



Best Practice

Evidence Based Practice Information Sheets for Health Professionals

Management Of Peripheral Intravascular Devices

Purpose

The purpose of this practice information sheet is to provide summarised best available evidence on the management of peripherally inserted intravascular devices, to reduce the risk of nosocomial infection.

Introduction

Intravenous devices are a common and important part of hospital practice for the administration of fluid, nutrients, medications, blood products and to monitor the haemodynamic status of a person. The use of intravascular devices can be complicated by a variety of local or systemic infectious events.

Catheter related infections, particularly catheter related blood stream infections, are associated with increased morbidity, mortality and prolonged hospitalisation.

Peripheral venous catheters have rarely been associated with bloodstream infections (BSI). Phlebitis is the most important complication associated with their use and is largely a physicochemical or mechanical phenomenon rather than infectious.

Factors that influence this include; type of infusate, type of catheter material, catheter size, and the patient's own risk for developing phlebitis. When phlebitis does occur there may be an increased risk of developing a local catheter related infection.

This Practice Information Sheet Covers The Following Concepts:

1. Microbiology & Pathogenesis
2. Strategies For Prevention Of Catheter Related Infection
3. General Recommendations
4. Recommendations For Peripheral Venous Catheters
5. Definitions & Diagnosis Of Catheter Related Infection

1. Microbiology and Pathogenesis

There has been a change in the distribution of pathogens reported to cause nosocomial bloodstream infections. Coagulase negative *Staphylococci* (CNS), the most common being *Staphylococcus epidermidis* is the most frequently reported pathogen. Factors attributed to this change include increased use of prosthetic and indwelling devices, improved survival in low birth weight neonates and

Grading The Evidence

Recommendations in this publication are categorised on the basis of the existing scientific data, theoretical rationale, applicability and economic impact. It should be noted that some areas of practice have little research evidence on which to base recommendations. The categories used to grade evidence are as follows:

Category IA. Strongly recommended for all hospitals and strongly supported by well designed experimental or epidemiologic studies.

Category IB. Strongly recommended for all hospitals and viewed as effective by experts in the field and consensus of HICPAC based on strong rational and suggestive evidence, even though definitive scientific studies may not have been done.

Category II. Suggested for implementation in many hospitals. Recommendations may be supported by suggestive clinical or epidemiologic studies, a strong theoretical rationale, or definitive studies applicable to some, but not all, hospitals.

No Recommendations; unresolved issue. Practices for which insufficient evidence or consensus regarding the efficacy exists.

increased use of intralipids in these patients as well as the recognition of CNS as true nosocomial pathogens rather than harmless commensals. Other commonly reported organisms that cause nosocomial BSI include *Staphylococcus aureus*, *Enterococci* and *Candida albicans*.

The pathogenesis of catheter related infections is complex but most appear to result from skin organisms at the catheter insertion site migrating into the catheter tract, eventually colonising the catheter tip. Contamination of the catheter hub may also be an important contributor to the colonisation of catheter lumens, particularly in long term catheters. Handwashing and aseptic technique are the major prevention strategies for catheter related infections.

Paediatric Patients

The epidemiology of intravascular device related infections in paediatric patients is less well described than that in adults. There have been few reported trials of intravascular devices in children and most published data are from studies in neonatal or paediatric intensive care units, where infection rates are higher than the general paediatric population.

As in adults, peripheral venous catheters in paediatric patients may be complicated by phlebitis, extravasation, and catheter colonisation. Extravasation has been identified as the most frequent complication and risk factors include; a patient age of less than one year, receipt of anticonvulsant drug therapy and duration of catheterisation of less than 72 hours. The rate of colonisation of catheters is variable, but based on a study in a neonatal intensive care unit the risk appears to be lower in those; with a birth weight of 1500 gm. or more, receiving systemic antibiotics and those not on parenteral nutrition. A study of critically ill children suggested the major factor that influenced the risk of colonisation was having the catheter in situ for longer than 144 hours. Because of the limited research evidence, few recommendations can be made regarding the management of paediatric patients with intravascular devices.

2. Strategies for Prevention of Catheter Related Infection

Handwashing and aseptic technique remain the major prevention strategies for catheter-related infections and methods of promoting these should be encouraged. In addition to this, it is important that all intravascular devices are removed as soon as use is no longer clinically indicated. There are other measures that may provide additional protection and these are discussed below.

Site of Catheter Insertion

Factors that should be assessed when choosing the catheter insertion site include any specific patient factors such as pre-existing catheters or anatomic deformity, the relative risk of mechanical complications and the risk of infection. The location of the peripheral catheter influences the risk of catheter related infection. Catheters inserted in the lower limbs have a greater risk of phlebitis than the upper limbs. The risk of phlebitis also differs between sites in the upper limbs. Adults with catheters inserted in the hand have a lower risk of phlebitis than those inserted in the wrist or upper arm.

Type of Catheter Material

The majority of peripheral venous catheters are made of Teflon or polyurethane and appear to be associated with fewer infectious complications than catheters made of polyvinyl chloride or polyethylene. As an alternative to synthetic catheters for peripheral venous access steel needles have the same rate of infectious complications, but are more frequently accompanied with the potentially serious complication of infiltration of IV fluids into the subcutaneous tissues, therefore the risks and benefits of using steel needles must be evaluated on an individual patient basis.

Midline Catheters

Midline catheters are longer peripheral catheters that are inserted via the antecubital fossa but do not enter the central veins. Midline catheters appear to be associated with lower rates of phlebitis

and infection than short peripheral catheters and cost less than central venous catheters.

Barrier Precautions During Catheter Insertion

Good handwashing before and attention to aseptic technique during the insertion of short peripheral venous catheters is a major component in the prevention of intravenous device related infections.

Replacement of Intravenous Catheters

Routine or scheduled replacement of intravascular catheters has been advocated as a method to prevent phlebitis and catheter-related infections. Studies show an increased incidence of thrombophlebitis and bacterial colonisation of catheters after they have been in situ for more than 72 hours. To reduce this risk, short peripheral catheters are commonly resited at 48 - 72 hours. Catheters should be removed; at the first sign of phlebitis, if they have been inserted in emergency situations and when they are no longer needed. There are currently no recommendations for the frequency of replacement of IV catheters in paediatric patients.

Replacement of Administration Sets

Studies show the optimal time for replacement of intravenous administration sets is 72 hours or more after initiation of use. Other fluids such as blood, blood products and lipid solutions are more likely to support microbial growth and so more frequent set changing may be required. There are no recommendations for the frequency of replacing tubing used for intermittent infusions. Short extension tubing connected to the catheter should be replaced when the catheter is resited.

Stopcocks used for injection of medications for IV infusions or collection of blood samples are commonly contaminated by micro-organisms, although their role in catheter device-related infections is unclear. It has been suggested that closed needle sampling systems reduce this contamination significantly.

Replacement Intravenous Fluids

In-use contamination of IV fluids (contamination before use) is a rare complication. The rate of extrinsic contamination (contamination introduced during use) is also low, and occurs more commonly with infusions used with CVCs or total parenteral nutrition, than with peripheral venous catheters. The 'hanging time' limit of 24 hours, that is commonly used for intravenous fluids, was introduced following epidemics in the 1970s. Currently there are no recommendations for non-lipid containing fluids.

Cutaneous Antiseptics and Antimicrobials Ointments

Skin cleansing / antiseptis is regarded as one of the most important measures for preventing catheter related infections, but there are few studies that have examined the efficacy of the different preparations. A sustained release chlorhexidine patch has been introduced, but its efficacy needs to be determined.

Tincture of iodine is still used in some centres prior to catheter insertion, but its efficacy in reducing catheter colonisation and infection has not been evaluated thoroughly. It may be effective, like povidone-iodine and alcohol, as a skin preparation before catheter insertion, but should be removed with alcohol prior to insertion of cannula, to reduce the risk of skin irritation. Antimicrobial ointments have been applied to catheter site at insertion and during dressing of catheter site, but the results of these studies are contradictory. In addition to the lack of evidence to support the use of antimicrobial ointments, there is potential for allergic reaction and microbial resistance.

Catheter Site Dressing Regimens

Transparent dressings have become a popular means of dressing catheter insertion sites, as they secure the device and permit continuous visual inspection. However, the use of transparent dressings remains controversial and is one of the most actively researched areas of catheter site care. Findings from studies comparing gauze dressings with transparent dressings are contradictory.

Intravenous Therapy Personnel

Some institutions have established infusion therapy teams, because insertion and maintenance of intravascular catheters by inexperienced staff may increase the risk of catheter colonisation and catheter related BSI. Available data suggest that specially trained or designated personnel responsible for insertion and maintenance of intravascular devices provide a service that effectively reduces catheter-related infections and overall costs.

In-line Filters

While in-line filters may reduce the incidence of infusion-related phlebitis, there is no evidence to suggest they are effective in preventing infections associated with intravascular devices and infusion systems. In-line filters are not recommended for infection control purposes.

Prophylactic Antimicrobials

The evidence concerning the prophylactic administration of antimicrobials to reduce the incidence of catheter related bloodstream infections is inconclusive. In addition to the lack of evidence to support the use of prophylactic antibiotics there is potential for allergic reaction and microbial resistance.

Flush Solutions, Anticoagulants, and Other Intravenous Additives

The purpose of flushing catheters is to stop thrombosis rather than infection, but as studies in long term catheters suggest thrombi and fibrin deposits appear to be factors in microbial colonisation, there may be a role for anticoagulants. Studies suggest that saline is as effective as heparin in maintaining catheter patency and reducing phlebitis. Studies have looked at the effectiveness at reducing phlebitis using heparin and hydrocortisone, given alone or together, and of glycerine trinitrate, but no recommendations can be made. In addition to the lack of evidence to support their use, the potential for adverse reactions may outweigh potential benefits.

Needleless Intravascular Devices

Needleless devices were introduced to reduce the incidence of needle stick injuries in health care workers. The lack of data makes assessment of their potential risk or benefit difficult, and the results of the few available studies are contradictory.

Other Issues

Nursing experts in Australia, New Zealand and Hong Kong in reviewing this practice information sheet have highlighted other issues associated with the insertion and management of intravascular devices that should be incorporated into nursing practice. The patient has an important role in the decision to insert, and in the location of, intravascular devices and at the very least should be informed about the reasons for insertion. Patients should be encouraged to report any discomfort such as pain, burning, swelling or bleeding. Patient comfort can be maintained during insertion with the use of topical local anaesthetic agents, and by avoiding multiple attempts at cannulation. Accurate documentation and record keeping must be maintained to ensure patient safety, to allow for audits, and to track any outbreaks of infection. This documentation should include, the date and time of insertion, and when tubing, filters and intravenous solutions were replaced.

3. General Recommendations

(adapted from CDC Recommendations for the prevention of nosocomial intravascular device related infections, available via the internet at <http://www.cdc.gov/>)

These recommendations are based on research findings and expert opinion.

Education And Training

- Conduct ongoing education and training of health care workers regarding the management of intravascular devices and appropriate infection control measures. *(Category IA)*

Surveillance For Catheter Related Infection

- Conduct surveillance for intravascular device-related infections to determine rates of infection. *(Category IB)*
- Palpate catheter insertion site for tenderness, daily through dressing. *(Category IB)*
- Visually inspect catheter site if tenderness has developed at insertion site. *(Category IB)*
- If dressing prevents palpation or visualisation of catheter insertion site, remove dressing and visually inspect site at least daily. Replace with new dressing. *(Category II)*
- Record the date and time of catheter insertion in an obvious location near catheter insertion site. *(Category IB)*
- Do not routinely perform surveillance cultures of patients or devices used for intravascular access. *(Category IB)*

Handwashing

- Wash hands before and after palpating, inserting, replacing, or dressing any intravascular device. *(Category IA)*

Catheter Insertion

- Do not routinely use cutdown procedures as a method to insert catheters. *(Category IA)*

Barrier Precautions During Catheter Care

- Wear non-latex or latex gloves when inserting an intravascular device. *(Category IB)*
- Wear non-latex or latex gloves when changing the dressings on intravascular devices. *(Category IB)*
- No recommendation for the use of sterile versus non-sterile clean gloves during dressing changes. *(Unresolved Issue)*

Replacement Of Intravascular Device

- Remove any intravascular devices as soon as its use is no longer clinically indicated. *(Category IA)*

Intravenous Injection Ports

- Clean injection ports with 70% alcohol or povidone-iodine before accessing the system. *(Category IA)*

Preparation And Quality Control Of Intravenous Admixtures

- Admix all parenteral fluids in the pharmacy in a laminar-flow hood using aseptic technique. *(Category IB)*
- Check all containers of parenteral fluid for visible turbidity, leaks, cracks, particulate matter, and the manufacturer's expiration date before use. *(Category IA)*
- Use single-dose vials for parenteral additives or medications when possible. *(Category II)*

In-Line Filters

- Do not use in-line filters routinely for infection control purposes. *(Category IA)*

Intravenous Therapy Personnel

- Designate trained personnel for the insertion and maintenance of intravascular devices. *(Category IB)*

Needless Intravascular Devices

- No recommendation for use, maintenance, or frequency of replacement of needless IV devices. *(Unresolved Issue)*

Prophylactic Antimicrobials

- Do not administer antimicrobials routinely before insertion or during use of an intravascular device to prevent catheter colonisation or bloodstream infection. *(Category IB)*

4. Recommendations For Peripheral Venous Catheters

(adapted from CDC Recommendations for the prevention of nosocomial intravascular device related infections, available via the internet at <http://www.cdc.gov/>)

These recommendations are based on research findings and expert opinion

Selection Of Catheter

- Select catheters based on the intended purpose and duration of use, known complications and experience at the institution. Use a Teflon catheter, a polyurethane catheter, or a steel needle. (*Category IB*)
- Avoid use of steel needles for the administration of fluids and medications that may cause tissue necrosis if extravasation occurs. (*Category IA*)
- Consider the use of midline catheters when the duration of IV therapy is expected to exceed 6 days. (*Category IB*)
- No recommendation for the use of antimicrobial or antiseptic impregnated peripheral venous catheters. (*Unresolved Issue*)

Selection Of Catheter Site

- In adults, use an upper extremity site in preference to one on a lower extremity for catheter insertion. Transfer catheter inserted in a lower extremity site to an upper extremity site as soon as the latter is available. (*Category IA*)
- In paediatric patients, insert catheters into scalp, hand, or foot site in preference to a leg, arm, or antecubital fossa site. (*Category II*)

Replacement Of Catheter

- In adults, replace short, peripheral venous catheters, and rotate peripheral venous sites every 48 to 72 hours to minimise the risk of phlebitis. Remove catheters inserted under emergency conditions, where breaks in aseptic technique are likely to have occurred. Insert a new catheter at a different site within 24 hours. (*Category IB*)
- In paediatric patients, no recommendation for the frequency of replacement of short peripheral venous catheters or for removal of catheters inserted under emergency conditions where breaks in aseptic technique are likely to have occurred. (*Unresolved Issue*)
- No recommendation for the frequency of replacement of midline catheters. (*Unresolved Issue*)
- Remove peripheral venous catheters when the patient has developed signs of phlebitis (ie, warmth, tenderness, erythema, palpable venous cord) at the insertion site. (*Category IA*)

Replacement Of Administration Sets

- A short extension tubing may be connected to the vascular device and may be considered a portion of the device to facilitate aseptic technique when changing the administration sets. Replace extension tubing when vascular device is replaced. (*Category II*)
- Replace IV tubing, including piggyback tubing, no more frequently than at 72 hour intervals, unless clinically indicated. (*Category IA*)
- No recommendation for frequency of replacement of IV tubing used for intermittent infusions. (*Unresolved Issue*)
- Replace tubing used to administer blood and blood products, or lipid emulsions within 24 hours of initiating the infusion. (*Category IB*)

Replacement Of Intravenous Fluids

- No recommendation for the hang time of IV fluids, including non-lipid-containing parenteral nutrition fluids. (*Unresolved Issue*)
- Complete infusions of lipid-containing parenteral nutrition fluids within 24 hours of hanging the fluid. (*Category IB*)
- When lipid emulsions are given alone, complete the infusion within 12 hours of hanging the emulsion. (*Category IB*)

Flush Solutions, Anticoagulants, Topical Agents And Other IV Additives

- Routinely flush peripheral venous cannula bungs with normal saline solution, unless they are used for obtaining blood specimens, in which case a dilute heparin (10 units per ml) flush solution should be used. (*Category IB*)
- No recommendation for the routine use of topical venodilators (eg, glyceryl trinitrate) or anti-inflammatory agents (eg, cortisone) near the insertion site of peripheral venous catheters to reduce phlebitis. (*Unresolved Issue*)
- No recommendation for the routine use of hydrocortisone or heparin in parenteral solutions to reduce phlebitis. (*Unresolved Issue*)
- Do not routinely apply topical antimicrobial ointment to the insertion site of peripheral venous catheters. (*Category IB*)

Cutaneous Antisepsis

- Cleanse skin with an appropriate antiseptic, including 70% alcohol, or 10% povidone-iodine, or 2% tincture of iodine, before insertion. Allow antiseptic to remain on insertion site for an appropriate length of time before proceeding. (*Category IA*)
- When tincture of iodine is used before catheter insertion, it should be removed with alcohol before insertion of the device. (*Category II*)
- Do not palpate the insertion site after the skin has been cleansed with antiseptic. (*Category IA*)

Catheter Site Dressing Regimens

- Use sterile gauze or transparent dressing to cover the catheter site. (*Category IA*)
- Replace catheter site dressing when the device is removed or replaced, or when dressing becomes damp, loosened, or soiled. Change more frequently in diaphoretic patient. (*Category IB*)
- Avoid touch contamination of the catheter insertion site when dressing is replaced. (*Category IA*)

5. Definitions And Diagnosis Of Catheter Related Infection

Establishing a clinical diagnosis of a catheter-related infection, especially catheter-related bloodstream infections (CR-BSI), is often difficult. While definitions have varied between studies, the following summarises the major points of the CDC guideline definitions.

Colonisation

Growth of an organism from the proximal or distal catheter segment, or the catheter lumen, and the absence of accompanying signs of inflammation at the catheter site.

Local Catheter-Related Infection

Growth of an organism from the proximal or distal catheter segment, or the catheter lumen, with accompanying signs of inflammation (eg. erythema, warmth, swelling, or tenderness) at the catheter site. In the absence of laboratory confirmation, catheter-related infection may be diagnosed when there is purulent drainage from the skin catheter junction.

Catheter-Related Bloodstream Infection

The isolation of the same organism from both the catheter segment and the blood in a patient with clinical symptoms of BSI and no other apparent source of infection. Blood specimen for diagnosis should preferably be drawn from a peripheral vein. In the absence of laboratory confirmation of BSI, defervescence (abatement of fever) after removal of an implicated catheter from a patient with a BSI is also considered indirect evidence of CR-BSI.

Infusate-Related Bloodstream Infection

The isolation of the same organism from both the infusate and separate percutaneous blood cultures with no other identifiable source of infection.

Acknowledgement

This practice information sheet was developed based on the work of the Hospital Infection Control Practices Advisory Committee (HICPAC), Centers for Disease Control and Prevention, Atlanta, Georgia, USA, and is reproduced with their permission.

For further clarification of any recommendation or to view references, the complete guideline is available via the internet at <http://www.cdc.gov/> and they have also been published in - CDC.,(1996), Guidelines for prevention of intravascular device-related infections, *American Journal of Infection Control*, 24(4), pp. 262 - 293. It should be noted that the CDC information has not been based on a "systematic review", but rather an extensive review of the literature and consensus by recognised experts.

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