

Prevention of Catheter-related Bloodstream Infection

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langkawi

CVC

Central venous catheter

CR-BSI

Catheter-related bloodstream infection

Category IA. Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies.

Category IB. Strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies, and a strong theoretical rationale.

Category IC. Required by state or federal regulations, rules, or standards.

Category II. Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale.

Unresolved issue. Represents an unresolved issue for which evidence is insufficient or no consensus regarding efficacy exists.

Introduction

- . CVC play integral role in management of critically ill patients
- . CVC disrupt the integrity of skin, making introduction of infectious agent. This leads to sepsis and possibly lead to death
- . Potential morbidity and mortality associated with CR-BSI
- . CR-BSI preventable if evidence-based infection control practices are adhered

Berenholtz CCM 2004

Provonovost NEJM 2006

Introduction

- . US :15 million CVC days
: 80 000 CR-BSIs / year

*Mermel Ann Intern Med 2000
O'Grady MMWR 2002*

- . Exact cost difficult to quantify
 - Expenditure
 - US\$11,971 per episode of CR-BSI
 - US\$56,167 per episode of CR-BSI

*Warren CCM 2006
Dimick Arch Surg 2001*

- Increased Length of stay
 - ICU-average increase of 2.41 days
 - Hospital stay-average increase of 7.54 days

*Warren CCM 2006
Warren CCM 2006*

- Mortality
 - Attributable mortality controversial
 - Unadjusted mortality rates 16-25%

 - Adjusted mortality rates 0-17%

*Higuera CCM 2005
Rosenthal AJMC 2003
Blot Clin Infect Dis 2005
Digiovine AJRCCM 1999
Diekema JCM 2003*

Introduction

- . > 3,500 CR-BSI per year
- . CVC-BSI rate of 23 per 1000 catheters
- . 6 infections per 1,000 catheter days in ICU VICNISS 2003-2004
- . Prolong hospital LOS by 7 days ICHE 1999
- . Attributable cost per BSI \$3,700-\$29,000 ICHE 1999
- . Attributable mortality for all BSIs : 12% Aust Prescriber 2003

Prevention strategies

- . Prior to placement of CVC
- . CVC remains indwelling in patient till removal

Prior to placement of CVC

1. Education
2. Hand hygiene
3. Maximal barrier precautions
4. Chlorhexidine skin antisepsis
5. Catheter site selection
6. Type of CVC
 - antibiotic/antiseptic-impregnated
 - multi-lumen

CVC indwelling in patient

1. Dressing care
2. Catheter securement devices
3. Daily review
4. Changing CVCs
5. Change of administration sets
6. Type of hubs
7. Prophylactic antibiotics
8. In-line filters
9. Prompt / Early removal

Education (1A)

- . Cornerstone of efforts to decrease CR-BSIs
- . Aim at entire healthcare team
- . Implementation in single-centre studies have shown marked decrease in CR-BSI

Coppersmith CCM 2002

Coppersmith Arch Surg 2004

Sherertz Lancet 2000

Eggimann Lancet 2000

- . Need to repeat programs regularly to cater for staff turnover

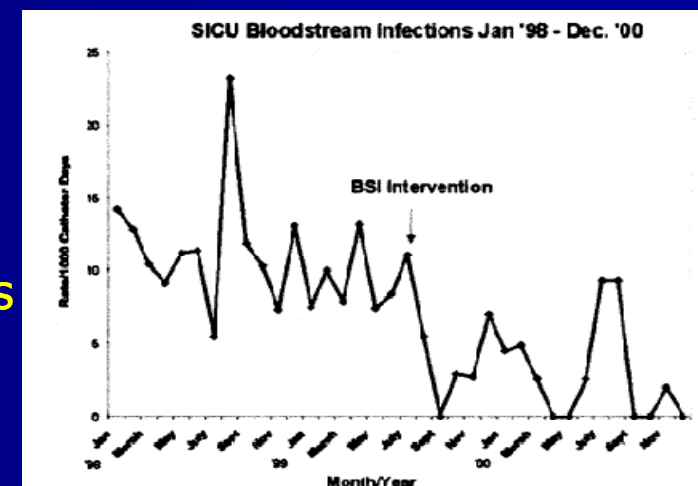
Education

Effect of an education program on decreasing catheter-related bloodstream infections in the surgical intensive care unit

Crit Care Med 2002 Vol. 30, No. 1

Craig M. Coopersmith, MD; Terri L. Rebmann, MSN; Jeanne E. Zack, BSN; Myrna R. Ward, BSN; Roslyn M. Corcoran, RN; Marilyn E. Schallom, MSN; Carrie S. Sona, MSN; Timothy G. Buchman, MD, PhD, FCCM; Walter A. Boyle, MD; Louis B. Polish, MD; Victoria J. Fraser, MD

- Pre and post intervention observational study
- Program directed towards nurses in 18-bedded surgical ICU
- Pre and post test
- 10 page self-study module related to CR-BSI (epidemiology, risk factors, prevention strategies etc)
- Verbal in-service at staff meetings
- Posters pasted in the ICU
- Decrease of 10.8 to 3.7 per 1000 catheter days
 $p < 0.0001$



Hand Hygiene (1A)

- . First step
- . Simplest
- . Despite repeated reminders, HCW repeatedly fail in this simple task
- . Chlorhexidine in alcohol or alcohol hand rub
- . Personal responsibility of the HCW inserting CVC

Maximal barrier precautions (1A)

- . ICU needs to be treated like it is an operating room
- . Studies have confirmed reduction in CR-BSI rates with full barrier precautions compared with less stringent precautions
- . Cost effective
 - Long-term savings from decreased morbidity and mortality outweighing small incremental costs associated with purchasing barrier supplies

Hu KK Clin Infect Dis 2004

Chlorhexidine skin antisepsis (1A)

- . Pathogenesis of CR-BSI related to catheter contamination at time of insertion
- . Skin antisepsis is crucial
- . Chlorhexidine 2% is preferred

Catheter site Selection

- . Optimal site is subclavian vein
- . CDC Grade 1A recommendation
- . Exceptions

Type of CVC – Impregnated CVC

- Developed to reduce CR-BSI
- Use for prevention of CVC microbial colonisation and CR-BSI remains controversial
- 3 types of impregnated CVC
 - › Antiseptic-impregnated
Chlorhexidine/silver sulfadiazine
 - › Antibiotic-impregnated
Minocycline/rifampicin
 - › Coated with silver/platinum/carbon

Type of CVC

Antiseptic-impregnated

- Impregnated with Chlorhexidine/silver sulfadiazine

- May be less susceptible to bacterial resistance

- Meta-analyses of 11 studies including 2603 CVCs

Standard CVC compared with chlorhexidine/silver sulfadiazine CVC

Incidence of CR-BSI : OR = 0.56 95% CI = 0.37-0.84

Incidence of colonisation: OR = 0.44 95% CI = 0.36-0.54

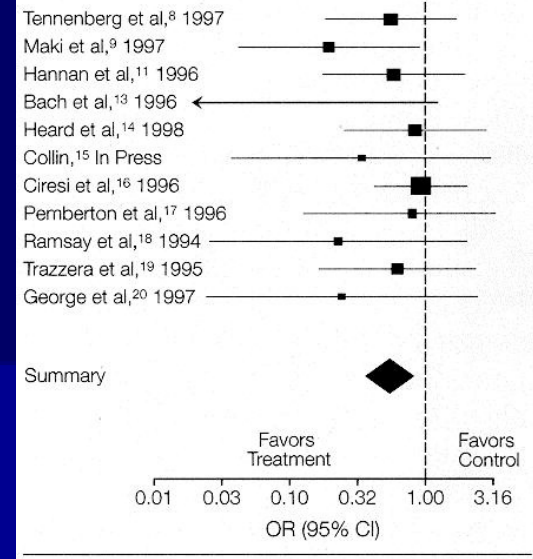
Favouring antiseptic-impregnated CVC

Only 1 study was sufficiently powered

- 1st generation-Coated on external surface

t1/2 against *S. epidermidis* is 3 days

Antimicrobial activity decreases over time (useful for first 14 days)



Veenstra JAMA 1999

Type of CVC Antiseptic-impregnated

Annals of Internal Medicine

ARTICLE

Effect of a Second-Generation Venous Catheter Impregnated with Chlorhexidine and Silver Sulfadiazine on Central Catheter-Related Infections

A Randomized, Controlled Trial

Mark E. Rupp, MD; Steven J. Lisco, MD; Pamela A. Lipsett, MD; Trish M. Perl, MD, MS; Kevin Keating, MD; Joseph M. Civetta, MD; Leonard A. Mermel, DO, ScM; David Lee, MD; E. Patchen Dellinger, MD; Michael Donahoe, MD; David Giles, MD; Michael A. Pfaller, MD; Dennis G. Maki, MD; and Robert Sherertz, MD

- External surface has 3X more chlorhexidine and combined with silver sulfadiazine Internal also coated with chlorhexidine. Has prolonged anti-infectivity properties
- 780 patients
- Colonisation : 13.3 s 24.1 per 1000 catheter days $p < 0.01$
- CR-BSI : 0.42 vs 1.24 per 1000 catheter days $p = 0.6$
- Conclusion : Reduce microbial colonisation compared with uncoated catheter and well tolerated

Type of CVC Antibiotic-impregnated

- Minocycline / rifampicin most common
- Luminal and external surfaces
- T1/2 against *S epidermidis* is 25 days
- Antimicrobial activity is present on both the external and the internal surfaces of the catheter
- Theoretically, provide continuous antimicrobial activity for 14 days
- Antimicrobial resistance is an issue of potential concern
- 1 multicentre RCT
Minocycline/rifampicin vs chlorhexidine/silver sulfadiazine (older generation) CVC
738 catheters in 698 patients
CR-BSI : 0.3% vs 3.4
Catheter colonisation : 7.9% vs 22.8%

Type of CVC Antibiotic-impregnated

- Meta-analysis of 7 RCT 1997-2006
Minocycline/rifampicin CVC vs CVC without mino/rifam
impregnation

CR-BSI OR = 0.23 95% CI 0.14-0.40

Catheter colonisation OR = 0.46 95% CI 0.31-0.69

Conclusion: CVC impregnated with minocycline/rifampicin
was effective in reducing CR-BSI and catheter colonisation

Type of CVC Coated with silver/platinum/carbon

- Recently developed
- Provides continuous release of silver ions (bactericidal, viracidal, fungicidal)
- **Several studies** (Corral J Hosp Infect 2003, Bong J Clin Patho 2003, Ranucci CCM 2003) evaluating CR-BSI and catheter colonisation have been neutral to favourable
- Fraenkel (CCM 2006) compared with minocycline/rifampicin
No difference in CR-BSI
Lower colonisation with minocycline/rifampicin

Conclusion:

- . Definite benefit in reducing CR-BSI and catheter colonisation
- . Concerns about bacterial resistance not demonstrated
- . CDC recommendation (1B)
 - Use antiseptic or antibiotic-impregnated CVC in adults whose CVC is expected to remain in place > 5 days, if after implementing a comprehensive strategy to reduce rates of CR-BSI and CR-BSI rates remain above the goal set by individual institution based on benchmark rates (1B)
(Burns patients, neutropenic patients)

Type of CVC

Multi-lumen

- Results of studies between single, double or triple-lumen catheters on rates of CR-BSI not consistent
- Ma et al (Clin Infect Dis 1998) demonstrated that TPN via multi-lumen catheters (double and triple) does not increase risk of CR-BSI
- Conclusion:
No increase in CR-BSI with use of multi-lumen CVC
- CDC: Use CVC with minimum number of ports or lumens essential for the management of the patient (1B)

Dressing care

- Transparent semipermeable polyurethane dressings are popular
 - Reliably secure device
 - Permit continuous visual inspection of catheter site
 - Permit patients to bathe without saturating dressings
 - Require less changes
- RCT of PAC
 - EOD change of gauze dressings vs 5-day change of transparent dressings
 - No difference in CR-BSI
- RCT of peripheral catheters
 - Rate of catheter colonisation using transparent vs sterile gauze dressing was comparable (5.7% vs 4.6%)

Maki CCM 1994

Maki JAMA 1987

Dressing care

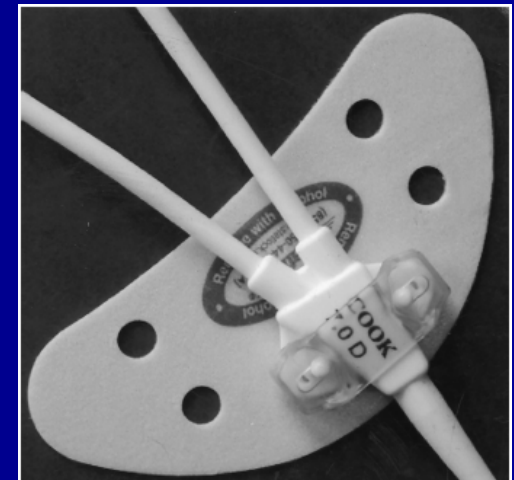
- Use sterile gauze or transparent semi-permeable polyurethane dressings according to institutional preference
- Bleeding : gauze dressings preferred
- Change grossly soiled dressings once visible
- CCMS: Change transparent dressings every 7 days (II)
Change gauze dressings every 2 days (II)

Dressing care

- Chlorhexidine dressings (Biopatch) demonstrated decrease in exit site colonisation but no change in CR-BSI rates (unresolved)
- Antibiotic ointment at dressing site
 - 1 RCT of 129 HD catheters
 - Povidone-iodine ointment applied at site of insertion demonstrated reduced incidence of exit-site infections, catheter tip colonisation and BSI
 - Mupirocin ointment –can reduce risk of CR-BSI but associated with resistance
 - Risk of cutaneous fungal infection

Catheter securement devices

- Sutureless securement devices advantageous over suture in preventing CR-BSI
- 1 study compared sutureless (Statlock) vs suture securement for PICC
CR-BSI = 2 vs 10 $p < 0.032$
Small population (170) and underpowered
- No recommendation (Unresolved issue)



Daily review and Surveillance

- Risk of CR-BSI increases the longer the CVC stays in place
- The necessity of a CVC must be assessed daily for its continued use
- If no indication – remove it
- Monitor catheter sites visually / palpation (1B)

Changing CVC

- CVC replacement at scheduled time intervals has not reduced CR-BSI rates
- 2 trials comparing a strategy of changing every 7 days vs a strategy of changing as needed
No difference in CR-BSI rates

Uldall Lancet 1981, Eyer CCM1990

- CDC : Do not routinely replace CVC, PAC, HD catheters to prevent CR-BSI (1B)

Changing CVC Guidewire exchange

- Guidewire exchange is associated with increased infectious risk and should not be performed routinely

Cook 1997

- **CDC:**
 - Do not use guidewire exchanges routinely for nontunneled catheters to prevent infection (1B)
 - Use guidewire exchange to replace a malfunctioning nontunneled catheter if no evidence of infection is present (1B)

Change of administration sets

- . Should be changed no more frequently than 96 hours
- . Blood/products/lipid-change daily

Cochrane Database Sys Rev 2005

- . CCMS (2004) :
Not more frequently than 72 hours is safe and cost-effective unless CR-BSI suspected (1A)

Needleless, open and closed hubs

- Have not been demonstrated to change CR-BSI rates

47 Niel-Weise BS, Daha TJ, van den Broek PJ. Is there evidence for recommending needleless closed catheter access systems in guidelines? A systematic review of randomized controlled trials. *J Hosp Infect* 2006; 62:406 – 413.

This is a well done review of five randomized trials of needleless closed catheter access systems. The authors conclude the quality of the trials was 'generally unsatisfactory' and while there is no infection risk that would warrant not using these systems, convincing evidence does not exist to warrant recommending them.

- CCMS : Wipe access port with alcohol wipe (1B)
Change needless components no more frequently than 72 hr (II)

Prophylactic antibiotics

- . No studies have demonstrated that oral or parenteral antibiotics reduce incidence of CR-BSI among adults
- . LBW infants-2 studies , vancomycin reduced CR-BSI but not mortality
- . NO ROLE

In-line filters

- . Reduce incidence of infusion-related phlebitis
- . No data to support efficacy in preventing CR-BSI
- . CDC: No recommendation for using in-line filters

Anti-coagulants

- Anticoagulant flush solutions to prevent catheter thrombosis, which serve as nidus for microbial colonisation
- Heparin reduced CV thrombosis but not CR-BSI
- Heparin-bonded coating with benzalkonium chloride (anti-thrombotic and antimicrobial)