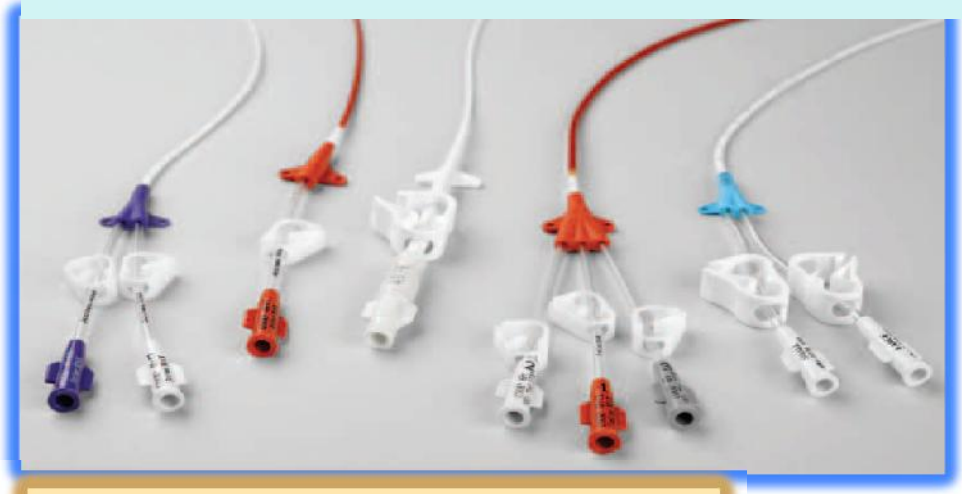
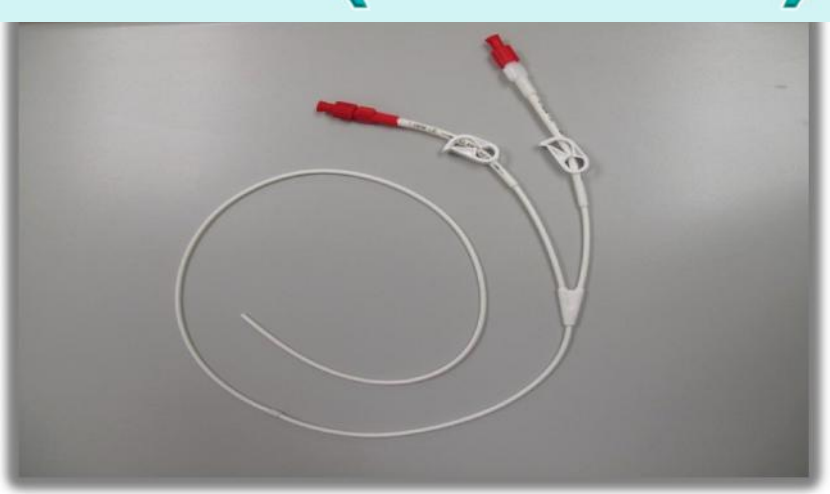
CARE & MAINTENANCE OF CENTRAL VENOUS ACCESS DEVICE (CVAD)





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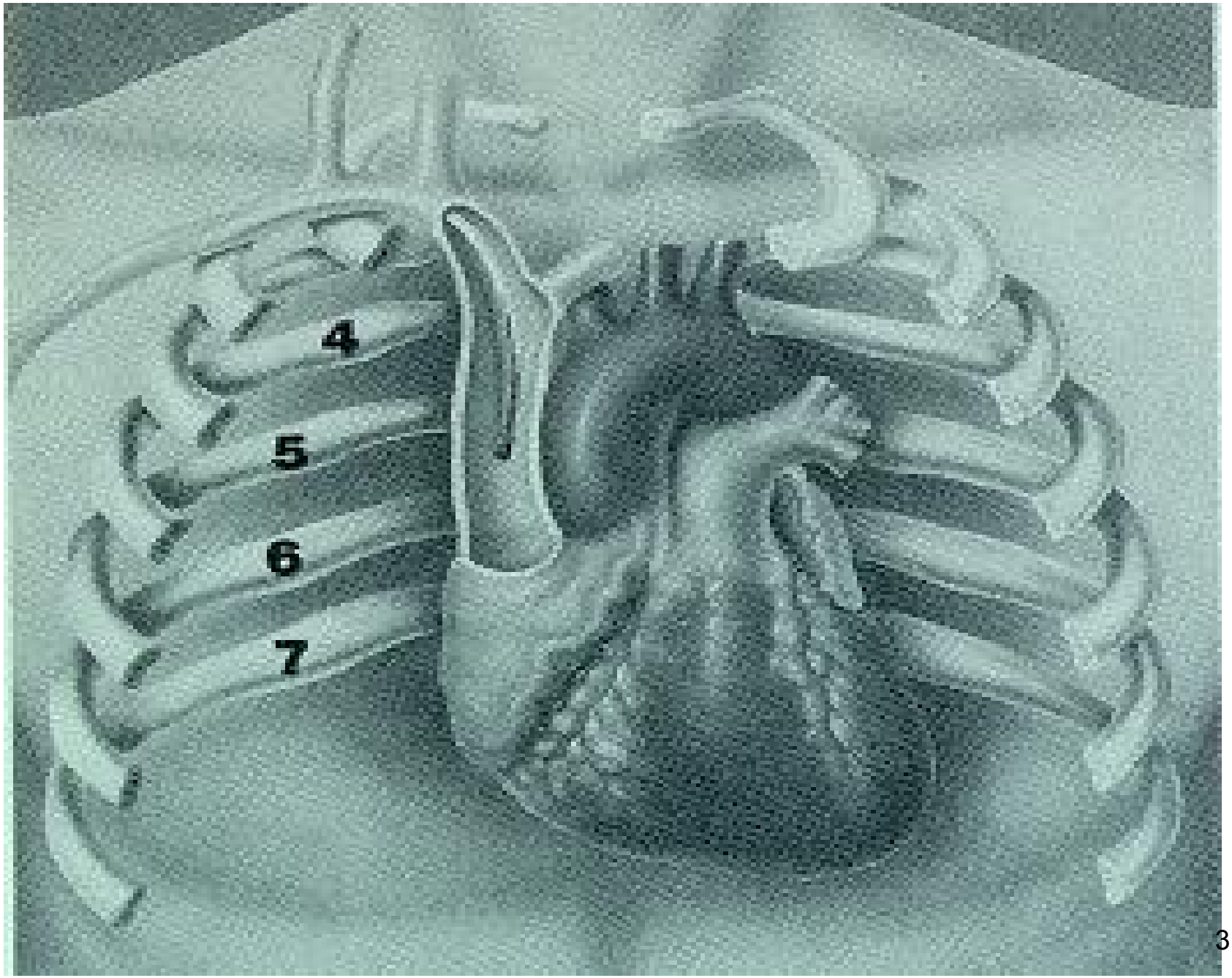
WHAT IS CVAD ?

Central venous access device (CVAD)

- tunneled catheters intended for long-term access
- inserted into the superior or inferior vena cava or right atrium or a large vein leading to these vessels
- place into the right atrium using fluoroscopy or ultrasound guidance
- It is radiopaque with female luer locking adapters and surecuff
- used for
  - administration of blood components, IV fluids, medications, chemotherapy, and parenteral nutrition
  - blood withdrawal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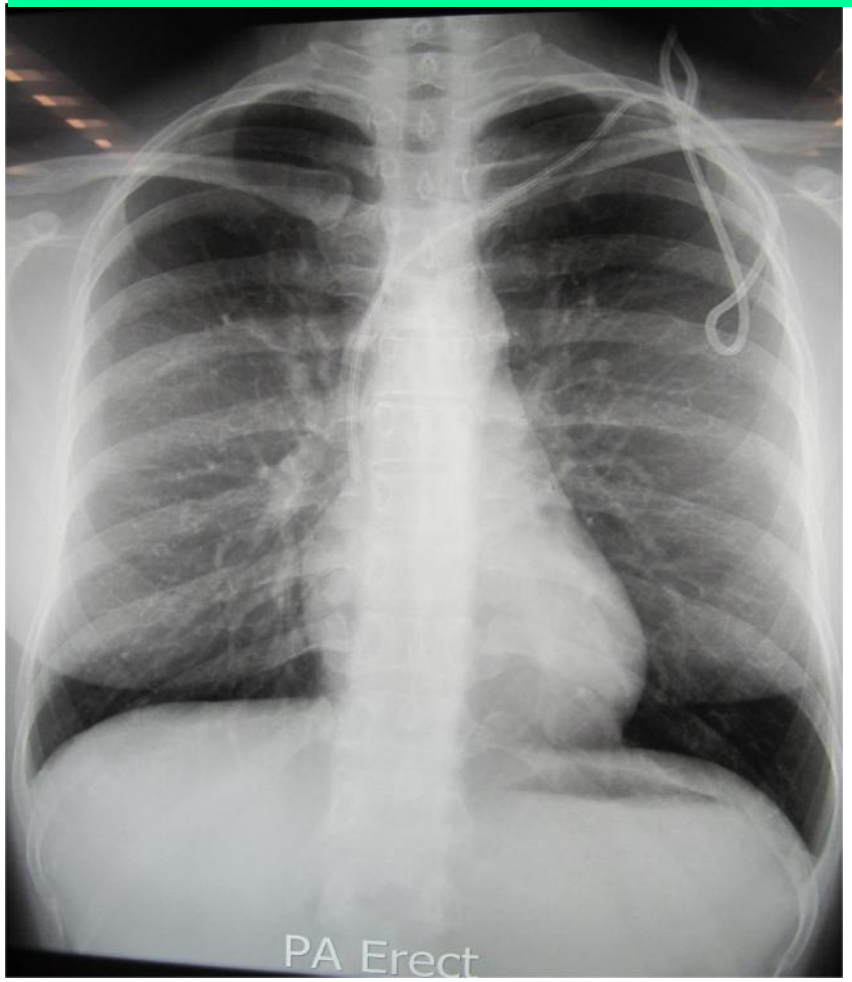
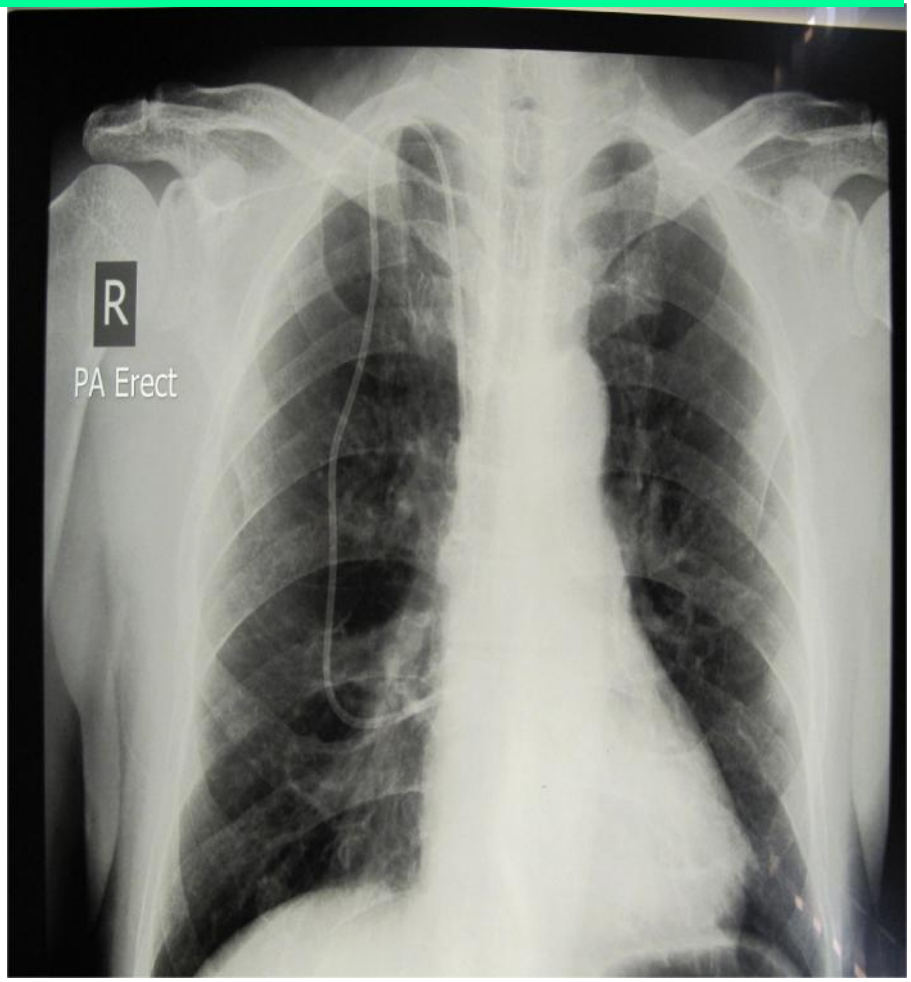
X Ray for Hickman catheter insertion





TYPES OF CVAD (1)

Design

'Open-ended' CVAD

- allows blood to reflux into the device lumen, so when the injection hub is removed, the catheter should be clamped to prevent air entering the patient's venous circulation
- e.g. Hickman or Broviac catheter, Perm catheter, Haemostar catheter etc.

TYPES OF CVAD (2)

Design

'Close-ended' CVAD

- The line has a patented with three-position valve,
- Not require for a clamp.
- single and double lumen. The red lumen is used for blood sampling.
- Heparin solution is not required
- e.g. Groshong lines.

TYPES OF CVAD (3)

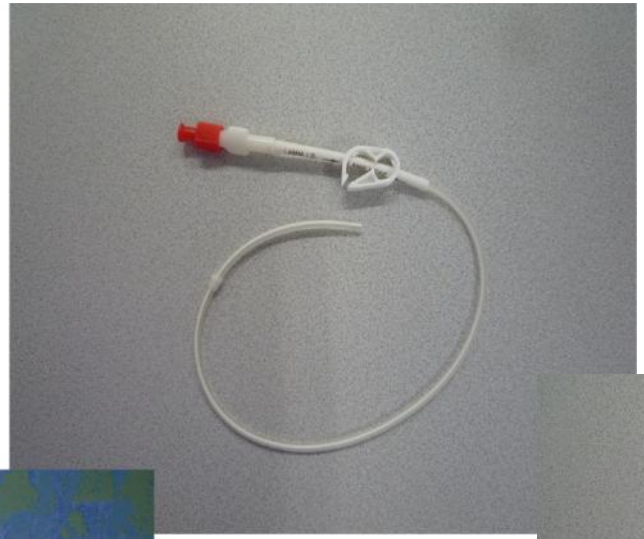
Size

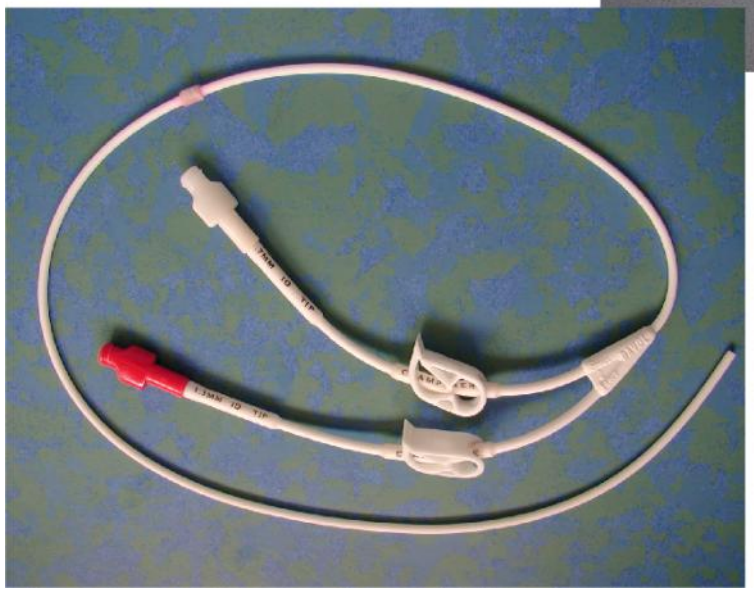
- Various in terms of length and gauge size
- Length expressed in either mm or cm
- Gauge size
  - refers to the external diameter of the device,
  - expressed in either ‘French’ (Fr) or ‘gauge’ (ga) size

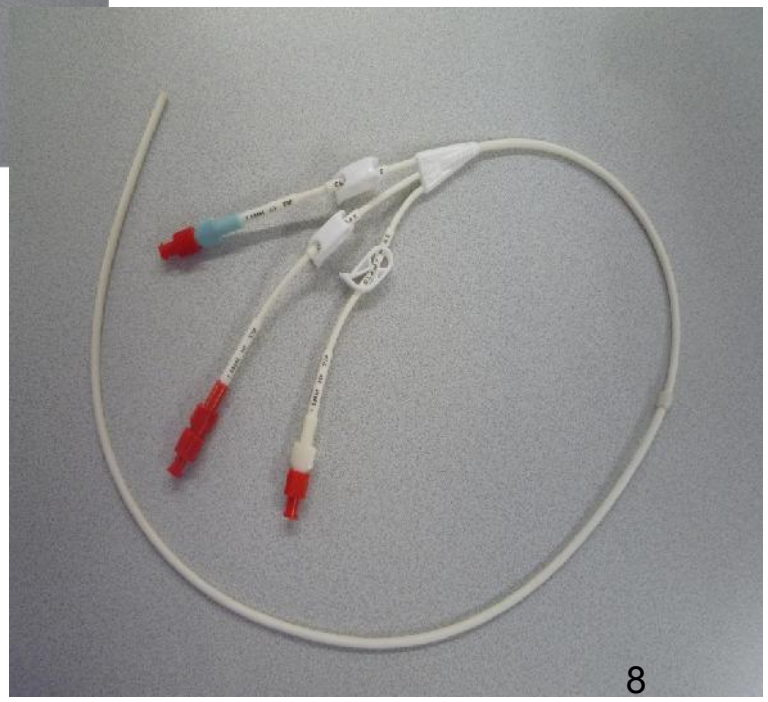
Lumen

- Single, dual or triple

HICKMAN CATHETERS

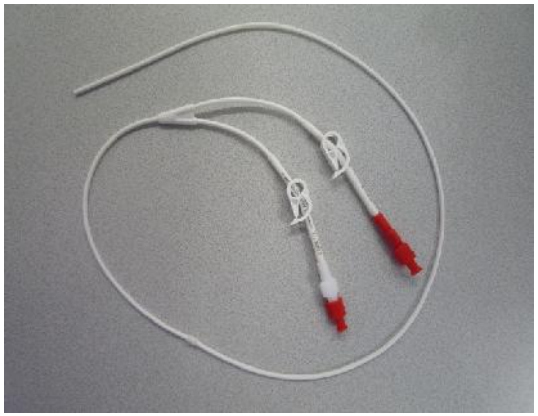






TYPES OF CVAD (4)

Construction material



- Polyurethane
  - more rigid
  - more likely to break
    - due to an inability to recover from kinking and bending
  - can cause irritation to the wall of the blood vessel
    - phlebitis and a higher incidence of thrombosis

TYPES OF CVAD (5)

Construction material (ctd.)

- Silicone rubber
  - very flexible and has the ability to recover from kinking and bending
  - softness
    - degree of phlebitis is not as severe as occurs with polyurethane CVAD
    - incidence of catheter-related thrombosis and infection are also reduced
  - easily damaged by sharp instruments

TYPES OF CVAD (6)

Broviac catheter

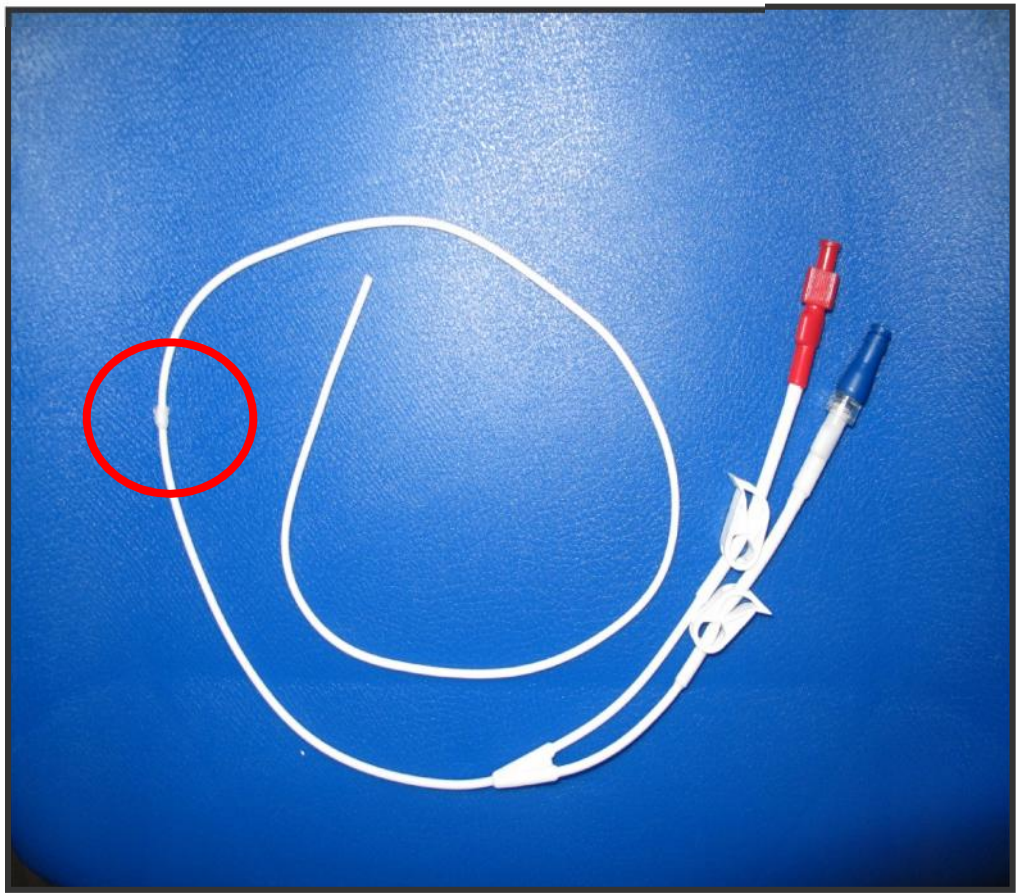
- developed by J. Broviac (American clinician) in 1970s for patients requiring prolonged parenteral nutrition
- tunneled under the patient's skin, on the chest wall, and accessed the CVS via the external jugular or cephalic veins
- had a **Dacron cuff** attached to the portion of catheter that was tunneled under the skin

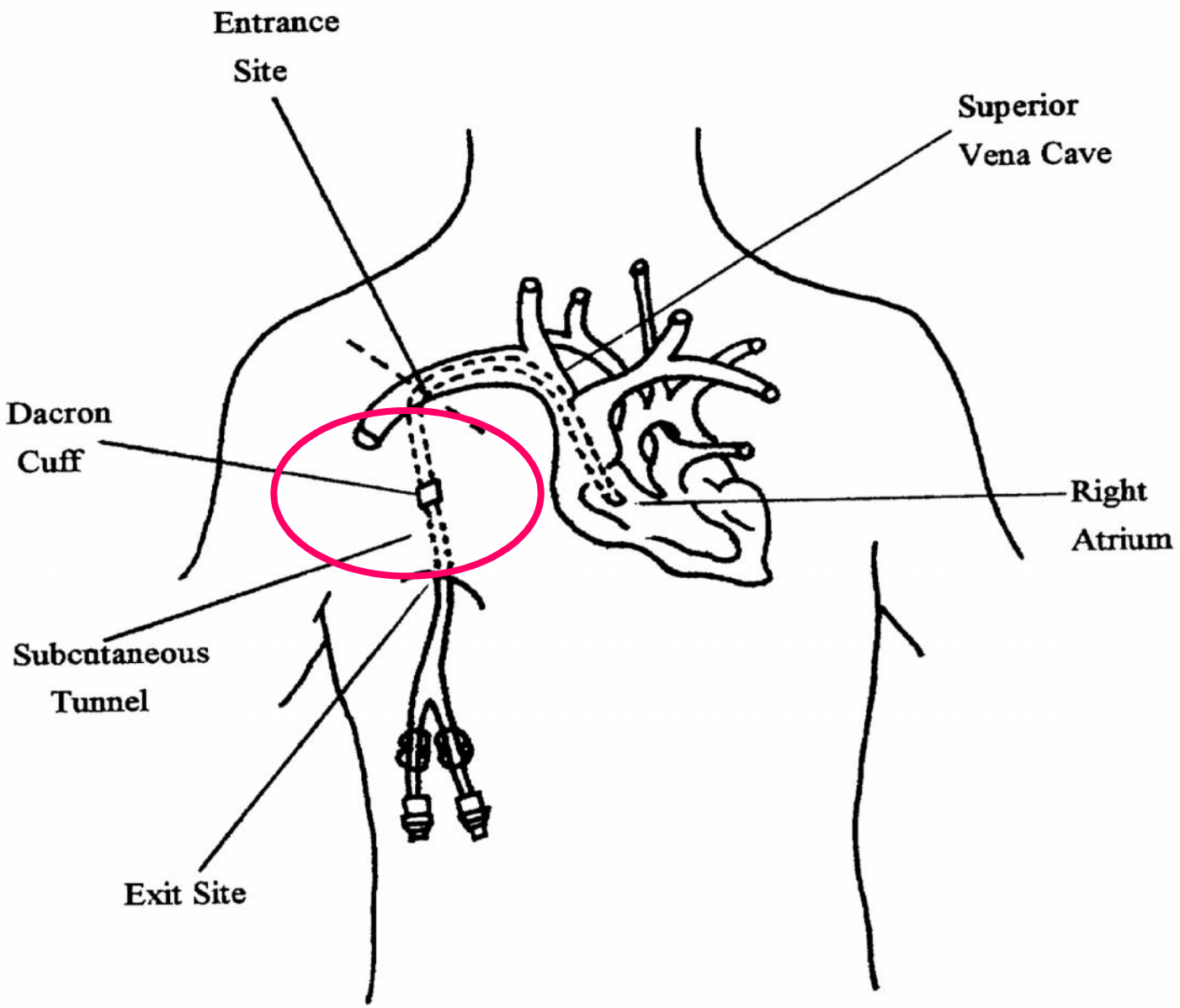
TYPES OF CVAD (7)

Hickman Catheter

- A silicone skin – tunneled catheter intended for long term access with Dacron Cuff under the skin tunnel
- inserted into the superior or inferior vena cava or right atrium or a large vein leading to these vessels.
- These lines have clamps for use, when accessing the line to prevent air embolism and/or blood loss.
- Available in single, double and triple lumen, usually color coded.
- The red or brown lumen is usually larger in size and is used for blood sampling.

Dacron Cuff




Entrance
Site
Superior
Vena Cave
Dacron
Cuff
Right
Atrium
Subcutaneous
Tunnel
Exit Site

TYPES OF CVAD (8)

aims of the Dacron cuff:

- facilitated the growth of the surrounding tissue around the cuff (2 to 3 weeks) ➡ stabilize the catheter without the need for suturing
- the in growth of tissue coupled with the skin tunneling technique

➢ seals the tract

➢ inhibits migration of organisms into the catheter tract, minimizing the potential for infection

TYPES OF CVAD (9)

Groshong Catheter

- A translucent or blue silicone, thin walled, blunt tipped, cuffed skin – tunneled catheter.
- The line has a radiopaque stripe and an attachable suture wing.
- The line has a patented three-position valve, which prevents the need for a clamp.
- Available in colour coded single and double lumen. The red lumen is used for blood sampling.
- Heparin solution is not required when flushing

TYPES OF CVAD (10)

Hemostar Catheter

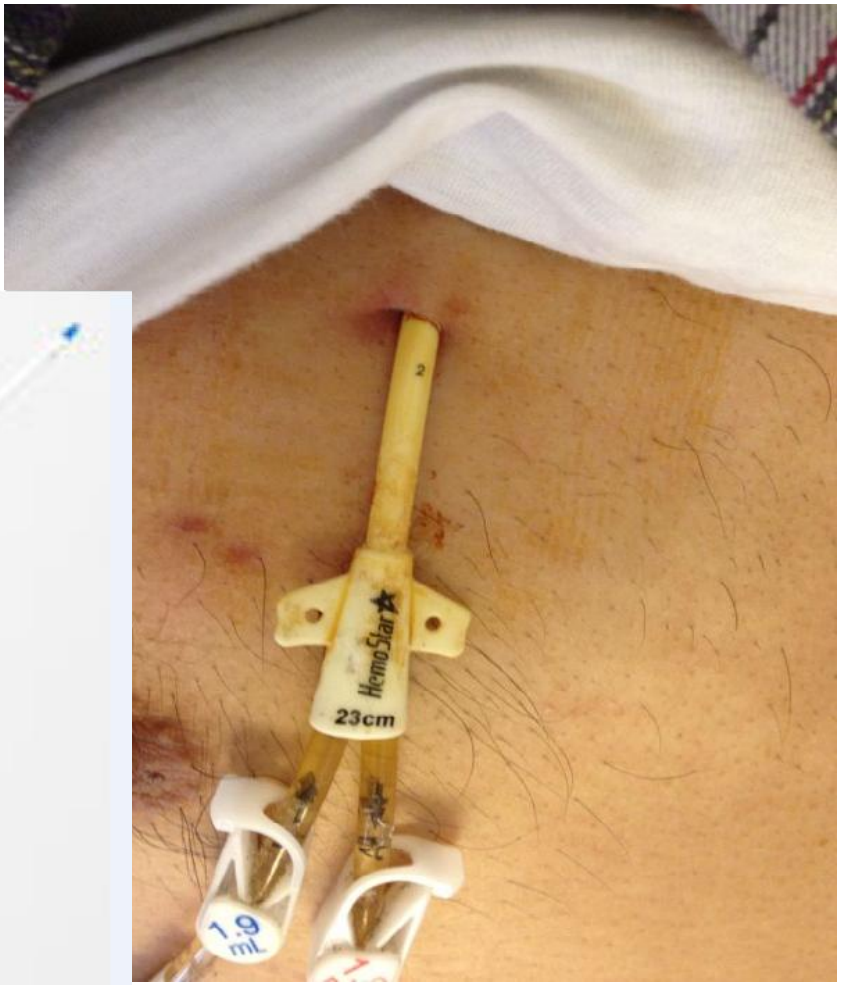
- **Purpose** – for Stem cell Harvesting and undergoing Autologous Peripheral Stem Cell Transplantation
- Long-term Hemodialysis tunneled Catheter (more rigid)
- Radiopaque polyurethane material with retention cuff
- Priming volume of 2-lumens are 1.8ml and 1.9 ml
  - discard more than 5ml blood before taking sample

TYPES OF CVAD (11)

Hemostar Catheter (cont'd)

- Allow for flow rates 500ml / min
- Acetone and PEG-containing ointment can cause failure of this device
- Alcohol or alcohol-containing antiseptics can be used to clean the catheter / skin site, but avoid prolonged or excessive contact.
- Use non alcohol containing antiseptics such as Povodine-iodine lotion for blood culture

HAEMOSTAR CATHETER



INSERTION OF CATHETER (1)

- Perform in Operating theatre or Radiotherapy Department
- A strict aseptic minor surgical procedure under X-ray or ultrasound guidance
- Usually under Local anaesthetic, administer on venous entry site and along the pathway for subcutaneous tunnel
- sometime M.A.C. for complicated condition
- G.A. is rare (except for severe psychological problem)

INSERTION OF CATHETER (2)

Preparation

- Check and correct clotting profile
- Antibiotic cover (Cephazolin or Clindamycin)
- Platelet concentrate topping up (keep > 50 x 10^9 /L)

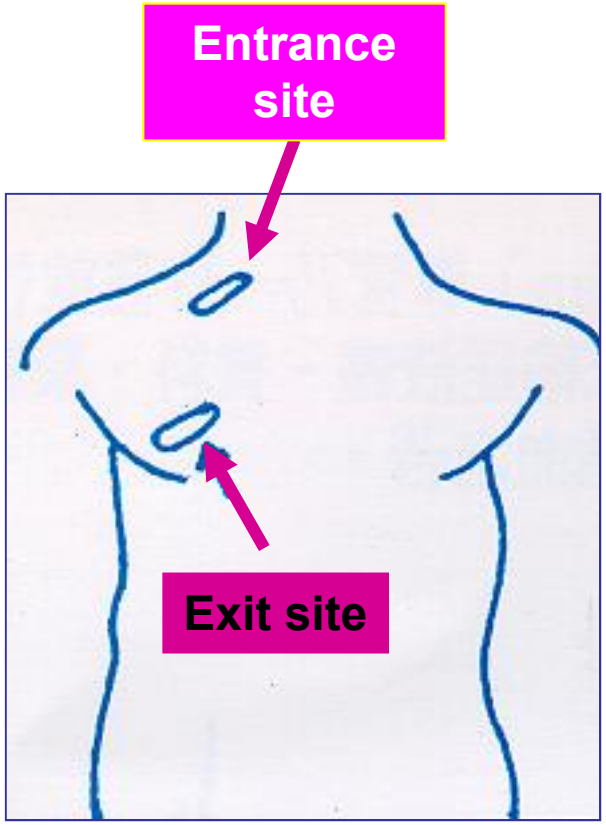
Consult Vascular team if

- More than 1 episode of previous insertion
- Very low platelet count (< 20 x10^9/L)
- Low neutrophil count (ANC < 1.0 x10^9/L)
- Suspicious SVC obstruction by solid tumour

INSERTION OF CATHETER (3)

two small incisions

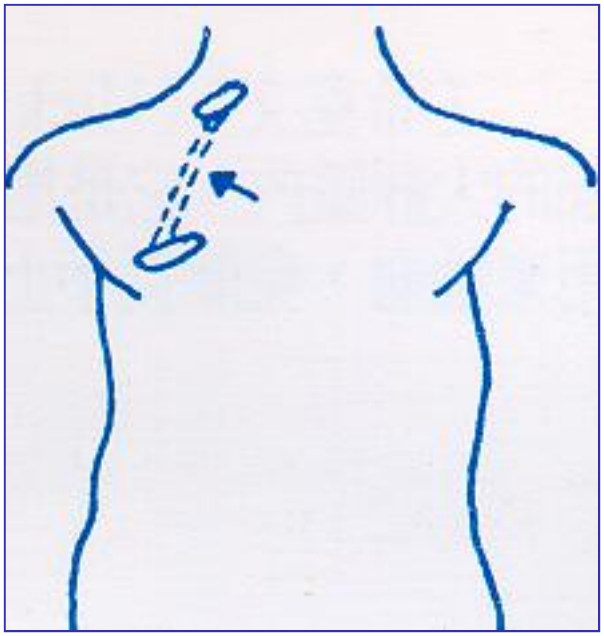
- upper chest near the neck by isolating the vein chosen for insertion of the catheter (entrance incision site)
- lower on the chest (exit site)



INSERTION OF CATHETER (4)

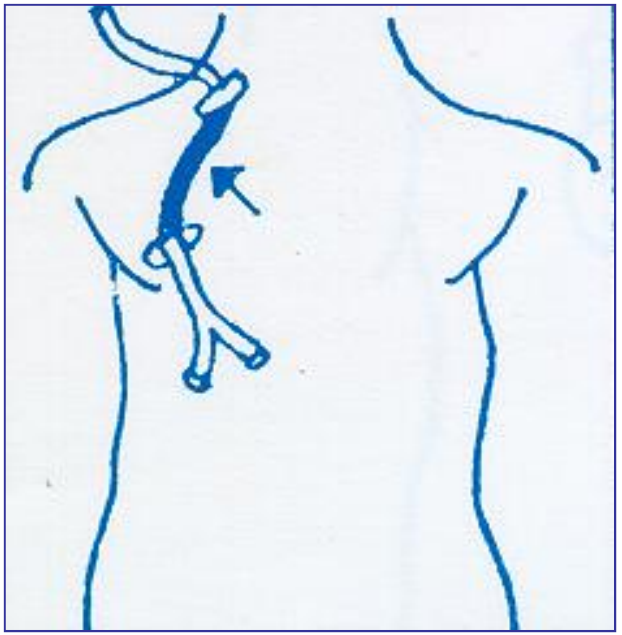
Subcutaneous tunnel

- just under the skin in between these two incisions



INSERTION OF CATHETER (5)

- Insert the catheter into the incision at the exit site
- Pull the catheter through the tunnel



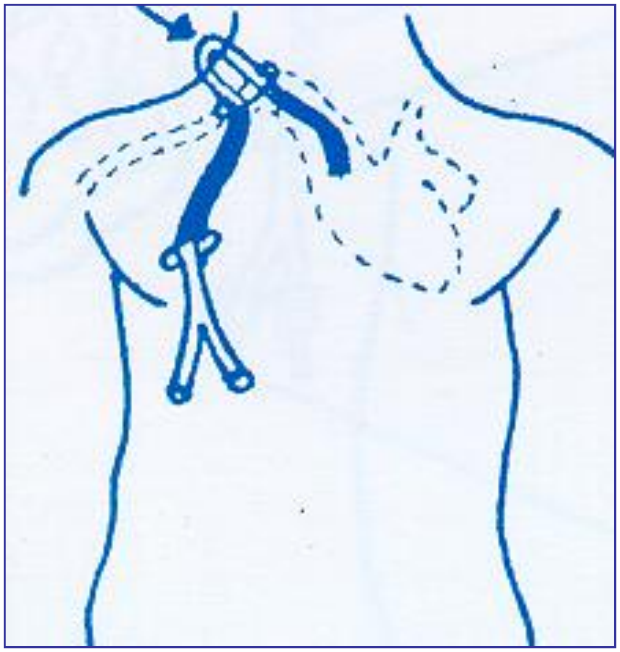
INSERTION OF CATHETER (6)

Position the Dacron cuff in the tunnel

- recommend tunnel to be 4 - 6 inches
- Dacron cuff rest approximately mid-way between the point of exit and the entrance site

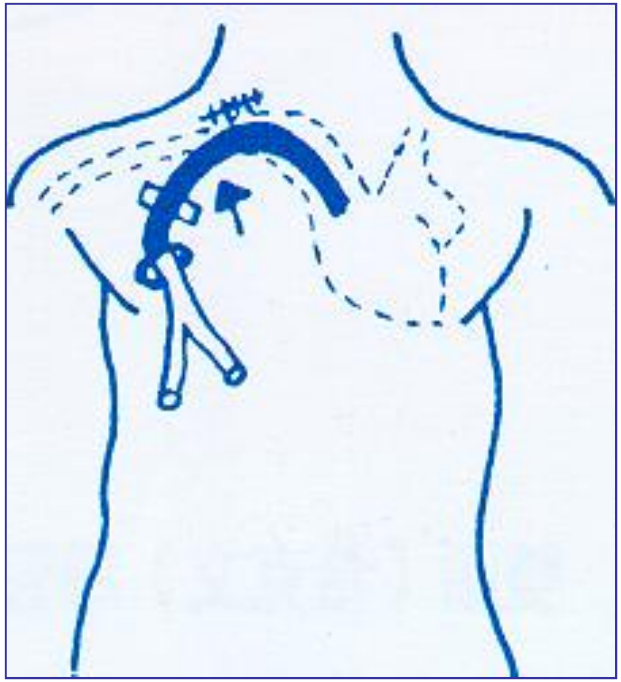
INSERTION OF CATHETER (7)

- Trim and flush the catheter
- Insert the clamped catheter then into the selected vessel through the entrance site



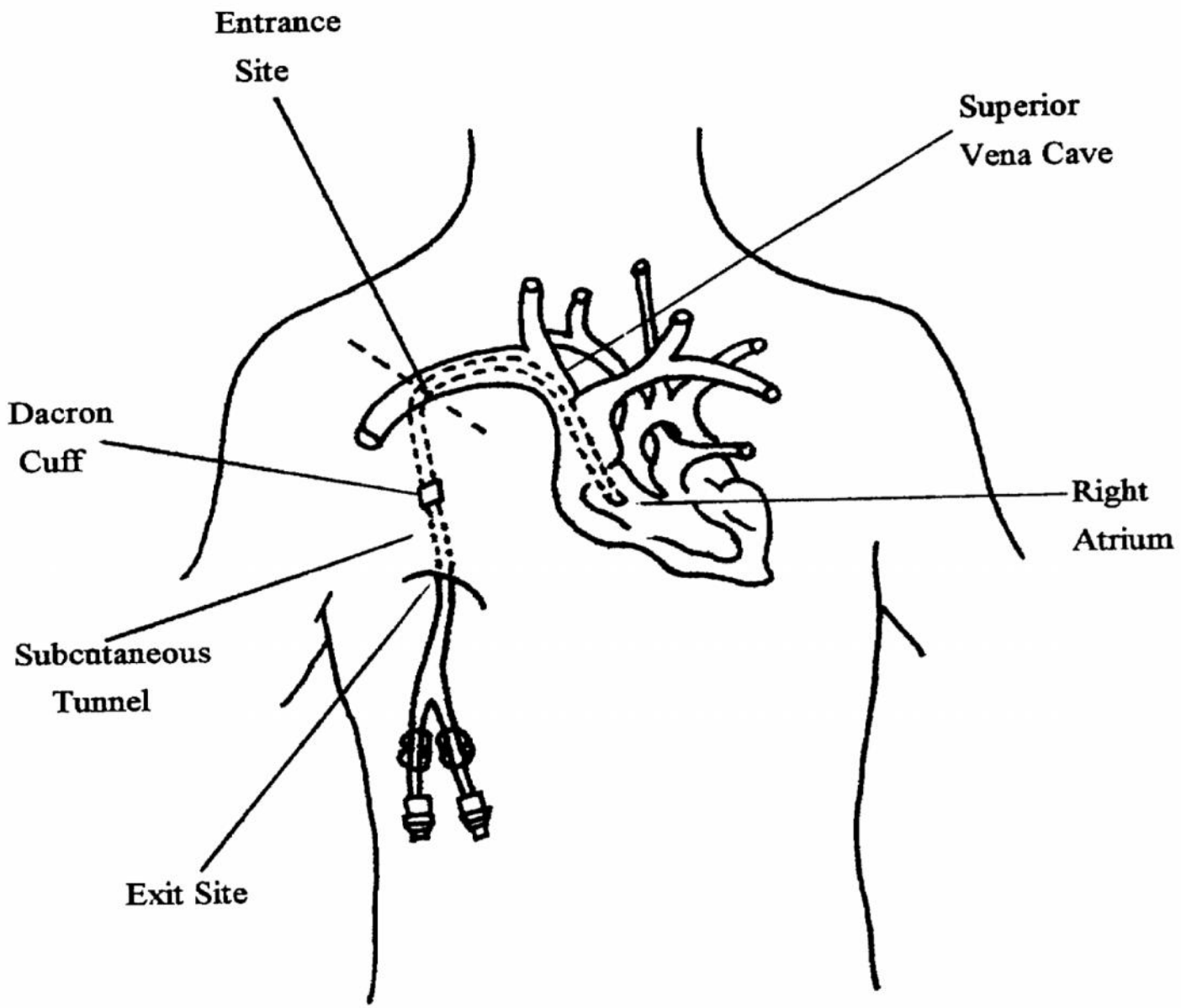
INSERTION OF CATHETER (8)

- Continue advance the catheter under flouroscopy to the junction of the superior vena cava and right atrium
- Unclamp catheter and draw blood through the lumens to insure patency



INSERTION OF CATHETER (9)

- Irrigate catheter lumens with normal saline and then heparinized saline
- Clamp catheter and attach injection caps
- Confirm catheter placement in ward (after insertion) before administration of IV fluids or drugs by
  - **radiograph**
  - **blood withdrawal**


Entrance
Site
Superior
Vena Cave
Dacron
Cuff
Right
Atrium
Subcutaneous
Tunnel
Exit Site

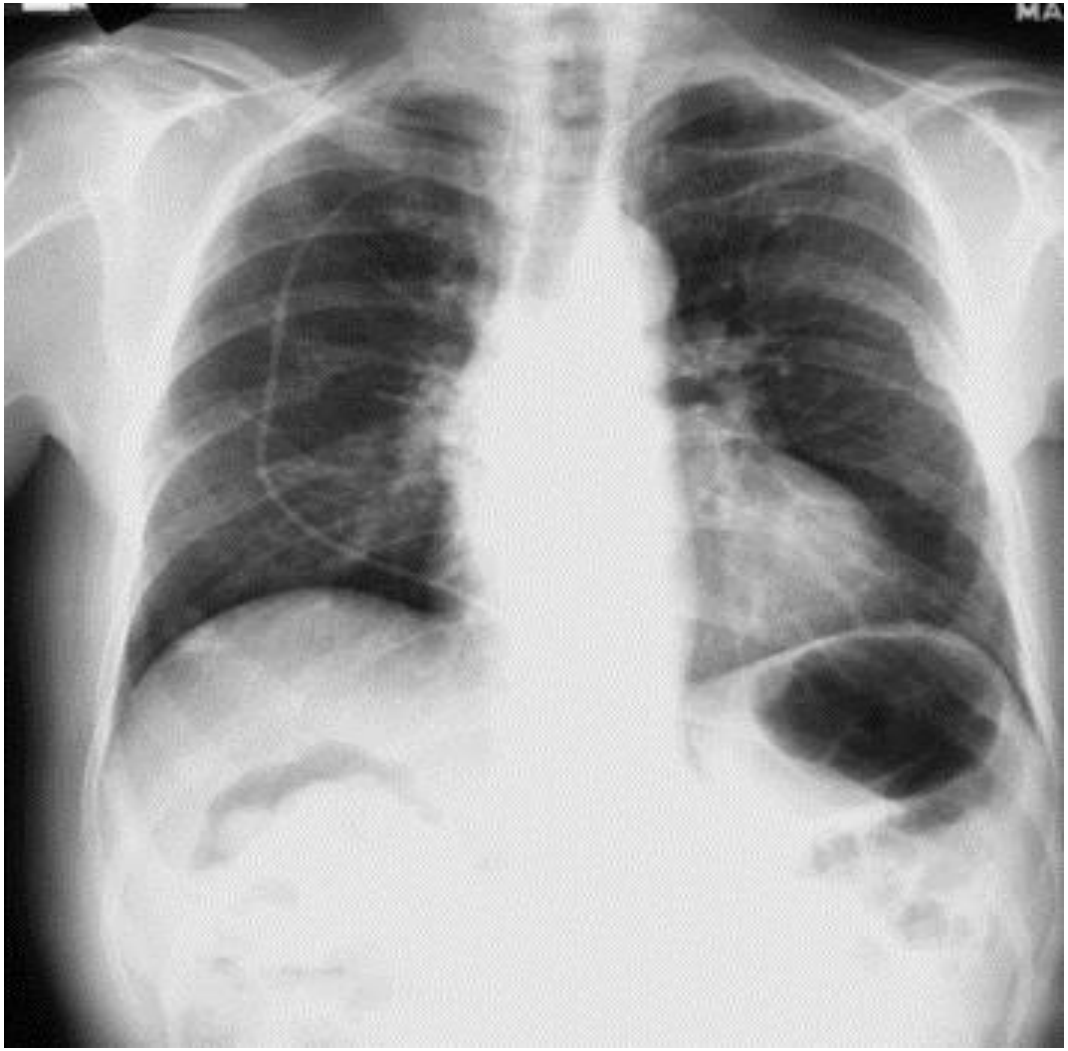
POSSIBLE COMPLICATIONS (1)

- Risks associated with anesthesia, surgery (e.g. bleeding, infection, pain) and postoperative recovery
- Exit site necrosis, haematoma
- Sepsis or infection
- Catheter malposition, occlusion, fibrin sheath formation at tip, dislodgement, or rupture
- Catheter or cuff erosion through skin

POSSIBLE COMPLICATIONS (2)

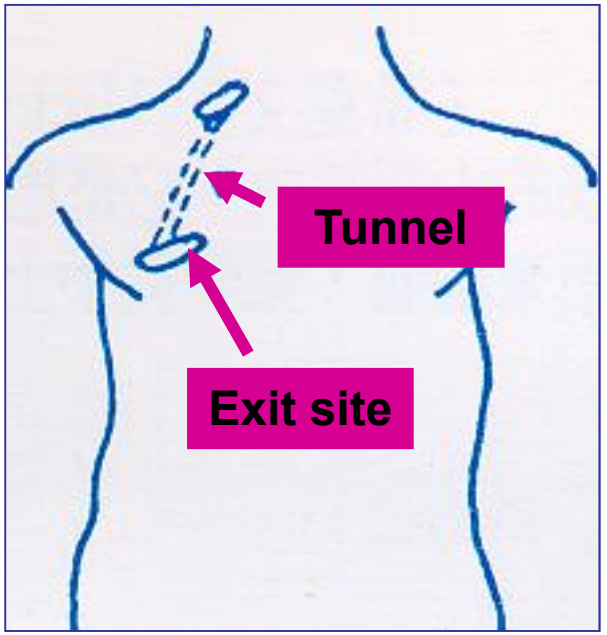
- Vascular thrombosis
- Embolus, thrombophlebitis
- Pneumothorax, haemothorax
- Perforation or laceration of vessels or viscus, brachial plexus injury
- Cardiac tamponade, endocarditis, cardiac arrhythmia
- Intolerance reaction to implanted device

POSSIBLE COMPLICATIONS (3)



INFECTION
DEFINITION (1)

- Exit site infection
  - erythema, tenderness induration, or purulence within 2 cm of the skin at the exit site of the catheter
- Tunnel infection
  - erythema, tenderness, induration in the tissues overlying the catheter and > 2 cm from the exit site



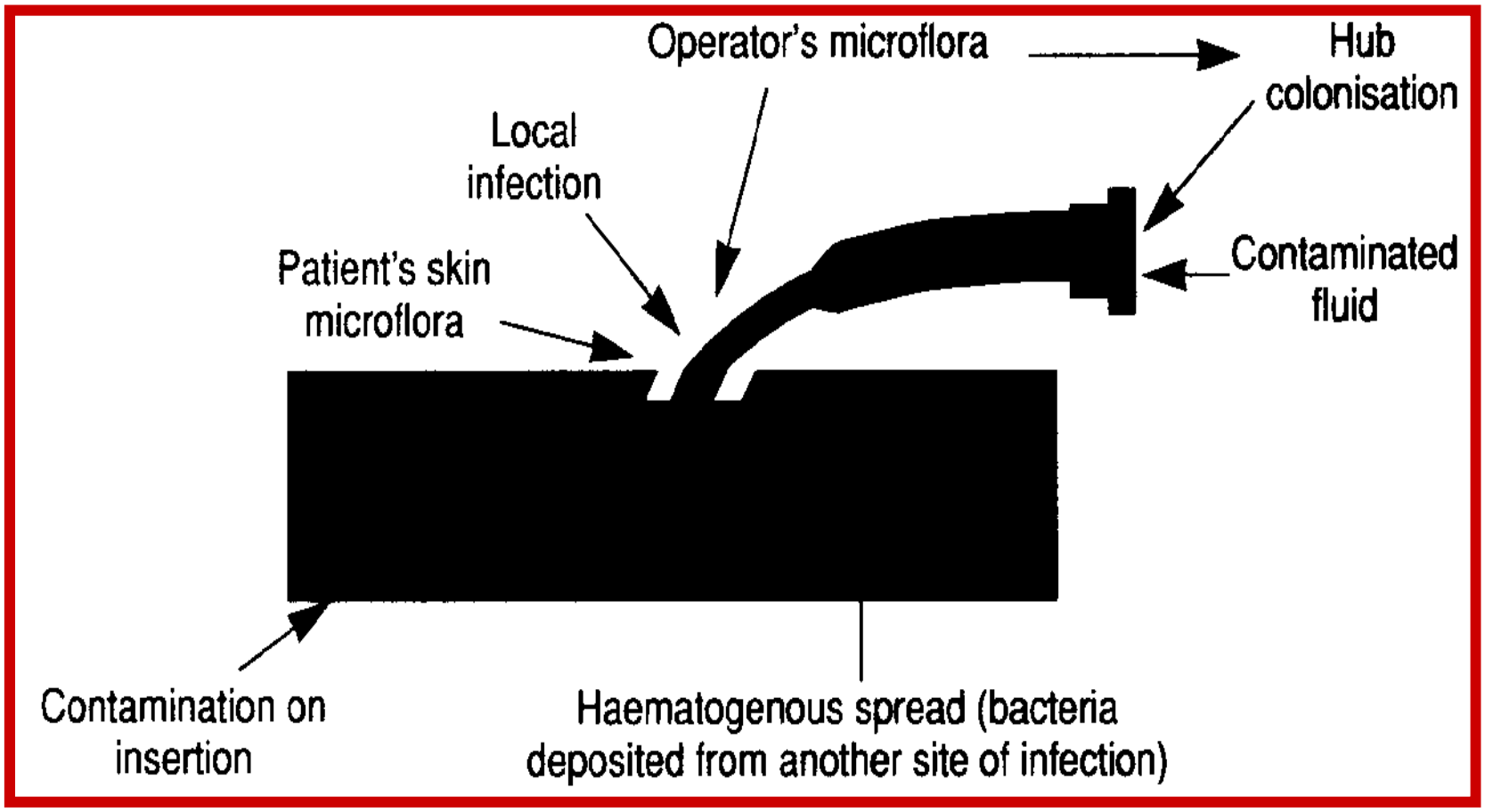
INFECTION
PATHOGENEISIS (2)

- Migration of skin organisms at the insertion site into the cutaneous catheter tract with colonization of the catheter tip
  - poor skin preparation, breach in aseptic technique
    - wound contaminated ➡ subdermal infection ➡ spreads along the subcutaneous tract surrounding the catheter and reaches the tip

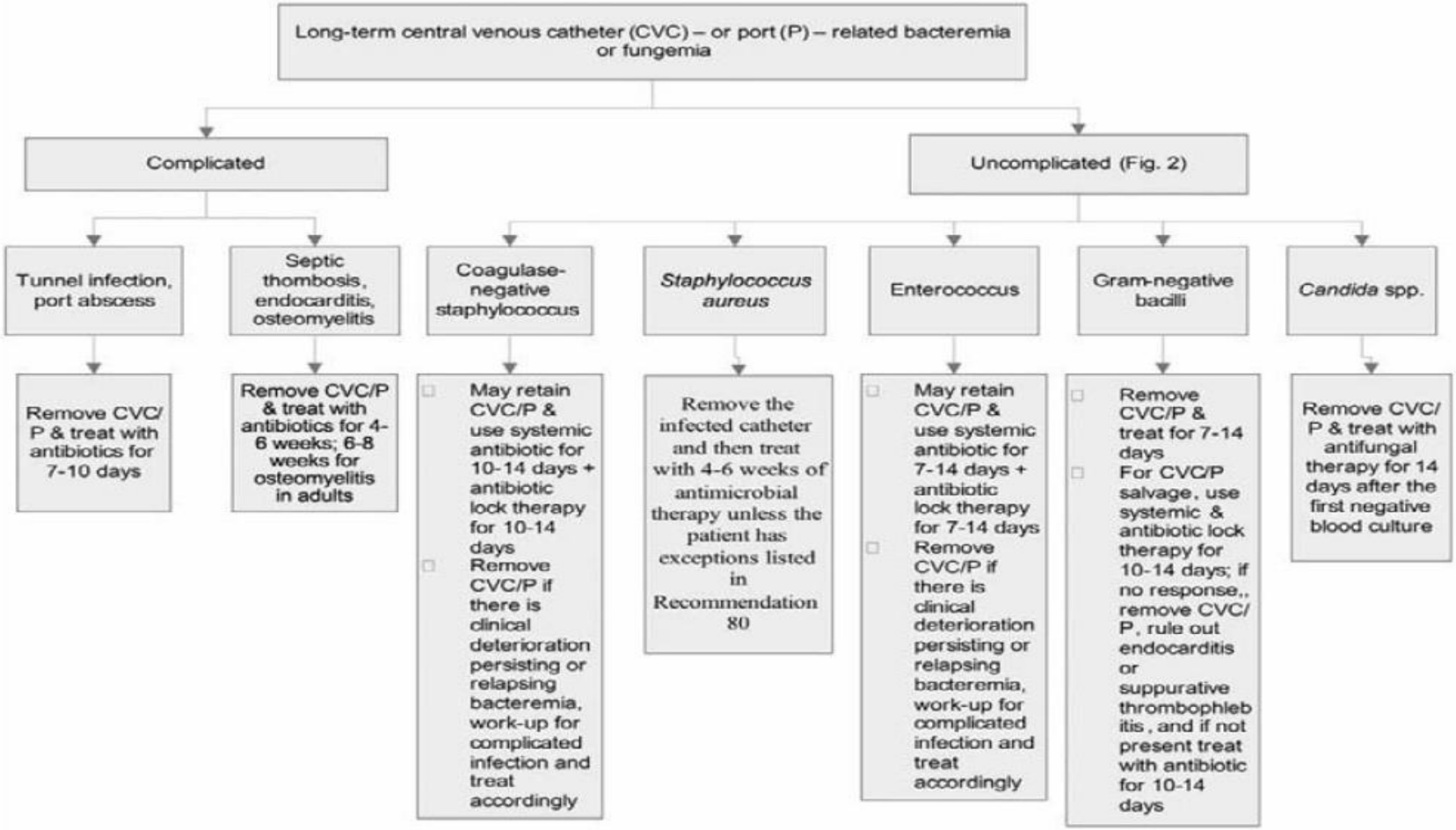
INFECTION
PATHOGENEISIS (3)

- Contamination of the catheter hub
  - ➡ intraluminal colonization of catheter
- Hematogenous seeding of the catheter tip from a distant focus of infection
  - infection exist prior to catheter insertion
  - secondarily infected from another source in the body
- Administration of contaminated infusate

INFECTION
PATHOGENEISIS (4)



INFECTION
PATHOGENEISIS (5)



Approach to the treatment of a patient with a long-term central venous catheter (CVC) or a port (P)-related bloodstream infection.

Clinical Practice Guideline for the Diagnosis and Management of Intravascular Catheter-Related Infection: 2009 Update by the Infection Diseases Society of America (CID 2009:49 , 1 July)

INFECTION
MANAGEMENT (6)

Sepsis Workup

- Blood culture from all lumens and peripheral blood with aseptic technique using 2% Chlorhexidine Gluconate Solution in 70% Alcohol
- Wound swab for culture
- CXR
- Specimens collection e.g. urine; sputum
- GI symptoms: haemorroid; diarrhoea
- Start broadspectrum antibiotics ASAP

INFECTION
MANAGEMENT (7)

Exit site infections

- daily exit site care
- normalization of neutrophil count
- antibiotics therapy
- resolve without catheter removal

Tunnel-related infections

- require removal of the device
- antibiotics therapy

PREVENTION

- Hand hygiene
- Aseptic non-touch technique
- Site care
- Hub care
- Education

HAND HYGIENE (1)

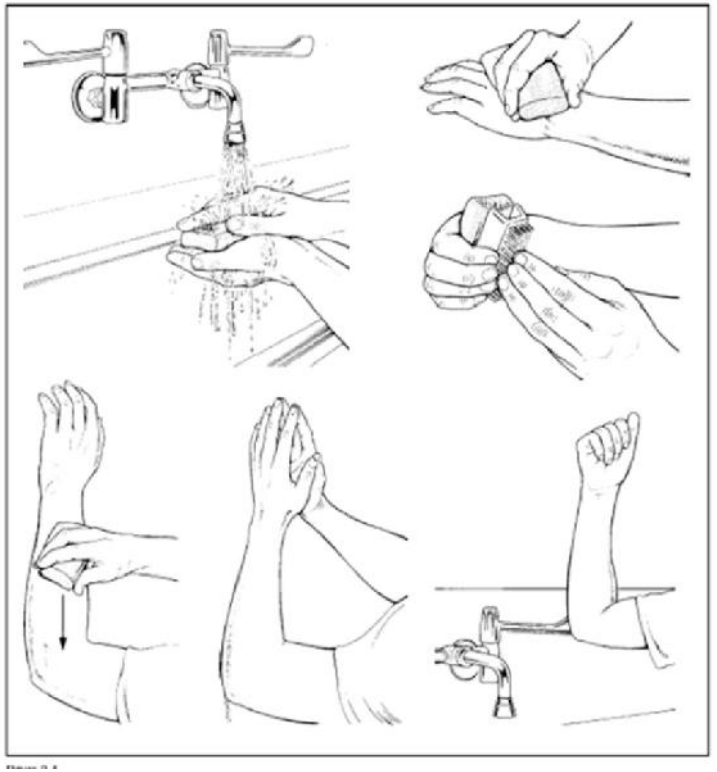
- Wash hands thoroughly with antimicrobial soap and water
  - before and after
    - dressing
    - accessing the intravascular device
  - after gloves removal

- Handwashing procedure should take at least 20 seconds
  - wet hands with running water

HAND HYGIENE (2)

Handwashing procedure

- apply antimicrobial soap in the middle of the wet hands and lather well
- use vigorous friction
  - rub the hands together
  - pay attention to nail beds and the webs between the fingers and thumbs



- rinse hands thoroughly with water and leave water running, pat hands dry with paper towel, turn water off with the paper towel

HAND HYGIENE (3)

Alcohol-based Handrub

- Preferably use an alcohol-based handrub for routine hand antisepsis in all clinical area
- Apply a palmful of the product and cover all surfaces of the hands.
- Rub hands until hands are dry.

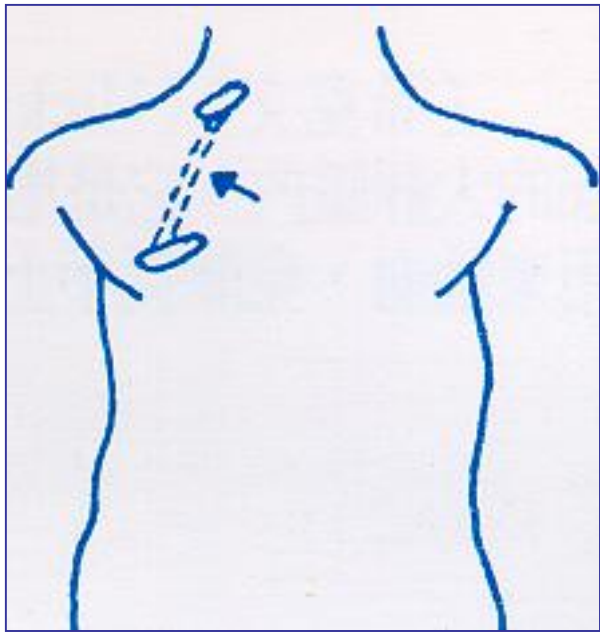
ASEPTIC NON-TOUCH TECHNIQUE

- Put on non-sterile latex gloves after handwashing
- Do not touch the key parts with the non-sterile latex gloves such as needles, syringe tips, exposed central line lumens

CATHETER SITE CARE (1)

Entrance incision site

- keep dressing intact for 72 hrs
- then change dressing and further keep it intact till off stitches on day 7 - 10 post-operatively



Exit site

- keep dressing intact for 72 hours
- then change dressing twice weekly till off stitches on day 21 - 30 post-operatively

CATHETER SITE CARE (2)

During the intact period

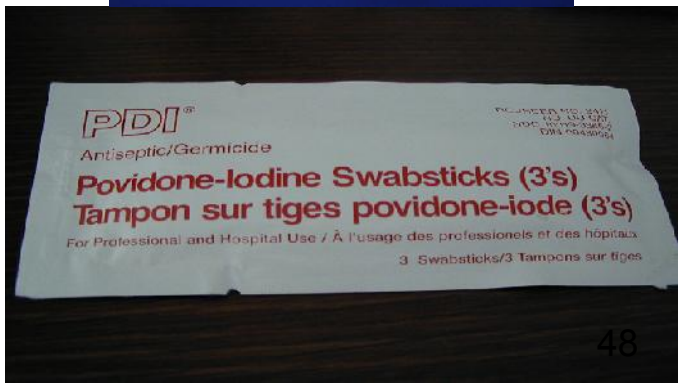
- persistent oozing: apply pressure dressing
- dressing change if it is heavily soiled, damped or loosened
- palpate around the site for tenderness daily through the intact dressing
- visually inspect the site if there is tenderness at the site, fever without obvious source or symptoms of infections
- daily dressing if line infection is suspected

CATHETER SITE CARE (3)

CATHETER SITE CARE (4)

Dressing changes

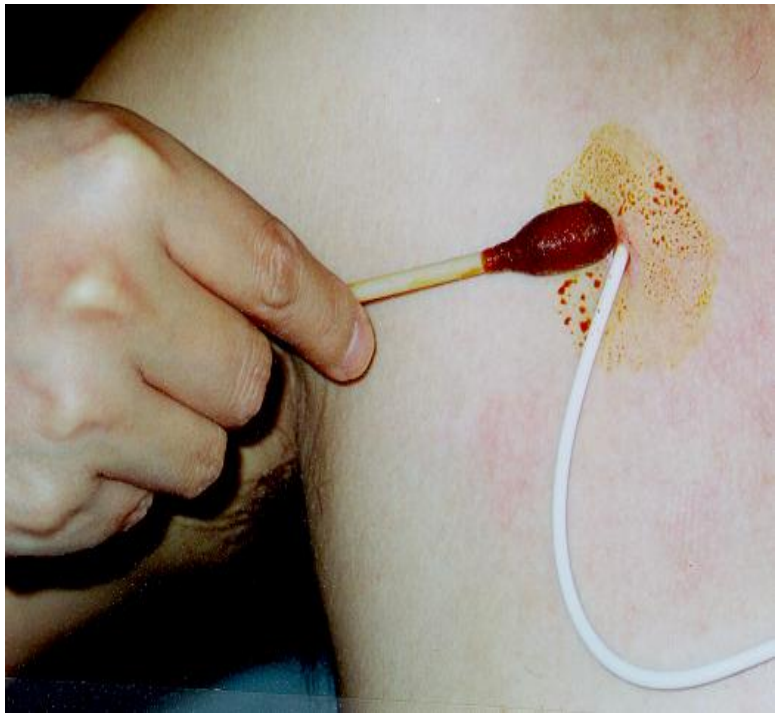
- wash hands thoroughly
- no masking but refrain from talking
- inspect any site abnormality and cleanse the site with 2% Chlorhexidine Gluconate Solution or Povodine-iodine lotion (stitches on, cuff exposed, or signs of site infection)



CATHETER SITE CARE (5)

Dressing changes

- Exit Site
  - hold the catheter up
  - starting at the exit site, cleanse in a circular motion moving from the innermost to the outermost
  - never return back to the exit site with the same swabstick
  - Repeat for 2 times



CATHETER SITE CARE (6)

Dressing changes:

- Clean the skin from the exit site up to 5 cm around the exit site in a circular motion for at lease 3 times

CATHETER SITE CARE (7)

Dressing changes

- Wipe the part of the catheter that will cover with dressing material with antiseptic in
- 3 aspects (Anterior, Posterior & Lateral)
- allow antiseptic to air dry

CATHETER SITE CARE (8)

Dressing changes

- apply semi-occlusive dressing
- coil and secure the catheter over dressing

CATHETER SITE CARE (9)

When stitch is off, exit site is healed with no abnormality

- wipe the exit site with alcohol wipe after shower
- Povidone-iodine swab can still be used
- no dressing is needed unless patient requires

CATHETER HUB CARE (1)

Catheter hub

- improve tightness of the catheter-tubing junction, but not to prevent endoluminal bacterial contamination
  - adequately cleaned before they are accessed or removed to prevent bacteria from gaining access into the lumen

    (commonest cause of catheter-related septicaemia was due to a catheter hub becoming colonized by microorganisms)

CATHETER HUB CARE (2)

Catheter flushing

- wash hands thoroughly
- put on non-sterile latex gloves
- prepare irrigants and syringes

CATHETER HUB CARE (3)

Catheter flushing

- swab the junction of the catheter with the luer lock cap thoroughly (~ 6-8 times)
- Repeat 3 times with a new alcohol prep one at a time

CATHETER HUB CARE (4)

Catheter flushing

- ensure catheter clamp is closed
- disconnect the luer lock cap
- swab the hub thoroughly 3 times with a new alcohol prep one at a time and allow to air dry

CATHETER HUB CARE (5)

Catheter flushing

- connect an empty syringe onto the hub
- release clamp
- withdraw 5 ml blood to clear the catheter

  (3 times of the priming volume)
- Re-clamp catheter

CATHETER HUB CARE (6)

Catheter flushing

- remove and discard blood syringe
- swab the hub
- Connect 10ml syringe with NS

Do not use a syringe less than 10 ml in capacity as the pressure created will damage or split the line.

- release clamp and clear the catheter thoroughly with a rapid push-pause technique

CATHETER HUB CARE (7)

PUSH-PAUSE TECHNIQUE

- Pushing 1ml at a time for 10ml normal saline into a catheter
- to create turbulent flow within the lumens
- decrease the risk of fibrin and platelets becoming adhered to the internal walls of the CVAD
- minimizing the risk of occlusion

CATHETER HUB CARE (8)

Catheter flushing

- re-clamp catheter and remove NS syringe
- connect a 10ml syringe with 5ml heparinized saline (50 iu / 5ml) onto the catheter
- release clamp and inject heparinized saline into the catheter lumens

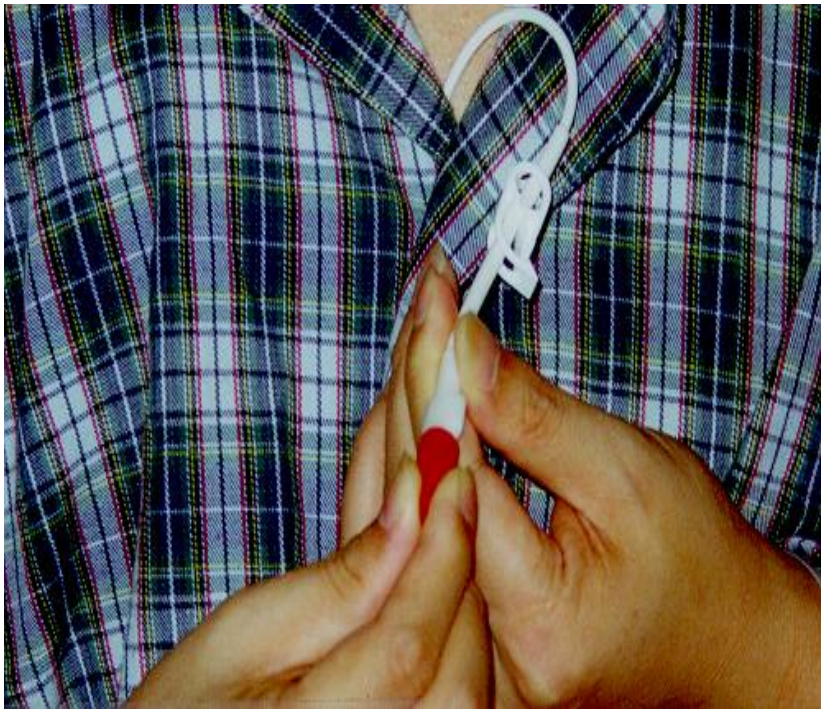
CATHETER HUB CARE (9)

Catheter flushing

– clamp the catheter while maintaining pressure when the plunger reaches the last 0.5ml HS in the syringe

CATHETER HUB CARE (10)

Catheter flushing



- re-clamp and remove the irrigant syringe
- swab catheter hub with alcohol prep
- allow to air dry, connect new cap
- tape catheter in position and documentation

CATHETER HUB CARE (11)

END CAP

Luer lock Cap

- Sterile and for single use, attached to the end of the catheter,
- risk of air embolism and accidental disconnection

CATHETER HUB CARE (12)

END CAP

Needleless intravascular devices

Bionector ~ PosiFlow

- Close needle less system, attached to the end of catheter
- Must be changed after one hundred uses or every seven days, whichever is sooner
- minimize infection by frequent exposure
- Change with aseptic technique
- Change whenever blocked or soiled

CATHETER HUB CARE (13)

VALSALVA MANOEUVRE

- Patient placed in the supine or tredelenberg position, which increases venous filling.
- Ask patients to breathe in and then tries to force the air out with the mouth and nose closed (i.e. against a closed glottis).
- This increases the intra-thoracic pressure so that the return of blood to the heart is reduced momentarily.

CATHETER HUB CARE (14)

Administration of IV fluid and Medication(1)

- Check patency before use
- Cleanse as per protocol
- Apply bionector for frequently used catheter hub
- Avoid unnecessary 3-way adaptor
- Administration sets in continuous use need not be replaced more frequently than at 72-hour intervals unless they become disconnected or a catheter-related infection is suspected

CATHETER HUB CARE (15)

Administration of IV fluid and Medication(2)

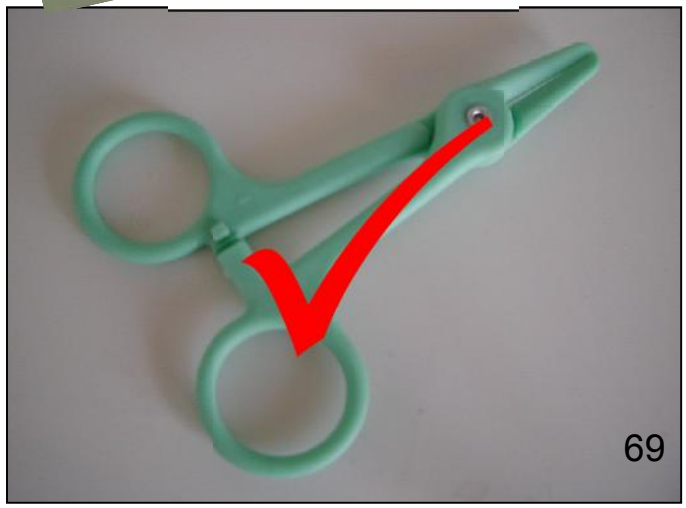
- Administration sets for blood and blood components should be changed every 12 hours
- If a multi-lumen catheter is used, one port must be exclusively dedicated for Total Parenteral Nutrition (TPN).
- Change tubing used to administer TPN within 24 hours of initiating the infusion.

EDUCATION (1)

Catheter handling and care

- sharp-edged instruments should never be used near the catheter

- only smooth-edged clamp or forcep should be used to clamp the catheter



EDUCATION (2)

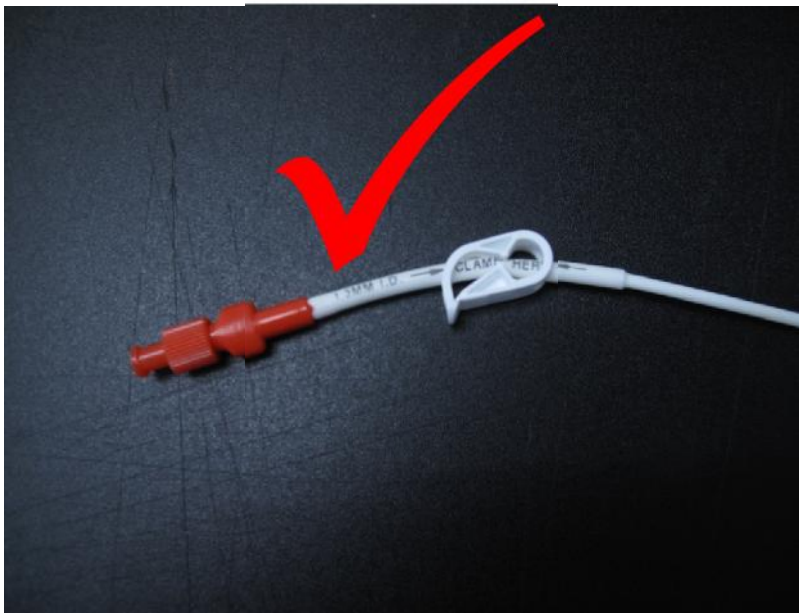
Catheter handling and care

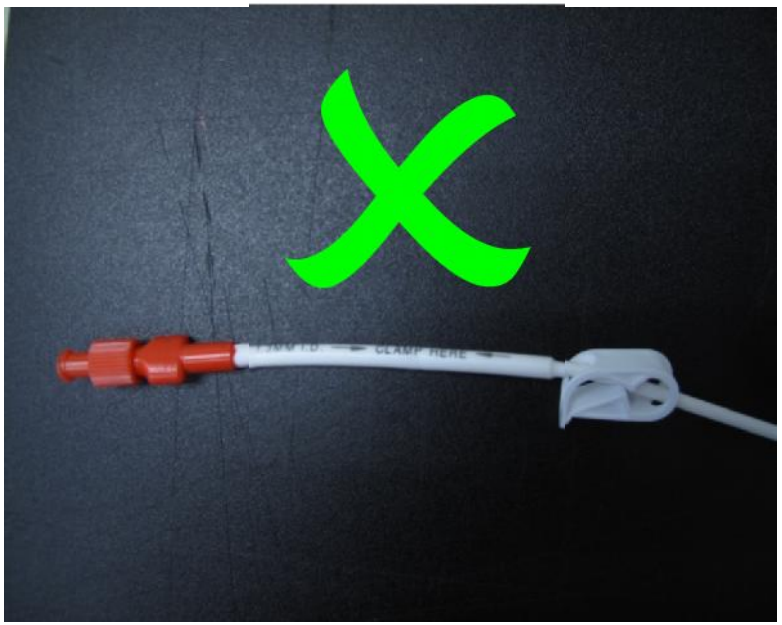
- secure catheter over chest to prevent catheter pulling or accidental dislodgement

EDUCATION (3)

Catheter handling and care

– clamp the catheter on the clamping sleeve





EDUCATION (4)

Catheter handling and care

- never use a syringe with capacity of less than 10ml with a CVAD as the pressure created will damage or split the line.
- A 3 pound force on the plunger of a 3 ml syringes generate pressure in excess of 30 psi (206 kpa) whereas 10ml syringe generates less than 15 psi (103 kpa) of pressure
- heparin lock each catheter lumen at least once weekly

EDUCATION (5)

Prepare for shower

- cover dressings if needed
- cover the catheter leg and cap with plastic bag
- tape the catheter over the chest in a ‘U’ shape

EDUCATION (6)

- Shower with antiseptic lotion containing ingredient ***TRICLOSAN***

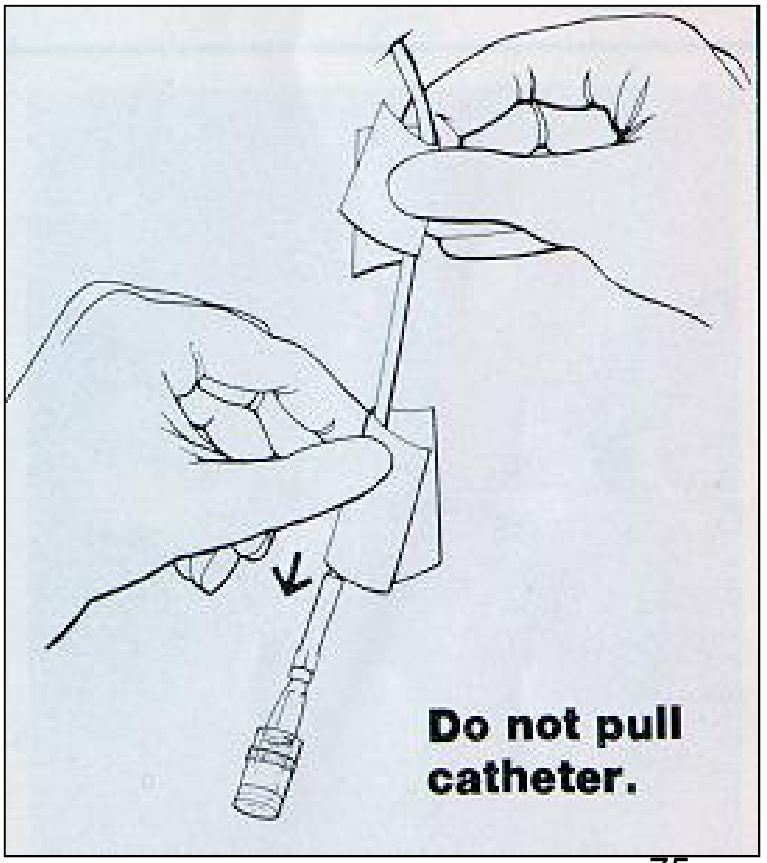
  e.g Microshield T; Dettol; Manning or Oilatum antiseptic cleanser

- After shower
  - mop skin dry with a clean towel (wash and dry daily after use, iron is needed only if there is not much sunshine to dry the towel and if patient is neutropenia)

EDUCATION (7)

After shower

- remove the bag
- use alcohol prep to wipe the catheter
- continue exit site care
- notify nurses / doctors of any abnormalities



EDUCATION (8)

Emergency Management

1. **<u>Suspected catheter leakage or break:</u>**

   Clamp the catheter with non-toothed forceps as close to the skin as possible and seek medical aid

2. **<u>Suspected catheter slippage:</u>**

   Secure catheter / control bleeding and seek medical aid

3. **<u>Catheter slipped out:</u>**

   Stop bleeding over entrance / exit site and seek medical aid

EDUCATION (9)

4. **Oedema / tenderness of neck, arm and shoulder of the same side of the catheter:**

   Ensure the clamp is closed and seek medical aid immediately

5. **Chest pain with cyanosis (emergency)**

   Make sure the catheter clamp is closed, lie on left side with head down.

Advice the relative to call ambulance and seek medical aid immediately

CATHETER OCCLUSION (1)

Intraluminal occlusion ➡ *complete obstruction*

THROMBUS: *not flush properly*

- cleared easily by flush gently with normal saline or heparinized saline in a 10 to 20ml syringe
- if unsuccessful may need thrombolytic agent

DRUG PRECIPITATE: *administer incompatible drugs*

- cannot be cleared easily
- can try with hydrochloric acid and ammonium chloride

CATHETER OCCLUSION (2)

- Extraluminal obstruction

  ➡ *complete obstruction to withdrawal occlusion*

  – **FIBRIN SHEATH**: *collect when catheter enters the vein*

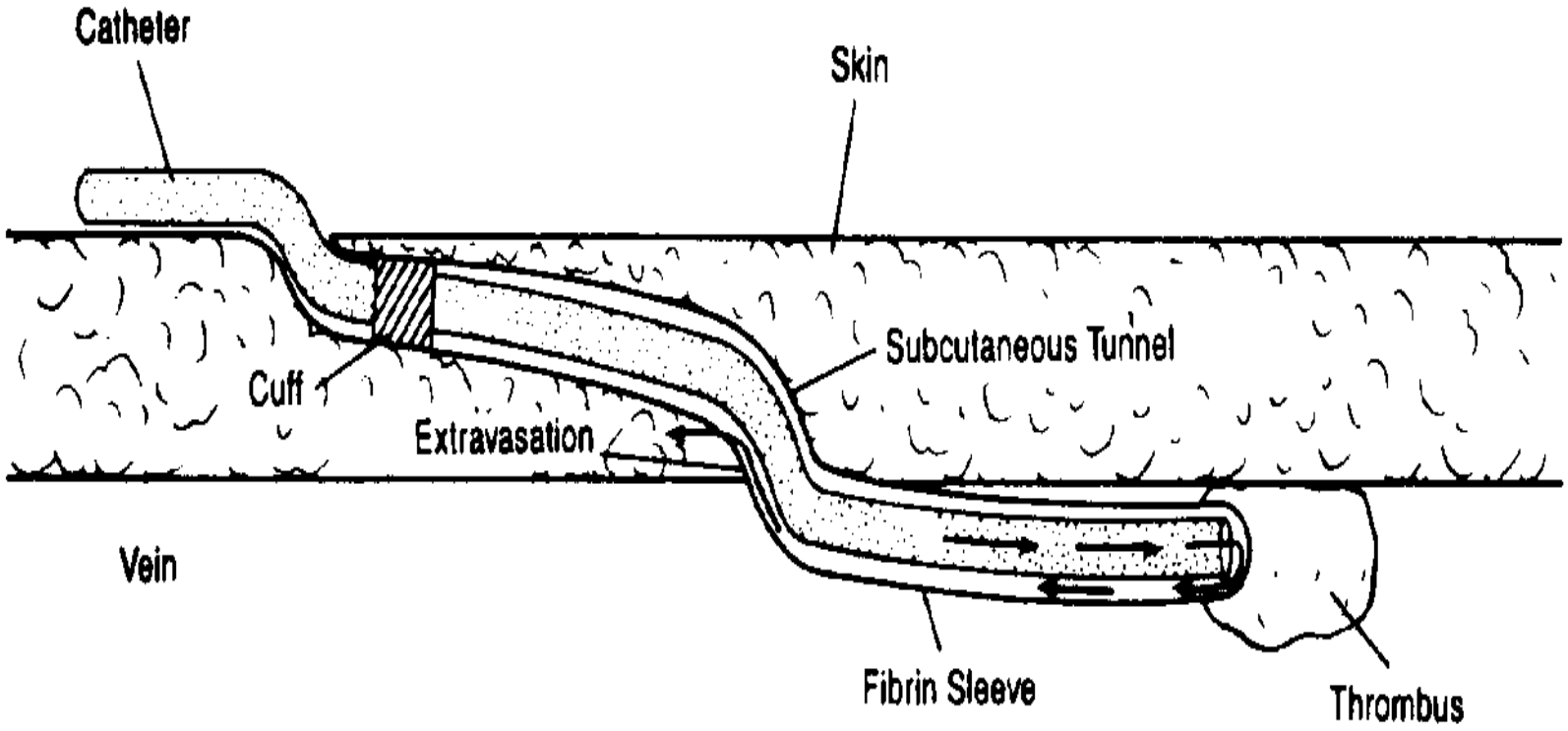
    - complete occlusion if extend around the whole catheter: resolved by fibrinolytic therapy
    - withdrawal occlusion when collect at the catheter tip so creates a one-way-valve when negative pressure is exerted to draw blood
      – solved by repositioning patients or having them perform the Valsava maneuver

CATHETER OCCLUSION (3)

Extraluminal obstruction (ctd.)

- **Mural thrombosis**
  - starts with damage to the venous intima by the catheter or catheter tip with thrombus formed and adhered to the vessel wall leading to total venous obstruction
  - initiate treatment promptly with anticoagulant or fibrinolytic therapy

CATHETER OCCLUSION (4)



CLEARING BLOCKED CATHETER (1)

- **Stage I – infusion runs slowly**
  - aspirate clots with an empty 10ml syringe
  - still occluded ⇨ try irrigation and aspiration with a 20 ml syringe half filled with 0.9% NS
  - still unsuccessful ⇨ try heparinized saline
- **Stage II – above fails or the catheter has been blocked for over 2 hours**
  - instill 2 - 3 ml pure heparin (1000 units/ml) into the catheter gently, leave for an hour and try to aspirate the clots

CLEARING BLOCKED CATHETER (2)

Stage III – If Stage I and II have failed

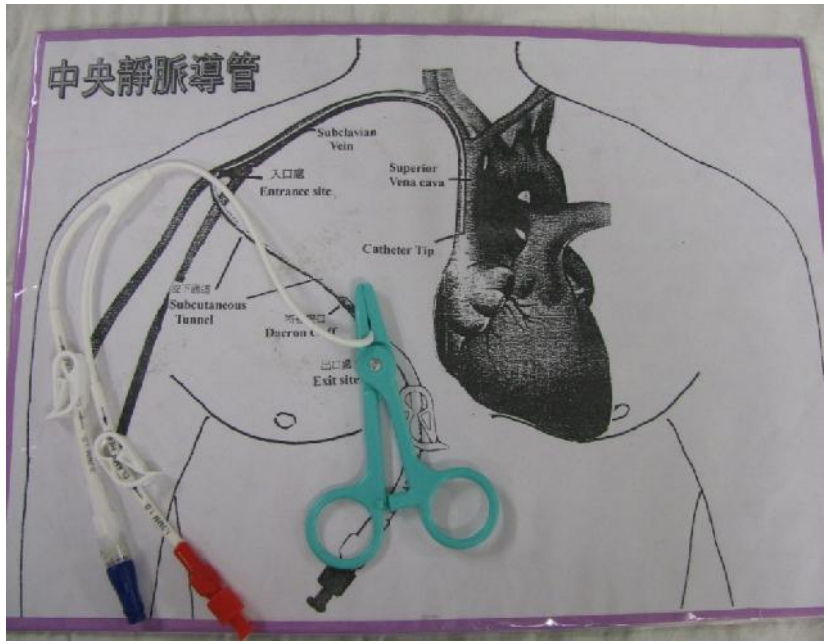
- confirm catheter position with Chest X-ray
- instill the urokinase solution (5000 / 6000 units urokinase in 2ml 0.9% NS) in a 10ml syringe with a gentle push-pull action
- leave for an hour and aspirate the urokinase solution and clot with an empty 10ml syringe
- if unsuccessful repeat the procedure
  - 3 times within 4 hour if platelet > 20 x 10^9/l
  - once only within 4 hour if platelet < 20 x 10^9/l

CATHETER DAMAGE

- rarely occurs during placement
- externally may sustain damage due to
  - excess pressure from syringes and pumps
  - sharp instruments near the catheter
- catheter repair is possible with repair kits
  - allow attachment of the new external segment
    - ➢For repair of the catheter body : requires at least **5cm** of undamaged catheter remaining from the skin exit site.
    - ➢For repair of the adapter leg: requires at least **2.5cm** of undamaged adapter leg remaining .

CATHETER REPAIR (1)

- treat any catheter damage immediately to prevent blood loss and / or air embolism
- clamp the catheter as close to the exit site with a smooth-edge clamp, and must remain clamp during repair



- place a sterile alcohol or povidine-iodine prep onto the broken portion of the catheter
- perform all procedures aseptically with sterile gloves and set

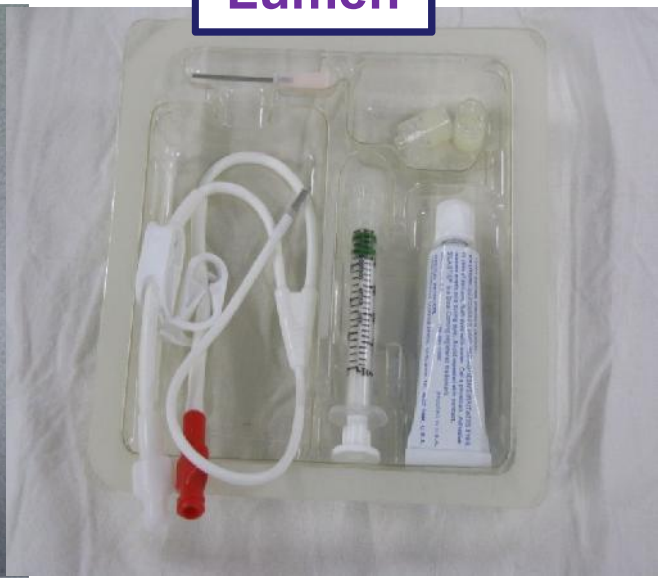
REPAIR KITs

- To choose an appropriate repair kit. (depends on the size and damaged part of the catheter)

RED LUMEN

WHITE LUMEN

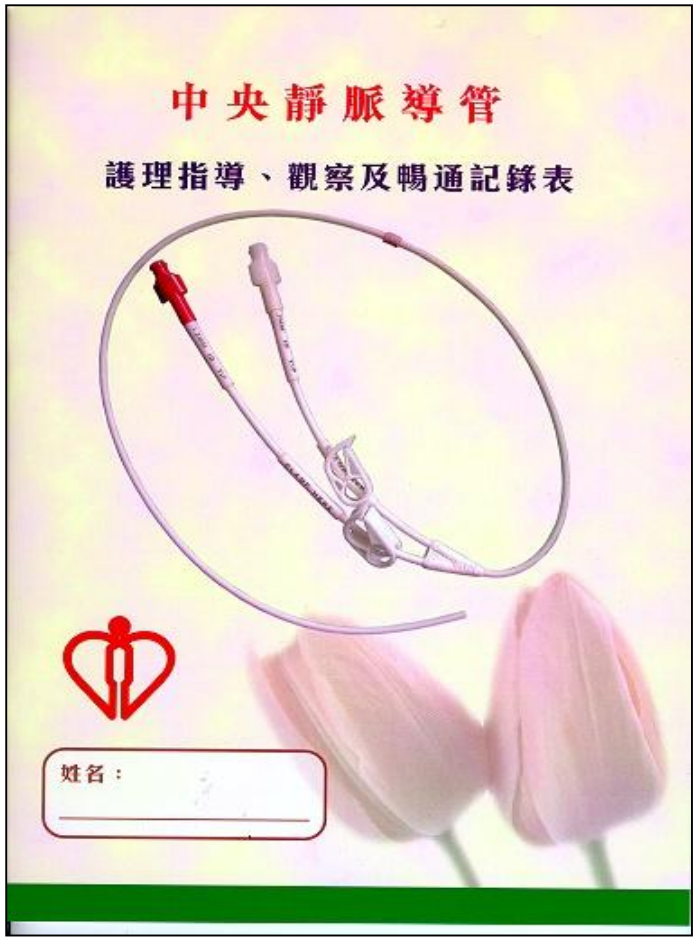
Double Lumen



CATHETER REPAIR (12)

- Simple procedure, requires care and patience
- Most important complication is cutting of the catheter and lead to catheter embolism
- Do not try to do it yourself unless you have received adequate demonstration and supervision before

CVC RECORD BOOKLET



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THANK YOU