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## **Complications of Central Venous Catheters**

**EPIDEMIOLOGY & DIAGNOSIS & PREVENTION**

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# CVC COMPLICATIONS EPIDEMIOLOGY & DIAGNOSIS & PREVENTION

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**Guidelines available on [www.evannetwork.info](http://www.evannetwork.info):**

British Committee for Standards in Haematology 2006

Center for Disease Control and Prevention 2002

EPIC 2007

GAVeCeLT 2007

IDSA 2001

National Institute for Clinical Excellence 2002

Royal College of Nursing 2005

Registered Nurses Association of Ontario 2004

ASPEN (JPEN 2002), ESPEN PN (Clin Nutr), Infusion Nurses Soc (J Inf Nurs 2006), SINPE (RINPE 2002)

# CVC COMPLICATIONS

## TOPICS

Complications due to the CVC  
maintainance (CRBSI and thrombosis)

- epidemiology
- diagnosis
- prevention

# Strength of Evidence

- A There is good research-based evidence  
(prospective, randomized trials)
  
- B There is fair research-based evidence  
(well designed studies without  
randomization)
  
- C The Guideline is based on expert  
opinion and editorial consensus

# CVC-RELATED INFECTIONS

## DEFINITION

- Colonization: growth of more than 15 cfu or more than  $10^3$  cfu at semiquantitative or quantitative culture of a segment of CVC in absence of clinical symptoms
- Local CVC-related infection: same criteria but with presence of local inflammation at the device site
  - Exit-site infection: inflammation within 2 cm of skin at the exit site of the CVC
  - Tunnel infection: inflammation overlying the CVC with distance of  $> 2$  cm from the exit site
  - Pocket infection: erythema and necrosis of the skin over the reservoir

# CVC-RELATED INFECTION

## DEFINITION

CVC-related bloodstream infection (CRBSI): isolation of the same organism (species and antibiogram) from cultures from CVC segments and peripheral blood in pts with clinical symptoms of bloodstream infection and no other apparent source of infection

# EPIDEMIOLOGY

- 200.000 and 5 millions long-term CVC inserted annually in UK and in USA, respectively
- 250000 to 500000 episodes of CRBS in USA annually, with a mortality rate of 12% to 25% and a prolongation of hospital stay by 10 to 40 days
- 25% of HPN pts has a complication which in half cases is infection and requires CVC removal in  $\frac{1}{4}$  of them (*Bozzetti 2002*)
- CRBSI rate:  $\sim 0.3$ /patient/year HPN (*Staun 2006*)

# MAJOR DIAGNOSTIC METHODS REQUIRING CVC REMOVAL

| Method   | Positivity      |
|--|-----------------|
| <ul style="list-style-type: none"><li>• Qualitative CVC segment culture</li></ul>      | Any growth      |
| <ul style="list-style-type: none"><li>• Semiquantitative CVC segment culture</li></ul> | $\geq 15$ cfu   |
| <ul style="list-style-type: none"><li>• Quantitative CVC segment culture</li></ul>     | $\geq 1000$ cfu |

# MAJOR DIAGNOSTIC METHODS NOT REQUIRING CVC REMOVAL

## Methods

- Qualitative blood culture through the CVC
- Quantitative blood culture through the CVC
- Paired quantitative blood cultures
- Differential time to positivity
- Acridine orange WBC cytology

## Positivity

Any growth  
 $\geq 100$  cfu/mL  
culture from CVC 3-5  
folds higher than from  
peripheral vein  
culture from CVC pos.  
 $\geq 2$  h earlier than from  
from peripheral vein  
visualization of any  
microorganisms

# DIAGNOSTIC METHODS

a meta-analysis of 51 studies showed that the paired quantitative blood culture is the most accurate test for diagnosis of CRBSI  
*(Safdar 2005)*

# PREVENTION

- Risk factors
- Team experience
- Type of catheters
- Site and technic
- Maintenance (dressing, skin/access care)

# PREVENTION

## RISK FACTORS in pts on Home Infusion Therapy (*Staun 2006*)

- Presence of stoma
- Advanced age
- Multilumen CVCs
- Previous CRBSI
- Recent BMT
- TPN
- Therapy outside home

# PREVENTION

## TEAM EXPERIENCE and SURGICAL CARE

- Proper education and specific training (adequate policy of hand washing)

**GRADE A** (*East 2005, EPIC 2005, Pronovost 2006*)

- Maintenance of maximal barrier precaution during CVC insertion

**GRADE B** (*CDC 2002, ASPEN 2002, EPIC 2007 SINPE 2002*)

# PREVENTION

## TYPE OF CATHETER (I)

- Teflon, silicone and PUR better than PVC and PE (*Maki 2006*)
- Single lumen usually preferable to multilumen CVC (**GRADE B**)
- Reserve one port exclusively for PN (**GRADE C**)

# PREVENTION

## TYPE of CATHETER (II)

Antimicrobial-coated CVC reduce CRBSI, and they are recommended in short-term PN in clinical setting with high frequency of CRBSI despite proper care of CVC.

**(GRADE A)** (*EPIC 2007, Hockenhull 2006, Maki 2006*)

## PREVENTION

### SITE and TECHNIC (I)

- Non-tunnelled CVC in Subcl Vein have “probably” lower risk than PCCs in antecubital area, in Jug vein, in femoral vein respectively (*CDC 2002, Deshpande 2005, Lorente 2004*).
- The recommended approach is the infra or supraclavicular route (**GRADE B**) (*CDC 2002*)
- the low lat approach to the Jug vein or at midarm is an advantageous alternative (*Pittiruti 2007*)
  - The CVC tip should be at the junction SCv and atrium (**CLASS A**) (*SINPE 2002, ASPEN 2002*)
- Tunnelling the CVC or connecting to a totally implanted subcutaneous port ↓ frequency of CRBSI and it is recommended for long-term HPN (**GRADE B**) (*CDC 2002*)

# PREVENTION

## SITE and TECHNIC (II)

- PICCs are “probably” associated with lower risk of CRBSI if compared with non-tunnelled short term CVCs and may be used when Subcl/Jug v approach is not recommended (tracheostomy etc...) (*EPIC 2007*)

# PREVENTION

## SITE and TECHNIC (III)

US guided placement may reduce CRBSI and is recommended for all CVC accesses **(GRADE C)** *(EPIC 2007, Karakitsos 2006, Pittiruti 2006)*

Moreover it is recommended to decrease the complications of venipuncture **(CLASS A)**

# PREVENTION

## MAINTENANCE

- Skin care: use chlorhexidine as 2% solution in 70% isopropyl alcohol (*EPIC 2007, Mimosz 2007*) **GRADE A**
- Dressing: in non-tunnelled CVC, prefer transparent semipermeable PU dressing to be changed every 7 d (*EPIC 2007*) **GRADE C**

Chlorhexidine impregnated dressings are recommended in high-risk adult pts (*Hanazaki 1999, Maki 2000*) **GRADE C**

# PREVENTION

## MAINTENANCE

- Access care: disinfect stopcocks, hubs and sampling ports preferably with 2% chlorhexidine gluconate in 70% isopropyl alcohol (**GRADE C**) (*Casey 2003, CDC 2000, EPIC 2007*)
- Change the CVC set every 24 / 72 hrs depending if you are infusing or not fats (**GRADE C**) (*CDC 2002, EPIC 2007*)

# PREVENTION

## WHAT SHOULD NOT BE DONE

- Do not put, routinely, stitches (*BCSH 2006*)
- Do not use prophylactic local or systemic antibiotics prior or during the infusion (**GRADE A**)
- Do not routinely replace non tunneled CVCs (**GRADE A**)
- Do not use in-line filters (*CDC 2002, EPIC 2007*) (**GRADE C**)
- Do not use systemic anticoagulation or flush with heparin before infusion (*EPIC 2007*) (**GRADE C**)

# THROMBOSIS

- Epidemiology
- Diagnosis
- Prevention

# EPIDEMIOLOGY

- Frequency of asymptomatic thrombosis is 0.3-28%\*
- Thrombosis at venography is 27-66%\*
- In HPN pts frequency is 0.05 episodes/CVC/year (*Staun 2006*)
- Pulmonary embolism in 15-25% of pts with thrombosis\*

\* *Verso 2003*

# EPIDEMIOLOGY

## RISK FACTORS

- Malignancy ( CVC-related thrombosis in 28% of pts and PE in 1/6-1/4 of them)
- Inherited thrombophilia (low antithrombin III levels, factor V Leiden carriers)
- CVC-related infection
- Fibrin sleeves are not associated with thrombosis
- Cutdown approach has similar risk to the percutaneous one

# DIAGNOSIS

- Thrombosis is often asymptomatic
- First sign is often a malfunction of CVC
- Clinical signs:
  - swelling of the neck and arm
  - appearance of superficial veins on the anterior chest
  - fever and signs of pulmonary embolism

# PREVENTION

- Silicone and recent PU catheters less thrombogenic
- Risk of femoral approach 40 times higher than Jug and 10 times higher than Subcl vein (*Merrer 2001, Timsit 1998*)
- Use an US-guided approach (**GRADE C**)
- Use low-diameter catheters (**GRADE B**)
- Place the tip at the atrial-caval junction (**GRADE B**) (*Biffi 2007*)
- Use LMWH 100 IU/Kg only in high-risk pts (**GRADE C**) (*GAVECeLT 2007*)

# PREVENTION in cancer pts

- 4 RCTs with LMWH or UFH: no effect
- 3 RCTs with Warfarin: no effect
- All 7 combined: reduction in symptomatic thrombosis
- Do not use prophylaxis (**GRADE B**) (*Am Coll Chest Phys 2004*)