American College of Surgeons Critical Care Review Course 2013: Infection Control

Overview:

I. Central line associated blood stream infection (CLABSI)

II. Ventilator associated pneumonia (VAP)

III. Catheter-Associated Urinary Tract Infections (CA-UTI)

IV. Clostridium Difficile Colitis (CDI)

I. Central line associated blood stream infection (CLABSI)

Epidemiology/risk factors:

-The number of CLABSIs has been estimated to be >250,000 per year
-Increase length of stay in the intensive care unit (ICU) by an average of 2.4 days and increase total hospital length of stay by 7.5 days
-Mortality impact controversial-Unadjusted mortality rates have ranged from 16-25% (complicated by the fact that patients with central lines are sicker)
-Adjusted mortality rates range from 0 to 17%
-ICU CLABSI rates: 1.5-2.1 per 1000 central line days (2006-2008)
-Risk factors for CLABSI include:

-Length of CVC duration
-Patient location (outpatient, inpatient floor, ICU)
-Type of ICU (highest in burn ICU, lowest in cardiothoracic ICU)
-Insertion site

-Type of catheter

-Number of lumens

-Number of manipulations/day

-Emergent placement

-Use of catheter for parenteral nutrition

-Incidence decreasing significantly due to increased scrutiny, public reporting

-Non-tunneled catheters are the most common and accounted for approximately 90% of CLABSIs

Diagnosis

-National Healthcare Safety Network definition:

- -Recognized pathogen isolated from blood culture not related to infection at other site -OR-
- -Fever >38, chills or hypotension and common skin contaminant isolated from two or more blood cultures drawn on separate occasions
- -Surveillance diagnosis for public and institutional reporting utilizes an "after the fact" definition
- -Clinical diagnosis is frequently challenging as physical examination is typically unrevealing, and the diagnosis generally relies upon culture data which will not be available when diagnosis is being considered
- -Distinction must be made between CLABSI and secondary bacteremia from a non-CVC source

Prevention

-Requires a comprehensive strategy

-Attention must also be paid to prevention before a CVC is placed, when a CVC is placed, and every day a CVC remains in place

1. Hand Hygiene

-Note: this is the same in every aspect of infection control

-Patient room

-Operating room

-CLABSI, VAP, C Diff, SSI, etc prevention

- -While importance of hand hygiene should be self-evident, this does not translate into practice
- -Physicians have lowest rates of hand hygiene in the hospital
- -Rate has not changed appreciably in over 30 years
- -Many surgeons believe a bedside procedure (CVC placement) is "different" or "less important" than even a minor operation-Either forget or make a decision to not perform hand hygiene prior to placing a CVC
- -This occurs despite the fact that a CVC may be in place in close proximity to the heart for a week or more
- -Hand hygiene can be performed by washing hands or using alcohol foam

2. Skin antisepsis

- -2% chlorhexidine (but not 0.5% chlorhexidine) decreases catheter colonization and/or CLABSI more effectively than 10% povidone-iodine and 70% alcohol solutions (Randomized controlled trials)
- -Even though chlorhexidine costs more on a per unit basis, the decreased incidence of CLABSI (with its associated morbidity and potential mortality) leads to a savings for each CVC placed
- -Daily baths with 2% chlorhexidine washcloths as opposed to soap and water have been shown to decrease the rate of CLABSI in a medical ICU
- 3. Full barrier precautions
 - -When placing a CVC, the patient's room needs to be treated similar to an operating room. -Full sized sterile drapes on the patient
 - -Mask, cap, sterile gown and gloves on the person placing the CVC
 - -Six-fold decrease in CLABSI with full barrier precautions compared to sterile gloves and a small drape

4. Anatomic site of insertion

-Subclavian vein is preferred to either the internal jugular or femoral vein for CVC insertion.

-2-3 fold increase in CLABSI with either internal jugular or femoral vein

-Person performing the insertion should have appropriate expertise

-Potential reasons to use a different anatomic site include significant coagulopathy, obvious site infection, inaccessibility or a need for chronic dialysis -Emerging data that this may also be preferable to PICC lines

5. Catheter care after insertion

-Chlorhexidine-impregnated sponges decrease CLABSI rate compared to standard dressings

-No difference in CLABSI rates between changing gauze dressings every other day and transparent dressings every seven days

-Gauze dressings are preferred when bleeding occurs

-Grossly soiled dressings should be changed immediately

-Antibiotic flush solutions? Benefit in high-risk patients?

- 6. Comprehensive prevention programs
 - -Comprehensive prevention programs dramatically decrease CLABSI rates
 - -Educational component

-Asking daily whether a CVC is needed

-While CVCs should be removed when they are no longer indicated, there is no benefit to routine replacement of CVCs or guidewire exchange of CVCs

-Empowering the bedside nurse to stop a CVC insertion for breaks in sterile technique

-A total of 103 ICUs in Michigan decreased CLABSI rates statewide from 77/1000 eatherer days to 14/1000 eatherer days even the source of 18

7.7/1000 catheter days to 1.4/1000 catheter days over the course of 18 months by using a program that included hand hygiene, full

barrier precautions, 2% chlorhexidine as a skin prep, avoidance of femoral catheters, and removing unnecessary CVCs.

7. Antiseptic or antibiotic coated catheters

-Two commonly used types of catheters

- -Antiseptic impregnated --chlorhexidine/silver sulfadiazine
- -Antibiotic impregnated --minocycline/rifampin
- -Most studies demonstrate either decreased CLABSI rates or decreased catheter colonization
- -No evidence of increased resistant organisms
- -No clear evidence when to use them. The CDC recommends using an impregnated catheter when a) a CVC is expected to be in place greater than five days,

b) a comprehensive institutional strategy to prevent CLABSIs in already in place (including full barrier precaution, 2% chlorhexidine prep and an educational program) and c) CLABSIs are higher than goal rates set by an institution

-While this sounds simple in theory, it is frequently not clear in advance whether a CVC will need to be in place for greater than five days.

II. Pneumonia with special emphasis on ventilator associated pneumonia (VAP)

Epidemiology/risk factors

- -Pulmonary complications cause nearly one of every four deaths that occur in the first postoperative week
- -Pneumonia is the third most common postoperative infection, after catheter-associated urinary tract infection and surgical site infection
- -In the ICU, the respiratory tract is the most common site of infection, accounting for 28% to 47% of all nosocomial infections
- -Risk factors for pneumonia in the postoperative setting for non-cardiac surgery include type of surgery, age, functional status, recent weight loss, chronic obstructive pulmonary disease, type of anesthesia, impaired sensorium, history of a cerebrovascular accident, blood urea nitrogen level, substantial transfusion, emergency surgical intervention, long-term steroid use, recent smoking, and significant recent alcohol use
- -VAP requires patient to have been on ventilator for at least 48-72 hours
- -Greatest risk factor for VAP is duration of mechanical ventilation
 - -Peaks at day 5 on the ventilator
 - -Plateaus after day 15
 - -Declines thereafter, uncommon on chronically ventilated patients
 - -Absolute mortality in VAP patients ranges from 12% to more than 50%
 - -Attributable mortality associated with VAP has not been determined with certainty
 - -VAP patients as a group remain in the ICU approximately 6 days longer than comparable patients without VAP although the increase in length of stay in the ICU is closer to 1 day in surgical patients

Diagnosis

-New CDC surveillance algorithm: "Ventilator Associated Events"

-≥2 calendar days of stable or decreasing minimum FiO2 or PEEP

-IF-

-Worsening oxygenation develops as defined by the following: -Increase of minimum FiO2 of >0.20 over baseline

-0R-

-Increase of minimum PEEP of ≥ 3cmH2O over baseline

...The patient has a "Ventilator associated Condition (VAC)"

-IF-

- -≥3 days of mechanical ventilation and within 2 days of worsening oxygenation the pt meets both of the following criteria:
 - 1) Temp > 38 deg C or <36 deg C, or WBC ≥12000 cells/mm^3 or ≤4000 cells/mm^3

-AND-

-2) A new antimicrobial agent is started

...The patient has an "Infection-related Ventilator-associated Condition (VAC)"

- -≥3 days of mechanical ventilation and within 2 days of worsening oxygenation, the pt meets one of the following criteria:
 - 1) Purulent secretions from lungs, bronchi, or trachea (Lab report of ≥25 neutrophils and ≤10 squamous cells per LPF)
 - 2) Positive culture of sputum, endotracheal aspirate, BAL, lung tissue, prot. brush specimen

... The patient has an "Possible Ventilator-Associated Pneumonia"

-IF-

- -≥3 days of mechanical ventilation and within 2 days of worsening oxygenation, the pt meets one of the following criteria:
 - 1) Purulent secretions from lungs, bronchi, or trachea (Lab report of ≥25 neutrophils and ≤10 squamous cells per LPF)

-AND-

Positive QUANTITATIVE culture endotracheal aspirate(≥10^5 CFU/ml), BAL(≥10^4 CFU/ml), lung tissue(≥10^4 CFU/ml), Prot. brush specimen(≥10^3 CFU/ml)

2) One of the following:

Positive pleural fluid

-Positive lung histopathology

-Positive legionella test

-Positive test for influenza, resp. syncytial virus, adenovirus,

parainfluenza, rhinovirus, human metapneumovirus, coronavirus

... The patient has a "Probable Ventilator-Associated Pneumonia"

-Diagnosing VAP may be more complicated than diagnosing postoperative pneumonia although there is significant utility to obtaining invasive quantitative cultures through an endotracheal tube

-Issues:

-No gold standard for diagnosing VAP

-Indicators to diagnosis VAP: fever, leukocytosis, increased or changed sputum production, and sputum culture. New surveillance does not use chest x-ray in diagnosis

-Unclear best method of obtaining sputum culture

-Noninvasive

-Tracheal aspiration

-Mini bronchoalveolar lavage (BAL)

-Invasively via BAL or a protected specimen brush

-Prior antibiotic therapy decreases chance of obtaining a positive culture

-Cultures should be obtained as rapidly as possible but antibiotics should not be

significantly delayed in order to obtain cultures

Prevention

-Requires a comprehensive strategy

-Attention must also be paid to prevention

...Before an operation and/or before an endotracheal tube is placed

...When an endotracheal tube is placed

...Post-operatively and/or every day an endotracheal tube remains in place

1. Prevention of post-operative pneumonia

-Pre-operatively, patients should be instructed about taking deep breaths and ambulating

-Post-operatively, incentive spirometry is a cost-effective therapy for preventing pneumonia with early ambulation

2. Hand hygiene

-Hand hygiene plays same role in VAP prevention as in CLABSI prevention (and SSI prevention and CAUTI prevention and spread of C. difficile colitis)

-Hand hygiene should be performed before and after contact with a patient who has an endotracheal tube or tracheostomy in place, regardless of whether gloves are worn.

-Hand hygiene should be performed before and after contact with any respiratory device that is used on a mechanically ventilated patient

- -Gloves should be worn for handling respiratory secretions or objects contaminated with secretions
- -Gloves should be changed after handling respiratory secretions

-Gloves should be changed between contacts with a contaminated body site and the respiratory tract or any portion of the ventilator circuit.

-Gowns should be worn when soiling with respiratory secretions is expected

3. Patient positioning

-Aspiration of upper airway secretions occurs in all patients

-However, critically ill patients have decreased host defenses and are at increased VAP risk. A reduction in aspiration of gastric contents can therefore decrease the incidence of VAP. The supine position is associated with an increased risk of aspiration. Especially important if the patient is receiving tube feedings

-Patients should be placed the patient in a semirecumbent position with the head of the bed elevated to at least 30° to 45° or greater assuming no contraindication exists

-Kinetic beds may also decrease VAP (and pressure ulcers) in surgical patients

4. Feeding route

-Head of the bed elevation reduces aspiration but does not prevent gastroesophageal reflux Gastric overdistention increases risk of aspiration

-Reluctance to feed a patient with elevated residuals should be balanced

against providing adequate nutrition post-operatively

-Enteral nutrition is preferable to parenteral nutrition

-Optimal timing of initiation of tube feedings is unclear

-Although feeding a supine patient increases risk of VAP, there is no documented difference in VAP rates following gastric or post-pyloric feeding

5. Ventilators and endotracheal tubes

-Routinely changing ventilator circuits does not prevent VAP rate

-Change circuits that are soiled with vomit or blood

-Change malfunctioning circuits

-Condensate should periodically be drained

-Heat moisture exchangers and heated water humidification systems yield similar VAP rates

-Open single-use catheter system and closed multiuse catheter system for suctioning yield similar VAP rates.

-Routine changing of inline catheters on closed systems also does not prevent VAP -Subglottic secretion drainage may delay the onset of VAP

-Silver-coated endotracheal tubes may prevent VAP

6. Preventing oropharyngeal colonization

-Giving chlorhexidine gluconate mouth care pre-operatively and post-operatively may decrease VAP. Has activity against both aerobes and anaerobes

-Oral care protocol including both chlorhexidine gluconate and toothbrushing can decrease VAP

-Like all infection control interventions, compliance with best practice is critical

7. Selective decontamination of the digestive tract (SDD)

-Terminology is misnomer – Full protocol contains the following:

-Short course of parenteral antibiotics

-Enteral antibiotics throughout ICU stay

-High levels of hygiene

-Surveillance cultures-Throat and Rectum

-Some studies show a significant decrease in:

- -Orophayngeal and rectal carriage of gram-neg microbes
- -Lower airway infections
- -Bloodstream infections

-Mortality

-HOWEVER, Significant concern that SDD leads to enhanced selection of resistant organisms

-SDD is rarely used in the United States and not recommended in guidelines to prevent VAP

-Historical only concern that drugs that increase stomach pH for ulcer prophylaxis might increase risk of VAP; however, this concern has NOT been validated when studied

- 8. Education and VAP bundles
 - -Educational programs that increase staff knowledge have been shown to decrease VAP rates
 - -A strategy stressing compliance with multi evidenced-based practices listed above is superior to a targeting a single intervention.

- -Institute for Healthcare Improvement bundle includes head of bed elevation, sedation holiday and daily assessment of readiness to extubate, peptic ulcer disease prophylaxis and deep venous thrombosis prophylaxis
- -Although not exclusively aimed at VAP, following this bundle decreases VAP rates

III. Catheter-Associated Urinary Tract Infections (CA-UTI)

Epidemiology/Risk Factors:

->500,000 cases of CA-UTIs a year in United States -Accounts for 23% of nosocomial infections in ICU -Incidence of catheter associated bacteriuria: 3-8% per day -Excess length of stay: 2-4 days -Risk Factors: (CDC) Technical: -Disconnection from drainage system -Placement of catheter outside operating room -Obstruction of drainage -Lower experience level of inserter Patient factors: -Female sex -Increased age -Impaired immunity -Incontinence -Diabetes -Meatal colonization -Ortho/Neuro service -Renal dysfunction

Diagnosis:

-CDC differentiates between Asymptomatic vs. Symptomatic CA-UTI -All criteria from www.cdc.gov

-Symptomatic UTI (SUTI) with indwelling catheter in place >2 days, diagnostic criteria: -Signs and symptoms (At least 1): Fever >38 Deg. Celsius; Suprapubic tenderness; Costovertebral angle pain or tenderness

-AND-

-Lab evidence: **One of the following 2 scenarios**:

A. At least 1:

-Pos dipstick for Leuk. Esterase and/or nitrite; pyuria (≥10 WBC/mm³ of unspun urine OR > 5 WBC/high power field of spun urine); Microorganisms on gram stain of unspun urine

-AND-

- -Urine culture of ≥10^3 and <10^5 CFU/ml with no more than 2 species of microorganisms
- B. Positive urine culture of $\geq 10^{5}$ CFU/ml with no more than 2 species of microorganisms

-Symptomatic UTI (SUTI) with indwelling catheter removed day of or day before,

criteria:

-Signs and symptoms (At least 1): Fever >38 Deg. Celsius; Suprapubic tenderness; Costovertebral angle pain or tenderness; urgency; frequency; dysuria

-AND-

-Lab evidence: One of the following 2 scenarios:

A. At least 1:

 Pos dipstick for Leuk. Esterase and/or nitrite; pyuria (≥10 WBC/mm^3 of unspun urine OR > 5 WBC/high power field of spun urine); Microorganisms on gram stain of unspun urine

-AND-

- -Urine culture of ≥10^3 and <10^5 CFU/ml with no more than 2 species of microorganisms
- B. Positive urine culture of $\geq 10^{5}$ CFU/ml with no more than 2 species of microorganisms

***If the catheter was in place on the day of or day before all above elements were together, then CA-UTI (if not, SUTI)

-Signs and symptoms (None of following): Fever >38 Deg. Celsius; Suprapubic tenderness; Costovertebral angle pain or tenderness; urgency; frequency; dysuria

-AND-

-Lab evidence:

 Positive urine culture of ≥10^5 CFU/ml with no more than 2 species of microorganisms

-AND-

-Positive Blood culture matching uropathogen or at least 2 matching blood cultures drawn on separate occasions if matching organism is a common skin colonizer

⁻Asymptomatic bacteremic UTI (ABUTI) with indwelling catheter, or catheter removed day of or day before, criteria:

Prevention: CDC Guidelines

- 1. Insert only for specific indications
 - -Acute retention/Bladder outlet obstruction
 - -Accurate measurements in critical patients
 - -Peri-op use in selected surgical procedures: surgery on aspects of genitourinary tract; prolonged duration of surgery; large volume infusions or diuretic use in surgery; intra-op monitoring of urinary output
 -Decubiti healing in incontinent patients
 - -Prolonged immobilization
 - -End of life care
- 2. Remove as early as possible
- 3. Inserters should be well trained and utilize strict sterile technique
- 4. Maintain closed, unobstructed drainage
- 5. Hand hygiene!

Controversies in CA-UTI

- 1. Alternatives to catheterization?
 - -Intermittent Catheterization can have lower rates of CAUTI compared to indwelling catheterization in various types of surgical patients
 - -Condom Catheterization?
 - -Unclear if lower risk of bacteriuria vs. CA-UTI
 - -Diapers?

-Can be a risk factor for urinary tract infection

2. Use bladder scanners?

-In a recent meta-analysis, the use of bladder scanners vs. clinical judgment to assess urinary retention and direct catheterization showed reduced need for catheter insertions and reduced CA-UTI. Study issues include: Variable scanned volumes which would lead to catheterization between studies; No uniform definition of CA-UTI

3. Antimicrobial catheters?

-In a recent review, Silver-alloy catheters and antibiotic-impregnated (Nitrofurazone) catheters have decreased incidences of bacteriuria in short term catheterized patients, however, the ultimate translation to reduced CA-UTI is unclear

IV. Clostridium Difficile Infection (CDI):

Epidemiology/Risk Factors:

-Only accounts for <25% of antibiotic-associated diarrhea -30-day mortality in the ICU for those with C. Diff can be as high as 37% -Risk Factors for death in the ICU: -Septic Shock -Ward to ICU transfer -Increasing APACHE II scores -Overall rate of emergent surgery with those hospitalized with CDI: 1.1% -30-day post-op mortality: 41% -Risk factors for post-op death: -Preoperative intubation (Most significant contributor) -Shock requiring vasopressors -Acute renal failure -Multiple organ failure -Age over 75 -Elevated WBC (>50,000 cells per ul) -Elevating lactate (>5 mmol/L)

Diagnosis:

-CDI suspected with clinically significant diarrhea-recommended not to screen regular bowel movements because of the possibility of colonization

-Cytotoxic assay

-Detected toxin B by its cytotoxic effects on cells or tissue cultures. 2-3 day turnaround -EIA of Toxins A and B

-Poor sensitivity (60%)-have led physicians to order "C. Diff x 3 days"

-Molecular assays (PCR)

-Used to detect toxin gene

-Multiple assays on the market

-Improved sensitivity and specificity compared to EIA

Prevention:

1. Hand hygiene

-Hand hygiene is imperative in the prevention and spread of C. difficile colitis -Wash with soap and water to eradicate spores; foaming gels may not be as effective in eliminating c. diff on the hands.

- 2. Glove and gown when contacting patients with CDI
- 3. Maintain contact precautions for as long as diarrhea is present
- 4. Antibiotic stewardship -Determined by local epidemiology of C. Diff

Controversies in CDI:

- 1. Ideal antibiotic regimen?
 - -Vancomycin is better than placebo for improvement in symptoms
 - -In a recent review, no statistically significant differences in effectiveness was observed between Vancomycin and the following antibiotics:
 - -Metronidazole
 - -Fusidic acid
 - -Nitazoxanide
 - -Rifaxamin
 - -? Improved outcomes with Teicoplanin
 - -Ideal combination regimen?
- 2. Fecal transplant as a treatment modality?
 - -Several case reports and small series describing procedure as "safe"
 - -No well designed randomized control trials
 - -Symptoms can improve immediately in up to 83% of patients
 - -Variable indications and administration techniques
- 3. When to operate?
 - -Failure of maximal medical management
 - -Elevated WBC >50,000 cells per ul and elevating lactate >5 mmol/L associated with increased peri-op mortality->? operate before level rise
- 4. Total abdominal colectomy vs. loop ileostomy for fecal diversion and administration of antibiotic irrigation into colon
 - -Mortality rates from total abdominal colectomy can vary from 35%-80% Preservation of colon may be as high as 92%
 - -Preservation of colon may be as high as 93%
 - -Mortality lower when comparing to historic controls: 19% vs 50%
 - -Can be done laproscopically
- 5. Probiotics as primary prevention -Not strongly recommended at this time based on available data

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