Liverpool Women's NHS Foundation Trust

CENTRAL VENOUS CATHETER MANAGEMENT CLINICAL GUIDELINE

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Contents

1. Statement.

This guideline has been compiled to address care, maintenance and monitoring of acutely ill patients requiring central line insertion, as an accurate aid to staff involved in the care of these patients.

2. Objectives

To ensure that all staff involved in CVC insertion, care, maintenance and monitoring of acutely ill patients requiring central line insertion have received adequate training and are deemed competent in the care of these patients.

To ensure that this training encompasses known complications, side-effects and risks associated with CVC insertion, care, maintenance, and monitoring.

3. Scope of the guideline

This guideline applies to all staff involved in CVC insertion, care, maintenance, and monitoring of acutely ill adult patients requiring central line insertion from Liverpool Women's Foundation Trust.

4. Monitoring

It is the responsibility of the Gynaecology and CSS Policy, Audit and Patient Information Group (Sub group of the Critical Care Delivery group) to monitor and audit compliance with this guideline once a year (minimum)

5. Professional Responsibilities

It is the responsibility of all staff involved in CVC insertion, care, maintenance and monitoring of acutely ill adult patients requiring central line insertion At Liverpool Women's Foundation Trust, to be aware of their obligations and responsibilities to provide safe clinical care and timely recognition and treatment of possible complications, with up to date documentation and a written follow up care.

6. Consultation.

This guideline was originally written by Dr Djabatey and has most recently been updated by Dr Permall and ratified by Anaesthetic Business Meeting and HDU Delivery Group.

7. Overview of Central Venous Catheters

The term Central Venous Catheter (CVC) refers to an intravenous catheter whose internal tip lies in a large central vein.
There are various different types of CVC but common to all is the idea that the tip of the catheter floats freely within the bloodstream in a large vein and parallel to the vein wall.
Blood flow around the catheter is maximised, and physical and chemical damage to the internal walls of the vein are minimised.

Opinions vary about the ideal place for the tip of a CVC[2] but it is generally accepted that for a catheter to be considered a “central catheter” the internal tip should be in one of the following positions.
a. Superior vena cava (SVC)
b. RA / SVC junction
c. Right atrium (RA)
d. Inferior vena cava below the diaphragm (femoral catheters)

Tip positions outside these areas are thought to be related to a significantly higher risk of complications, notably thrombosis[3,4,5,6,7].

8. Indications

- To monitor central venous pressure/haemodynamic monitoring
- To administer irritant, vesicant or hyper-osmolar drugs / fluids (for example Noradrenaline/Adrenaline, sodium bicarbonate)
- To provide long term access for frequent or prolonged use (e.g. chemotherapy, antibiotics, blood sampling, haemodialysis etc.).
- Extremely difficult venous access

9. Insertion

Insertion of a CVC is an invasive procedure which must only be performed by trained, competent personnel using “optimal aseptic technique, including a sterile gown, gloves, and a large sterile drape”[11].
The use of ultrasound to achieve venous access is recommended by NICE guidelines[12]

Whether the catheter is inserted under general anaesthetic, sedation or simple local anaesthetic will depend upon the situation, the patient, the type of catheter to be inserted and local practice.

Guidelines for the procedure of insertion of Central Venous Catheters are not covered here.

The choice of device will depend chiefly on the purpose for which it is intended.
As a general principle the lumen diameter and the number of lumens should be kept to a minimum, since larger bore catheters and multiple lumens are associated with higher infection and thrombosis risks[11, 13].

In high dependency settings large bore catheters and multiple lumens tend to be used as they are essential for management of the acutely ill patient.

10. Centrally Inserted Non-tunnelled CVCs

Often called Central Lines / Neck Lines / CVP lines.

Centrally Inserted Non-tunnelled CVCs are most commonly found in acute settings. They are not suitable for long-term use because they rarely remain free of infection for longer than 7 – 10 days.

The catheter is usually inserted via the subclavian, jugular or femoral veins with the tip positioned in the Right Atrium, the Superior or Inferior Vena Cava. It is secured using non-dissoluble sutures.

Non-tunnelled CVCs may have single or multiple lumens. Each lumen provides independent access to the venous circulation so that incompatible drugs/fluids may be administered simultaneously.

Each lumen is equipped with an integral clamp to seal the catheter and guard against air entry, haemorrhage and infection. Needle free systems (Bionector) should be attached to the lumens. When decontaminating the Bionector observe the sheath is not damaged, replace immediately. Three way taps should not be used.

The entry site should be covered by a semi-permeable IV dressing and changed aseptically after 24 hours, then every 72 hours thereafter.

Chest x-ray should be taken after insertion of a CVC (excluding femoral) and interpreted by an anaesthetist deemed competent to confirm position. Lumens should not be used prior to confirmation of correct siting.

11. Regular Care of CVCs

CVCs must be reviewed daily:

- Is the device still required? Likelihood of infection increases with duration a CVC remains in situ.
- The insertion site should be examined each shift for signs of infection and inflammation.
- Is the patient showing signs of systemic infection – eg pyrexia, tahcyardia, hypotension
- Administration sets should be examined for signs of disconnection, contamination and air.

Flushing CVCs:

- Flush CVCs immediately:
    - After placement
    - Prior to and after fluid infusion
    - Prior to and after blood drawing

Administration set changes:

Administrations sets including all connections, piggyback tubing and extension devices, must be replaced as follows:

- Replace any extension tubing when the vascular device is replaced – all new lines must be attached to completely new infusions and transducers.
- Discard if becomes disconnected
- Crystalloid and clear fluids and non-lipid solutions: every 96 hours
- Blood or blood products: replace immediately after transfusion is completed

12. Removal of Non-tunnelled CVCs

Qualified nurses who have been assessed as competent following these guidelines, may remove central lines

Procedure:

- Check patient's coagulation status. If there is an increased risk of bleeding discuss with medical team before proceeding. If platelets are < 50, platelets should be administered immediately prior to the procedure. If the patient is anticoagulated, this should be managed as for surgery.
- The risk of air embolism increases if patient is dehydrated, is unable to lie flat, or has an uncontrolled cough. Assess for these risks. Only proceed if satisfied that it is safe to do so.
- Use aseptic technique throughout.
- Lie the patient flat and tip the head of the bed downward 15-30 degrees to reduce the risk of air embolism (except femoral catheters). Remove the dressing. If there is any sign of infection, take a swab of the exit site.
- Remove any stitches.
- Ask patient to perform Valsalva's manoeuvre (ie take a deep breath, hold it, and bear down). If patient unable to do this, remove the catheter during expiration and NEVER when the patient is breathing in, as this will increase the risk of air being sucked into the venous system.
- Gently and swiftly pull out the catheter and immediately apply pressure to the site using sterile gauze. The patient can now breathe normally and the bed can be returned to the flat position.
- Continue applying pressure to the exit site for three minutes (or longer in cases of deranged clotting) and ensure haemostasis is achieved.
- During this time observe patient for signs of haematoma (ie, swelling, pain, altered voice, airway obstruction).
- Apply a sterile occlusive dressing.
- If there is resistance to catheter removal, this could be due to vasospasm. Do not attempt forceful removal – this could result in vein or catheter fracture. Applying a warm compress to dilate the vein can help – seek further assistance if resistance persists.
- Examine the full length of the catheter post removal to assess for catheter fracture. If suspected, position the patient head down and left side – this may help trap the catheter fragment in the right ventricle and prevent migration to lungs. If the catheter fragment is palpable, apply pressure distal to the fragment to prevent migration.
- If systemic infection is suspected, use sterile scissors to cut off the tip of the catheter and without contaminating it drop it into a dry sterile specimen pot. Send it to microbiology for culture.
- Keep the patient supine for 30-60 minutes post CVC removal and continue to monitor.
- 2-5 hours bed rest is required after femoral CVC removal, depending on clotting profile, to reduce the risk of bleeding.
- The wound should be kept dry for 5 to 7 days and the wound monitored until healed.

13. Management of Complications

See Appendix 1 for more detailed discussion of complications

Pyrexia plus or minus: rigor after flushing, sore throat, generally feeling unwell, hypotension, tachycardia, shock, exit site / tunnel infection

Possible cause:

Catheter Related Blood Stream Infection

Management:

- Refer to medical staff. May be treatable without catheter removal depending on patient's clinical status and colonising organism.
- Take blood cultures from each lumen and peripherally. Follow local guidelines when taking blood cultures
- Monitor observations, including heart rate and blood pressure. Frequency will depend on patient's clinical status.
- If there are signs of exit site infection see below.

Inflammation and tenderness at the exit site / skin tunnel / port pocket plus or minus exudate

Possible cause:

Infection

Management:

- Take a swab
- Refer to medical staff. May resolve with antibiotics
- Increase frequency of dressing change & cleaning depending on amount of
- Exudate.
- Minimum 4 hourly observations and MEWS, Increase as per MEWS policy if score> 1.

No flashback of blood but catheter flushes well.

Possible causes:

- Clotted blood in catheter
- Fibrin sheath
- Malpositioned catheter
- Drug Precipitation

Catheter is sluggish or there is only intermittent free flow of fluids.

Possible causes:

- Clotted blood in catheter
- Malpositioned catheter
- Drug Precipitation

Catheter is completely blocked.

Possible causes:

- Clotted blood in catheter
- Drug Precipitation

NB: In Implantable Ports needle may be incorrectly positioned: check before taking any other action.

Management refer to Intravenous Access Care and maintenance guideline (Intranet Critical Care, HDU folder).

Pain or visible swelling when catheter is used or fluid leaks from exit site when catheter is flushed.

Possible causes:

- Malposition of catheter
- Internal catheter fracture

- Fibrin Sheath
- Separation of port and catheter (Implantable ports)

Management:
- Refer to medical staff: a malpositioned catheter should usually be removed. Internal fracture cannot be repaired.
- If there is a fibrin sheath severe enough to cause leakage the catheter should be removed.
- If catheter is fractured or faulty complete Adverse Incident Form and retain the catheter to send to Medical Physics / manufacturer.

Leakage from external portion of catheter when flushed.
Possible cause:
- External catheter fracture

Management:
- Clamp catheter above leak to prevent air entry.
- Catheter must be repaired or removed as soon as possible. Some catheters can be repaired if equipment & expertise available. The advisability of repair will depend on the patient's clinical status as it carries a risk of infection.

Complete Adverse Incident Form and retain the catheter to send to Medical Physics /manufacturer.

Swelling of shoulder, neck, arm or face, with or without pain, inflammation, distension of neck veins/peripheral vessels
Possible cause:
- Thrombosis.

Management:
- Refer to medical staff for investigation of suspected thrombosis. It may or may not be possible to treat thrombosis without catheter removal.
- Thrombosis and infection often occur together so blood cultures may be necessary.

Cardiopulmonary symptoms including any of the following: respiratory distress / failure apnoea, reduced o2 saturation levels, tachycardia, bradycardia, hypotension, pallor, cyanosis, anxiety, chest pain, loss of consciousness
Possible causes:
- Pneumothorax
- Air or catheter embolism
- Pulmonary embolism
- Cardiac tamponade / pericardial effusion

Management:
- Call for medical assistance / / resuscitation team
- Administer O2
- Monitor vital signs

Palpitations / Abnormal ECG
Possible causes:
- Cardiac arrhythmias related to CVC

Management:
- Call for urgent medical assessment

- Monitor vital signs

14. Training

CVC insertion, care, maintenance and monitoring of acutely ill patients requiring central line insertion will be included in junior anaesthetists' induction pack.

15. Audit Outcomes

This guideline will be audited annually, and any recommendations and changes in practice will be monitored by the HDU Delivery Group.

16. Associated Guidelines

Policy for Central Venous Catheter Insertion and Management in Critical Care, Liverpool University Hospitals, June 2022.

17. Consultation and Ratification Process

This Guideline will be consulted and ratified within the Critical Care group meeting and Anaesthetic Consultants meeting

18. Intranet Classification

Tags (separated by ;)	CVP;

19. Version Control Sheet

Version	Date	Author	Status	Comment
1	Nov 10	Gill Murphy	Archived	Guideline Creation
1.2	Nov 14	Emer Bell	Archived	Updated
2	Sept 16	Debi Rice	Archived	Updated
2.4	Dec 19	Debi Rice	Archived	Extended for 3 months
3.0	Mar 23		Current	Minor amendments

Appendix 1: Complications of CVCs

(i) Pneumothorax
A pneumothorax is the presence of air in the pleural space between the lungs and the chest wall. It can occur during the insertion of a CVC when a needle used to access the subclavian or jugular veins inadvertently punctures the lung. The person inserting the catheter is not

always aware that this has happened, so it is common to screen for pneumothorax by carrying out a routine CXR four hours after insertion.
A pneumothorax may be clinically silent and only noticed on the routine X-Ray. It may lead to a life-threatening emergency situation with respiratory distress, reduced oxygen saturation levels, tachycardia or hypotension. A small pneumothorax may resolve spontaneously. In severe cases a chest drain may be necessary.

(ii) Infection
Infection is the most common complication associated with central venous access[35] and one of the most serious[36] with estimated mortality rates ranging from 1 – 35%.
Contamination can occur during insertion of the CVC or at a later stage via the hands of healthcare workers, or transferred from the patient's skin or other anatomical sites. Infection may be relatively minor or may be life-threatening.
Bacteria can colonise a CVC either on its exterior or interior surface: ie colonisation is either extraluminal or intraluminal. Extraluminal infections usually begin at the exit site and may remain confined to that area or may track along the catheter into the bloodstream. Intraluminal infections are caused by contamination via the hub of the catheter [38].
Exit site infections can often be treated successfully with antibiotics, especially in tunnelled CVCs where the vein and the exit site are separated by the tunnel. In non-tunnelled centrally inserted CVCs, however, treatment is less likely to be successful, as there is less distance between the exit site and the blood stream[11]. By the same token, infections in tunnelled CVCs involving the skin tunnel itself above the cuff are notoriously difficult to treat and the same applies in implantable ports where there is
infection of the port pocket.
The risk of infection can be reduced by strict adherence to Aseptic Non-Touch Technique.
Intravenous tubing and Bionectors should be changed according to Trust Infection Control Guidelines.

(iii) Thrombosis
Thrombosis occurs when a clot develops within the vein around the catheter. Unless the clot is at the internal tip of the catheter, it will not usually affect the patency of the catheter. Thrombosis formation is a natural response to vascular injury. Damage to the vessel wall can occur during catheter insertion, or may be due to mechanical or chemical irritation in an incorrectly placed catheter eg where the tip of the catheter is in too small a vein, or rubbing against the vein wall instead of floating parallel to it.
The risk of thrombosis is increased in patients who are pregnant or immobile or who have diabetes or cancer. Surgery, chemotherapy, hormonal agents, haemodialysis and CVC-related infection are all thought to be risk factors[13,28,39,40]. It used to be thought that minidose Warfarin might reduce the risk of thrombosis in Cancer patients, but this has recently been disproved[26].
Patients who develop thrombosis are at increased risk of pulmonary embolism and infection[39].
A large proportion of patients with CVCs have thromboses which are never detected[41, 42].
When a thrombosis does become symptomatic, it will usually cause swelling of the arm, neck and / or face.
There may be associated pain, tingling or numbness, distended neck or peripheral veins[43, 44].
The presence of a thrombosis can usually be confirmed by use of Doppler ultrasound.
Unless the catheter is incorrectly positioned, it is often possible to treat a thrombosis using anticoagulants without removing the catheter. This is probably the best course of action for a patient who still requires a CVC, because taking the catheter out will expose him/her to the added risks of another catheter insertion, including, of course, thrombosis.

(vi) Cardiac Arrhythmias
Atrial or ventricular arrhythmias can occur when the tip of the CVC is placed within the heart[9,46,47]. In practice, CVC tips correctly placed in the right atrium rarely cause arrhythmias.

Any patient experiencing palpitations or arrhythmias should be assessed by a medical team as soon as possible.

(vii) Cardiac Tamponade

This is a rare complication of CVCs, seen mainly in neonates. Cardiac tamponade arises when fluid (in this case blood) accumulates in the pericardial space around the heart and impairs cardiac function.

This is a catastrophic, often fatal event. The patient is likely to exhibit a sudden onset of severe cardiorespiratory symptoms.

Cardiac tamponade can arise in a patient with a CVC if the heart is punctured either during insertion or subsequently by a malpositioned catheter.

(viii) Patency Impairment

Patency should be considered to be impaired in any of the following situations:

The catheter is completely blocked and cannot be flushed at all.

The catheter can be flushed using a syringe but there is sluggish, absent or intermittent free-flow when infusion of fluids by gravity is attempted.

The catheter flushes easily but aspiration of blood is sluggish or absent.

Patency problems should be taken seriously. Ignoring the early signs may lead to the development of more serious problems with cannot then be easily rectified – eg complete blockage or thrombosis28.

The causes of patency problems include

Clotted blood within the catheter: This can be avoided by good flushing techniques as described in these guidelines. When problems do arise, they can usually be solved relatively easily by use of a thrombolytic such as Urokinase: see Using Thrombolytics (page 16).

Fibrin Sheath: Fibrin sheaths are thought to occur in most CVCs left in place for over 7 days48. A fibrin sheath is a kind of sleeve made of a fibrous collagen substance which can form around the catheter within the blood stream. It may extend to form a kind of “sock” protruding beyond the tip of the catheter, and if this happens it may impair the patency of the catheter: most commonly it will prevent blood from being withdrawn from the catheter because the fibrin sheath is sucked against the tip of the catheter. In severe cases a fibrin sheath may also lead to backtracking of infused fluids between the fibrin sheath and the catheter, causing leakage of those fluids into the tissues49. Fibrin sheaths are associated with an increased risk of infection50 as they provide an ideal medium for the proliferation of bacteria.

Mechanical obstruction: A mechanical obstruction can occur internally or externally. Internal obstruction may be due the catheter being incorrectly positioned: eg there is an internal kink or the tip of the catheter is resting against a vessel wall rather than floating free within the bloodstream (see Incorrect Position below). This might be because of poor insertion technique, or it might be that the catheter was put in correctly but has subsequently become dislodged. A simple Chest X-Ray will often reveal an incorrectly positioned catheter. External kinking of the catheter can also cause patency problems: its’ worth checking for a bra-strap or an over-tight stitch before looking for a more complicated cause!

Build-up of lipids from parenteral nutrition or drug precipitation within the catheter caused by too high a concentration or incompatibility of drugs: If this appears to be a likely cause of occlusion, consult Medical/Pharmacy advice for a suitable agent to dissolve occlusion.

(ix) Incorrect Position

A CVC should be considered to be in an incorrect position when any of the following apply:

The tip is not in the Right Atrium, the Superior Vena Cava or the Inferior Vena Cava.

The tip of the catheter is not floating freely parallel to the vein wall.

The catheter is kinked within the body or pinched between internal structures

Incorrect position may be the result of poor insertion technique or may occur spontaneously in a previously well-positioned catheter. It is not unknown for a CVC to “migrate” within the venous system for no apparent reason. Hadaway reports that “Changes in intrathoracic

pressure, coughing, sneezing, Valsalva manoeuvre such as during heavy lifting, vigorous extremity use, forceful flushing, or congestive heart failure could lead to migration of the tip"28.
In addition the catheter may become dislodged if it is not correctly secured in place, or is accidentally pulled.
If a CVC is incorrectly positioned there is a high risk of thrombosis and patency impairment 20,51. If it is kinked internally there is also the risk that the catheter may split, leading to extravasation of drugs / fluids and in serious cases, embolisation of the catheter itself.
You should suspect incorrect position if there are patency problems despite the use of a thrombolytic, if the patient complains of pain on flushing, if the external length of the catheter increases, if the patient develops a thrombosis, or if the cuff of a tunnelled CVC protrudes from the exit site52.
A malpositioned, kinked or pinched catheter should be repositioned, replaced or removed as soon as practicable Leaving it in place for any length of time represents a high risk of thrombosis and/or catheter fracture / embolism.

(x) Extravasation of Fluids / Drugs due to Incorrect Needle Position or Needle Dislodgement (in Implantable Ports)
The non-coring needle should be correctly placed into the port (Diagram 6). If the needle is not inserted far enough into the port or if the needle misses the port altogether this may lead to fluids / drugs being infused into the subcutaneous tissues.
The needle may become dislodged if it is inadequately secured with dressing tape, if there is tension on the extension tubing or if the needle used is of insufficient length, causing the patient's normal movements to loosen the needle. The problem will usually be noticed when there is discomfort and/or oedema at the entry site combined with lack of free-flow of fluids.
If extravasation has occurred or is suspected, the needle should be removed and a fresh needle used to access the port correctly.
This may occur externally or internally and may result from over-forceful flushing, trauma to the catheter or incorrect position (eg kinking leading to wear-and-tear).
An external fracture will result in leakage of blood or fluids from the catheter. Sometimes there is an obvious fracture. The line must be clamped or folded over on itself immediately to prevent air embolism. Sometimes the catheter can be repaired or replaced over a guidewire but the advisability of this will depend on the patient's clinical status. In addition, unless the correct equipment and expertise
are available for a repair to be carried out, the catheter should be removed immediately, as there is a high risk of infection and air embolism.
Internal fracture will usually result in patency impairment and / or pain, redness and swelling when the catheter is flushed.. There is a risk that the catheter itself will embolise. If this occurs there may be no symptoms at all or there may be signs of pulmonary embolism. ie acute onset of any or all of the following - anxiety, pallor, cyanosis, shortness of breath, rapid weak pulse, hypotension, chest pain, loss of consciousness.

20. References

2 Vesely, T. "Central Venous Catheter Tip Position: A Continuing Controversy" Journal of Vascularand Interventional Radiology, Volume 14(5) May 2003, pp 527-534
4 Puel V et al 1993. "Superior vena cava thrombosis related to catheter malposition in cancer
5 Eastridge BJ and Lefor, AT. "Complications of indwelling venous access devices in cancer patients". Journal of Clinical Oncology. 13(1):233-8, 1995 Jan.
6 Schuster M, et al. "The carina as a landmark in central venous catheter placement". British Journal of Anaesthesia 2000; 85: 192–4
7 Fletcher S, Bodenham AR. "Safe placement of central venous catheters: where should the tip of the catheter lie?" British Journal of Anaesthesia 2000; 85: 188–91.

June 2001.
9 Bivins MH and Callahan MJ “Position-Dependent Ventricular Tachycardia Related To A Peripherally Inserted Central Catheter” Mayo Clinic Proceedings, 75 (4): 414-6, 2000 Apr
10 NAVAN (National Association of Vascular Access Networks) “Tip Location Of Peripherally Inserted Central Catheters” Journal of Vascular Access Devices, Summer 1998
11 Pratt RJ et al (2001) “The Epic Project: Developing National Evidence-based Guidelines for Preventing Healthcare associated Infections. Phase 1: Guidelines for Preventing Hospital-acquired
Infections”. Journal of Hospital Infection 2001 January; 47(Supplement):S1-S82
12 National Institute for Clinical Excellence (September 2002) “Guidance on the Use of Ultrasound
Locating Devices for Placing Central Venous Catheters.” NICE Technology Appraisal No 49. London: National Institute for Clinical Excellence. Available from www.nice.org.uk
13 Grove, Jay R and Pevec, William C “Venous Thrombosis Related to Peripherally Inserted Central
Catheters” Journal of Vascular and Interventional Radiology Volume 11(7) July/August 2000 pp 837-
840
15 Wickham R et al "Long-term CVCs - Issues for Care" Seminars in Oncology Nursing Vol 8 No 2 May 1992 pp 133-147
16 Wilson J A "Preventing Infection During IV Therapy" Professional Nurse March 1994 pp 338-392
18 Todd, J “Peripherally Inserted Central Catheters and their Use in IV Therapy”
British Journal of Nursing Vol 8 No 3 1999 pp 140-48
19 Camp-Sorrell D "Implantable Ports - Everything you Always Wanted to Know" Journal of Intravenous Nursing Vol 15 No 5 Sep/Oct 1992 pp 262 - 272
20 Krzywda, E et al “Catheter Infections: Diagnosis, Etiology, Treatment, and Prevention”
21 Schulmeister L "Needle Dislodgement from Implanted Venous Access Devices; Inpatient and
23 Haller L and Rush K "CVC infection: a review" Journal of Clinical Nursing Vol 1 1992 pp 61-66
24 Rowley, S “Aseptic Non Touch Technique (ANTT)” Nursing Times Feb 15th Vol 97 No 7 2001: Infection Control Supplement V1-V111
25 Cornock M "Making Sense of CVCs" Nursing Times Vol 92 No 49 Dec 4th 1996 pp 30-31
26 Young, A “WARP - A multicentre prospective randomised controlled trial (RCT) of thrombosis prophylaxis with warfarin in cancer patients with central venous catheters (CVCs)” 2005 ASCOAnnual Meeting
27 RCN IV Therapy Forum “Standards for Infusion Therapy” Royal College of Nursing July 2003
28 Hadaway L “Major Thrombotic and Nonthrombotic Complications: Loss of Patency” Journal of Intravenous Nursing Vol 21 No 5S September/October 1998
30 Maki D G et al "Prospective Randomised Trial of Povidone Iodine, Alcohol and Chlorhexidine for
Prevention of infection Associated with Central Venous and Arterial Catheters” Lancet 383 1991 pp339-343
31 Krzywda, E “Predisposing Factors, Prevention and Management of Central Venous Catheter
33 Oliver L "Wound Cleansing" Nursing Standard Vol 11 No 20 Feb 5th 1997 pp 47-51
34 Drewett, S “Central venous catheter removal: Procedures and rationale” British Journal of Nursing. London: Dec 8, 2000-Jan 10, 2001.Vol.9, Is. 22; pg. 2304