Principles of Asepsis – Renberg 2010

Asepsis is the process of minimizing the number of microbes present and decreasing their transport in order to decrease infection (my definition). It includes a variety of rules and procedures, but is more of a mental state. In other words a surgeon cannot depend on having to consciously consider the impact of each action on asepsis - every action should automatically be done in an aseptic manner.

During aseptic surgery, not everything is *sterilized* (the killing of all microorganisms through chemical or physical means). Some items are only *disinfected* (the destruction on pathogenic microbes or the inhibition of their growth), while others are merely cleaned or covered. As a surgeon it is vital that you understand the concept of asepsis, the pathogenesis of infection, the contribution of the various components of surgical preparation and your role in maintaining the aseptic environment.

*****Please review chapters 1 -7 and 10 in Fossum's text.

Pathogenesis of infection

This discussion should be a review and summary of bacteriology and pathology notes; students are encouraged to consult those sources if they require a refresher.

Not every break in aseptic technique results in a surgical infection. No surgery is performed in a completely sterile manner since neither the patient nor the environment can be sterilized (therefore all wounds have some degree of contamination). *The goal is to create and maintain a situation that makes infection unlikely to occur*.

Surgical infections

-Generally defined as 10^5 bacteria per gram of tissue

-Fewer bacteria are required to begin colonization

-Critical inoculating dose depends on the local environment, the patient, and the bacteria:

- Patient factors
  - Extremes of age
  - Poor health (immunocompromised)
  - Poor nutrition
  - Shock/poor circulation

- Environment factors
  - Traumatized/necrotic tissue
  - Exudate (hematoma!)
  - Foreign material
  - Antibiotics

- Bacterial factors
  - Virulence
  - Number
  - Most common source is patient (endogenous)
  - Air is the most common vehicle (bacterial concentration in the air is proportional to the activity in the room)
  - Staph and Strep most common. Fecal Gram-negatives also. Nosocomial infections.

Prevention
- Select patients appropriately
- Prepare patients appropriately
- Prepare personnel appropriately
- Sterilize equipment appropriately
- Maintain OR appropriately
- Use appropriate technique
- Maintain post-op care
- Be aware of factors that increase risk of infection
  - -Length of surgery
  - -Clipping hair prior to induction

Sterilization

Your responsibility as a surgeon will often include having an idea how the sterilizers function so you know what the appropriate methods are for a given item. You should understand how items should be arranged and how to determine if sterilization has been accomplished. You are responsible for assuring that your instruments are being cared for correctly.

1. Steam autoclaves
   - -Steam - wet heat kills at lower temperature
   - -Pressure - used to increase the temperature
   - -Condensation results in heat transfer and therefore cell death
   - -Need contact with each surface
   - -Various types of autoclaves vary in function; most common is the gravity displacement autoclave
   - -Minimum = 13 minutes @ 120°C/250°F
   - -Longer for linen packs
   - -Allow for drying time
   - -Arrange things so air is not trapped (e.g. bowls facing down or sideways)

2. Ethylene oxide
   - -A cyclic ether that kills by alkylation
   - -Gas at room temp
   - -Flammable/explosive unless mixed with CO_2 or freon
   - -Efficacy is influenced by concentration, temp, time and humidity

-Need to provide aeration time (natural or mechanical)
-Diffuses so positioning less important
-Do not gas items that have previously been irradiated (toxic results)

3. Cold sterilization (chemical sterilization)
   -A variety of disinfectant solutions (e.g. glutaraldehyde)
   -Less efficacious
   -Poor choice for most applications

4. Plasma sterilizers
   -Use a vapor form of H_2O_2 to create reactive ions
   -Not for paper or fabrics generally
   -Expensive but effective

5. Ionizing radiation
   -Expensive
   -Generally used in prepackaged items (suture etc)

Instrument care
- Manual scrubbing with special detergents
- Ultrasonic cleaners
- Instrument milk
- Packaging
  -paper wraps better than fabric
  -double wrap
  -specific shelf life depending on wrap and storage
  -include indicators
  -boxlocks should be open, instruments disassembled

Indicators of sterilization
- Chemical
  -Color change indicates that the conditions of sterilization have been reached (temp, gas presence)
  -Does not guarantee sterility
  -Should be placed both in center of pack and on outside
- Biologic
  -True indication of sterility
  -Impractical for everyday use
  -Periodic monitoring

Surgical Team Preparation

Three components to maintaining asepsis by the surgical (and anesthesia) personnel: attire, behavior, scrubbing

Surgical attire:

Scrubs
- -made of durable, lint-free material
- -limited life
- -should have elastic cuffs
- -shirt should be tucked in; undershirts should not protrude past the sleeves
- -covered with lab coats if outside the O.R., not worn outside the building!
- -do not use for dirty procedures - bathing, cleaning cages, cast change etc
- -laundered daily and changed if contaminated

Caps
- -hair has higher bacteria count than other skin
- -all hair should be covered (neck, sideburns, beard)
- -disposable or laundered daily, changed between surgeries

Shoe covers
- -new every time you enter the OR
- -help keep environment clean

Masks
- -don't actually decrease environmental bacteria counts
- -mainly to decrease droplets falling to wound (talking, sneezing etc)
- -different pore sizes
- -be sure to wear correctly

Gowns
- -material and construction are important
- -limited life span (50-100 launderings)
- -disposable is better
- -The "sterile zone" is from neck to waist in the front only - backs are not considered sterile even though the gown may wrap around.

Gloves
- -originally developed to protect the hands
- -not totally impermeable (2-4% come with holes)
- -surgeon often not aware of holes

<u>Aseptic behavior:</u>
Assume that bacteria instantly jump from any "dirty" surface to any "clean" surface they touch. Assume that the entire surface is contaminated. Assume that bacteria fall from any "dirty" surface to whatever is below them. Remember that bacteria can float through the air.

Therefore:

-Minimize motion in the O.R. Minimize the number of people present and the amount of traffic in and out of the room.
-Gowned personnel should pass back to back
-Non-gowned personnel should never get between sterile objects/people
-The edges of a drape are considered contaminated
-A nonsterile hand should never reach over a sterile field (even to open a pack)
-Below the waist or table is not sterile
-Drapes cannot be moved toward the incision once placed

These are rules of conduct even if they are not factually correct in every instance (e.g. even if you know your hand didn't touch anything when you dropped it below your waist).

Scrubbing:
Objective is to: Remove dirt and oil
Decrease transient microbes to near zero
Depress resident microbes
Anatomic timed scrub or counted brush stroke scrub
Five minutes – good rule of thumb
Keep hands up, watch drips, careful with towel

Scrub solutions (surgeon or patient):
Hexachlorophene (pHisoHex)
- A polychlorinated bisphenol
- Disrupts cell walls and precipitates proteins
- Often mixed with PCMX for better G- spectrum
- Bacteriostatic for G+
- Cumulative

*Iodophors
- Iodine + carrier (povidone)
- Less irritating than straight iodine
- Penetrates cell and increases oxidation, forms reactive ions and protein complexes
- Good spectrum except spores
- Fair efficacy in the presence of organic material
- Some residual activity

*Chlorhexidine gluconate
- Cationic bisbiguanide
- Disrupts cell membranes and precipitates cell contents
- Good spectrum except only fair versus fungi and spores
- Not effective in the presence of organic material
- Generally less irritating than iodophors
- Some residual activity

Parachlorometaxylenol (PCMX)
- Halogen substituted xylenol
- Disrupts cell walls and inactivates enzymes
- Good G+ spectrum, moderate G-, only fair for fungi and viruses

Triclosan
- Diphenyl ether
- Used in bar soap
- Moderate efficacy

*Alcohols (ethyl and isopropyl)
- Coagulate proteins
- Poor in the presence of organic material
- Poor efficacy against viruses and spores
- Loses potency with time (evaporates)
- Good for defatting and drying, rapid kill
- Can be irritating

Quaternary ammoniums
- Cationic surface agents
- Slow kill
- Inactivated by organic material

Patient Prep

The goal is to *reduce* the surface bacteria (20% of bacteria are deep and therefore inaccessible).
Be sure of surgical site and positioning
Think about other procedures (bone grafts, drains, and tube placement)

Hair removal
- Clipping is preferable to shaving or depilatories; all cause some trauma
- Clip immediately prior to surgery
- General rule - 15cm to every side of incision
- Use sterile, water-based gel in wounds
- Wear lab coats

Scrub
- Various solutions
- Use circular pattern from incision out
- Never go back to center after touching the limits of the prep
- Replace sponges and repeat until clean
- Be gentle
- Avoid excessive moisture
- Often alternate antiseptic with alcohol or saline
- "Dirty" scrub is done in prep room; "clean" scrub is done in OR
- Clean scrub should be done sterilely

Transport
- Avoid contamination
- Be aware of lines, hoses etc
- Caution with fractures (lest they become open)

Draping
- Isolate the field
- Secure drapes
- Use impermeable drapes
- Special draping techniques for various situations

Facilities

- Clean - daily routine
- Separate - not used for other purposes
- Appropriately ventilated - positive pressure ventilation, laminar flow, high turnover
- Closed - keep doors closed
- Low traffic - only essential, properly attired personnel
- Clean and dirty OR's