and considerations are required to reach a consensus that is practical and clinical that may dictate if a CVAD be used; such as clinician and patients' preference, operating room time, cost, expert availability and resources to support the CVAD.

**Conclusions**

There is insufficient evidence to inform recommendations at this time regarding choice of device. There is also insufficient evidence to inform recommendations or to recommend systematic changes in current practice regarding any particular device. In the absence of evidence for or against any particular protocol, other considerations may be used in decision-making, such as patient convenience or the standardization of protocols across regions. The standardization of protocols is of value in and of itself, as it can increase patient confidence in nursing care as patients move from one clinical setting to another and can simplify nursing education.

The Central Venous Access Device Guideline Panel recommends, based on the absence of randomized trials or well-designed epidemiologic studies on any of the questions addressed by this report, that research institutions develop trials that can supply evidence to inform decision-making on these issues. It may be that there is no difference in clinical outcome between the various combinations of device and solution protocols that are currently used, but this should be firmly established through further research.

One other limitation the panel found troubling was the fact that intraluminal thrombosis was not consistently defined or measured across studies, thus causing difficulties in comparing results or ensuring that all intraluminal thromboses are true intraluminal thromboses.

**Recommendations**

There is insufficient evidence for or against the choice of a particular protocol in the adult cancer population. Recommendations by the panel regarding the schedule of solutions, volumes, concentrations, and frequencies are based on a consensus of the expert clinical opinion and the experience of the CVAD Panel in their practices and the best available evidence. These recommendations are framed as a consensus schedule and are presented in Table Four.

The purpose of the consensus schedule is to provide clinical institutions and other organizations with a framework on which to build their own institutional protocols, and to encourage standardization of protocols across clinical settings. While there is dearth of evidence to drive practice change, standardization of protocols is of value in and of itself as it can increase patient confidence in nursing care, improve the patient experience, and simplify nursing education. Other important considerations include:

- The impact on patients, families, and staff of inconsistent practice, at a time of transition of care between settings.
- The cost to patients and families in both quality of life and dollars of potentially unnecessary increase in frequency of hospital visits for CVAD management that are required by some hospitals.
- The cost to the health care system associated with more frequent flushing with more costly solutions that may not be justified.

**Indicators**

There is insufficient evidence to determine specific indicators that may have an impact on the decision to insert a CVAD or for catheter-related intraluminal thrombosis among adult cancer patients.

**Future research recommendations**

The Central Venous Access Device Guideline Panel recommends, based on the absence of randomized trials or well-designed epidemiologic studies on any of the questions addressed by this report, that research institutions develop trials that can supply evidence to inform decision-making on these issues.

| <b>Table Four. Consensus recommendations for locking central venous access devices in adult cancer patients</b> |                      |                           |                      |                                                  |
|-----------------------------------------------------------------------------------------------------------------|----------------------|---------------------------|----------------------|--------------------------------------------------|
| <b>CVAD</b>                                                                                                     | <b>Lock Solution</b> | <b>Volume<sup>A</sup></b> | <b>Concentration</b> | <b>Frequency</b>                                 |
| Implanted device (e.g. Port-A-Cath™)                                                                            | Heparin              | 5 mL                      | 100 units/mL         | After each use or every four weeks if not in use |
| Closed-ended Tunnelled catheter (e.g. Groshong™)                                                                | Sterile Saline       | 10 mL                     | 0.9%                 | After each use or weekly if not in use           |
| Open-ended Tunnelled catheter (e.g. Hickman™)                                                                   | Heparin              | 3 mL                      | 100 units/mL         | After each use or weekly if not in use           |
| Closed-ended PICC (e.g. Groshong™)                                                                              | Sterile Saline       | 10 mL                     | 0.9%                 | After each use or weekly if not in use           |
| Open-ended PICC (e.g. Cook™, Vaxcel™)                                                                           | Heparin              | 3 mL                      | 100 units/mL         | After each use or weekly if not in use           |

CVAD, central venous access device; PICC, peripherally inserted central line

**NOTES:**

<sup>A</sup> Rationale for volumes was based on dead space volume of the catheter plus sufficient volume to ensure positive pressure. The volume of solution should be altered if the volume of the catheter being used is non-standard or unique. The weight of patient is not a consideration when determining the volume of solution; the volume of the catheter is the key parameter.

- Guidelines published by the Oncology Nursing Society (ONS) in 2004 were used as a framework for the consensus schedule.
- Heparin use would be contraindicated in patients with Heparin-Induced Thrombocytopenia (HIT)
- All catheters should be flushed with a minimum of 10 mL of normal saline prior to locking to prevent solution incompatibilities.
- Positive pressure apparatuses are not included in the recommendations because this data is still emerging and was not fully reviewed by the guideline panel.

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