Topical Antiseptics for Dialysis Patients

NKC Auburn In-service

Sep 28,2021

Objectives

1. Be familiar with types of antiseptics used in dialysis units.
2. Appreciate the relative efficacy of common antiseptics.

Antiseptics

- From Greek ἀντί *anti*, "against" and σηπτικός *sēptikos*, "putrefactive“ (decay)
- Antimicrobial substances that are applied to living tissue/skin to reduce the possibility of infection, sepsis, or putrefaction.
  - **Disinfectants**: Destroy microorganisms found outside the body or on non-living objects
  - **Antibiotics**: Destroy bacteria within the body.

Features

- Some antiseptics are germicides, capable of destroying microbes (bacteriocidal)
- Others are bacteriostatic and only prevent or inhibit their growth.

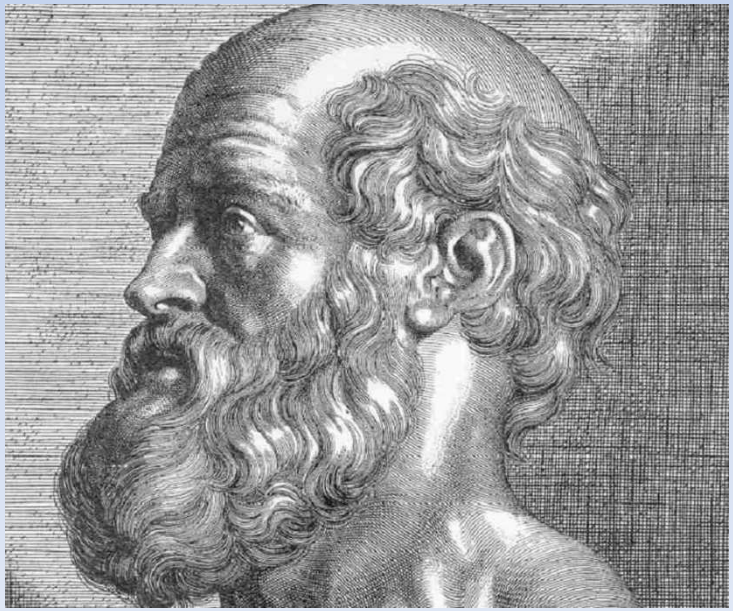
Examples

- Alcohol
- Chlorhexidine gluconate (CHG)
- Iodine
- Hydrogen peroxide
- Sodium hypochlorite solution (bleach)

History of Antiseptics

Ancient Greece

- Hippocrates, a Greek physician and surgeon, 460-377 BC, known as the father of medicine, used vinegar to irrigate open wounds and wrapped dressings around wounds to prevent further injury.
- He washed ulcers with wine and dressed them with fig leaves.



Ancient Rome

- Galen, a notable Roman surgeon, was first to recognize that pus from wounds inflicted by the gladiators preceded wound healing.
- Applied spice ointments to wounds.

The Dark Ages

- Advances achieved in wound care and surgery for healing wounds by Hippocrates and Galen were lost after the fall of the Roman Empire.

Medieval Ages

- Hugh of Lucca, Theoderic of Servia, and Henri de Mondeville were opponents of Galen's opinion that pus was important to healing.
- They advocated:
  - Draining and cleaning the wound edges with wine
  - Dressing the wound after suturing
  - Leaving dressing on for ten days, soaking it in warm wine

Prior to the mid-19th century…

- Limb amputation was associated with an alarming 50% postoperative mortality from sepsis.

Joseph Lister (1827–1912)

- English surgeon in London.
- Following Louis Pasteur's discovery that tissue decay was caused by microscopic organisms, Lister theorized that the spread of these microbes through surgical wounds was responsible for death in the postoperative period.

Joseph Lister

- 1865: Began treating wounds with **carbolic acid** (phenol) in an effort to prevent tissue decay and the resultant infectious complications.
- Result: Incidence of surgical sepsis fell dramatically, catalyzing the adoption of modern antiseptic techniques:
  - Instrument sterilization.
  - Use of surgical scrub and rubber gloves.
  - Sterile patient preparation.

Listerine

- 1879: **Listerine** developed as an antiseptic mouthwash product by Joseph Lawrence, a chemist in St. Louis, Missouri.
- Named after Joseph Lister.
- Contains alcohol, menthol, methyl salicylate, and thymol.
- Promoted with the slogan "Kills germs that cause bad breath".

Listerine

- **1895**: Promoted to dentists for oral care.
- **1914**: First over-the-counter mouthwash sold in the United States
- **1920s**: Runaway success until the 1920s, when it was pitched as a solution for bad breath.
- **1927**: Company briefly marketed Listerine Cigarettes
- **1930s-1950s**: Advertised that it would prevent dandruff if applied to the head.
- **1950s-1980s**: Advertised that it would prevent colds.

Antiseptics Used in Dialysis Units

Common Antiseptics used in Dialysis Units

- Alcohol
- Iodine
- Chlorhexidine
- Sodium hypochlorite (bleach)

Alcohol-Based Solutions

- Typically contain either ethyl alcohol or 70% isopropyl alcohol
- Very effective antiseptic agents.
- Fast and short acting, has broad-spectrum antimicrobial activity, and is relatively inexpensive.

Rubbing Alcohol

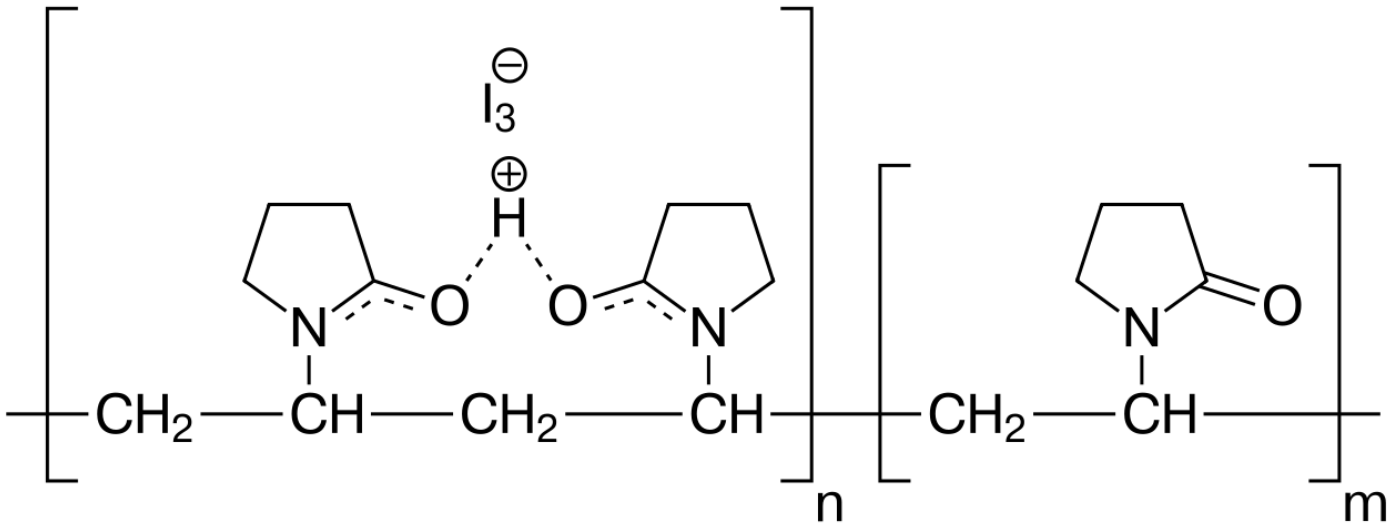
- Popularized in North America in the mid-1920s.
- Original rubbing alcohol was literally used as a liniment (lotion) for massage; hence the name.

Side-Effects

- Volatile and flammable
  - Few reports of operating room fires originating from alcohol-based skin preparation resulting in significant injury to patients and staff.
  - Flammability can be avoided by allowing skin to completely dry and avoiding preparation of areas with excessive body hair that can delay alcohol vaporization
- Poisoning can occur from ingestion, inhalation, absorption, or consumption of rubbing alcohol
  - Should not be applied to mucous membranes.

Povidone-iodine (PVP-I)

- Broad spectrum antiseptic for topical application in the treatment and prevention of wound infection.
- Chemical complex of povidone, hydrogen iodide, and elemental iodine. It contains from 9% to 12% available iodine.
- Works by releasing iodine which results in the death of a range of microorganisms.



Povidone-iodine (PVP-I)

- Discovered in 1955 at the Industrial Toxicology Laboratories in Philadelphia by H. A. Shelanski and M. V. Shelanski.
- Included on the World Health Organization's List of Essential Medicines.
- Sold under a number of brand names, including Betadine
- Works by iodinating lipids and oxidizing cell membranes of bacteria; no resistance develops.

Side-Effects

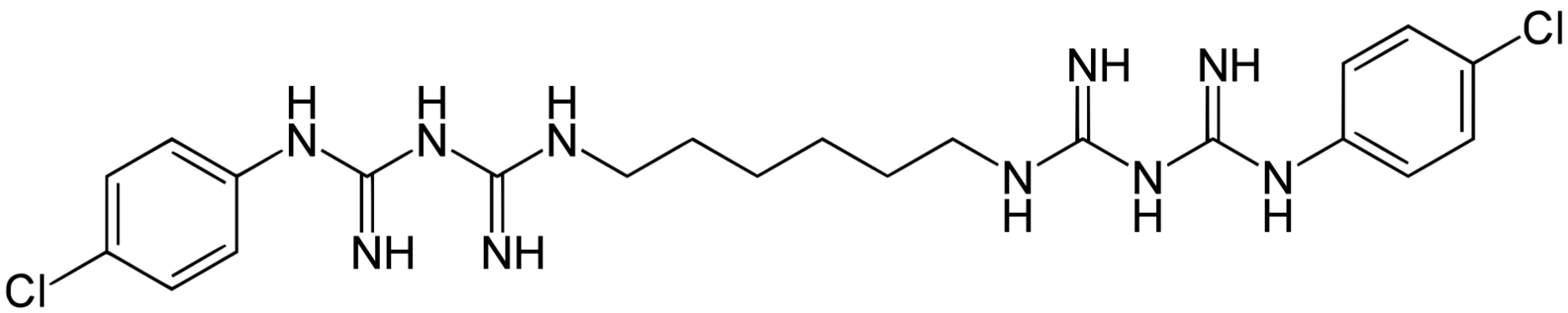
- Sensitization rate to the product is 0.7%
- Rashes: Hives, itching, redness of skin, stinging, inflammation.
- Iodine can also be absorbed into the body to various degrees, depending on application area and condition of the skin. Too much iodine can cause hyperthyroidism (overactive thyroid gland).

Chlorhexidine

- AKA Chlorhexidine gluconate (CHG)
- Came into medical use in the 1950s.
- Included on the World Health Organization's List of Essential Medicines
- Available over-the-counter.
- Brand names: Hibiclens, ChloraPrep, DynaHex, etc.

Chlorhexidine

- Works by disrupting bacterial cell membranes.
- Has more sustained antimicrobial activity, and more resistant to neutralization by blood products, than the iodine or alcohol.
- Applications: Hand washing; showering prior to surgery; skin preparation agent; cleaning wounds, preventing dental plaque, treating yeast infections of the mouth.



Side-Effects

- Skin irritation
- Teeth discoloration (when used as a mouthwash)
- Allergic reactions.
- Eye problems if direct contact occurs
- Toxic to ear if placed into the ear canal with a rupture ear drum.

Comparison of Antiseptic Agents

Bazzi, Ali et al. Alcohol + Iodine vs Iodine alone on severity of inflammation of access site in hemodialysis patients. Article 8, Volume 4, Issue 4, Winter 2015, Page 77-86.

- **Purpose**: To determine the effect of the combination of alcohol and Betadine on the severity of inflammation in the vascular access site in hemodialysis patients
- **Methods**: RCT. N=68 patients undergoing hemodialysis in Iran, randomly assigned to one of 2 groups of antiseptic for their dialysis access:
  - **Control group**: Povidone iodine alone
  - **Intervention group**: Povidone iodine + alcohol in 2:1 ratio before starting dialysis.
- **Outcome**: Inflammation of vascular access.
- **Results**: Mean severity of inflammation in the intervention group (0.2±0.2) was lower than that in control group (1.1±0.4) ($p<0.05$).
- **Conclusion**: Alcohol + Iodine is more effective than Iodine alone in reducing the inflammation and consequently the infection in the vascular access site in hemodialysis patients.

Srinivas A et al. Chlorhexidine vs Iodine. Surgery Today. 2015 Nov;45(11):1378-84

- Prospective randomized controlled trial conducted on patients undergoing clean-contaminated upper abdominal surgeries.
- N=351 patients 18-70 years old were randomized into two groups: (1) chlorhexidine and (2) povidone iodine skin preparation before surgery.
- Results: Infection rate – 10.8% (Chlorhexidine) vs **17.9%** (povidone iodine); p = 0.06.
- Conclusion: Chlorhexidine > Iodine in preventing skin infections.

Paglialonga F et al. Catheter infections, Iodine vs CHG. Hemodial Int. 2014 Oct;18 Suppl 1:S13-8.

- **Purpose**: To assess the efficacy of chlorhexidine (CHG) and a 5% povidone-iodine solution on the incidence of CVC-related infections in children on HD.
- **Methods**: The incidence of exit-site infection (ESI), tunnel infection (TI), and bloodstream infection (BSI) was assessed in two groups of tunneled CVCs.
  - **Iodopovidone group**: N=14 CVCs used between 1 January 2011 and 30 June 2012 in 10 children, whose median age at the time of CVC placement was 11.8 years (range 1.2-19.2): 5% povidone-iodine was used for CVC exit-site care.
  - **CHG/Alcohol group**: N=13 CVCs used from 1 August 2012 to 31 January 2014, 0.5% chlorhexidine gluconate/70% isopropyl alcohol was used for the exit site, and 2% chlorhexidine gluconate/70% isopropyl alcohol spray for the hub.
- **Results**:
  - Exit site infection: n=10 (Iodine group) vs 1 (CHG)
  - Tunnel infection n=1 (iodine group) vs 0 (CHG)
  - Blood stream infection: 1.7/1000 CVC days (Iodine group) vs 0.36/1000 CVC days (CHG)

Shiri, Hosein et al. Chlorhexidine vs. Povidone-iodine on bacterial colonization and local catheter infections. Iran J Crit Care Nurs. 2015;8(1):25-30.

- **Purpose**: To compare the effects of chlorhexidine and povidone-iodine (Betadine) on bacterial colonization and local infection at catheter insertion site among patients receiving hemodialysis.
- **Methods**: n=56 patients who had undergone central venous catheterization for receiving hemodialysis at Golestan hospital, Ahvaz, Iran, randomized to chlorhexidine (CH) or the Betadine groups.
  - Catheter insertion site in the chlorhexidine and the Betadine groups was cleaned and disinfected by using chlorhexidine 4% and Betadine 10%, respectively.
  - Groups were then compared with each other in terms of bacterial colonization and local infection at catheter insertion site.
- **Results**: Incidence of bacterial colonization and local infection at catheter insertion site in the chlorhexidine and the Betadine groups was 3.6% and 21.5%, respectively (P value<0.001).
- **Conclusions**: Chlorhexidine is more effective than Betadine in minimizing bacterial colonization and local infection at the insertion site of catheters among patients receiving hemodialysis.

Mimoz MD PhD et al. Chlorhexidine-Based Antiseptic Solution vs Alcohol-Based Povidone-Iodine for Central Venous Catheter Care. *Arch Intern Med.* 2007;167(19):2066-2072.

- **Methods** Consecutively scheduled central venous catheters inserted into jugular or subclavian veins were randomly assigned to be disinfected with Iodine/alcohol or CHG/alcohol.
- **Results** Of 538 catheters randomized, 481 (89.4%) produced evaluable culture results.
  - **CHG/alcohol**: 50% decrease in the incidence of catheter colonization (11.6% vs 22.2% [*P* = .002]; incidence density, 9.7 vs 18.3 per 1000 catheter-days) and with a trend toward lower rates of catheter-related bloodstream infection (1.7% vs 4.2% [*P* = .09]; incidence density, 1.4 vs 3.4 per 1000 catheter-days).
  - Use of povidone-iodine associated with increased risk of infection (adjusted relative risk, **1.87**; 95% confidence interval, 1.18-2.96).
- **Conclusion** CHG/alcohol should be considered as a replacement for povidone-iodine (including alcohol-based) formulations in efforts to prevent catheter-related infection.

Shelton DM. CHG vs Iodine at PD Exit Site. Perit Dial. 1991;7:120-4.

- Study at Baptist Hospital in Nashville, TN, compared CHG vs Iodine on bacterial colony counts at the PD catheter exit site.
- Results: 24 hours after exit site care with iodine, more patients (54%) had Coagulase negative Staph than did patients cleaned with CG (15%).

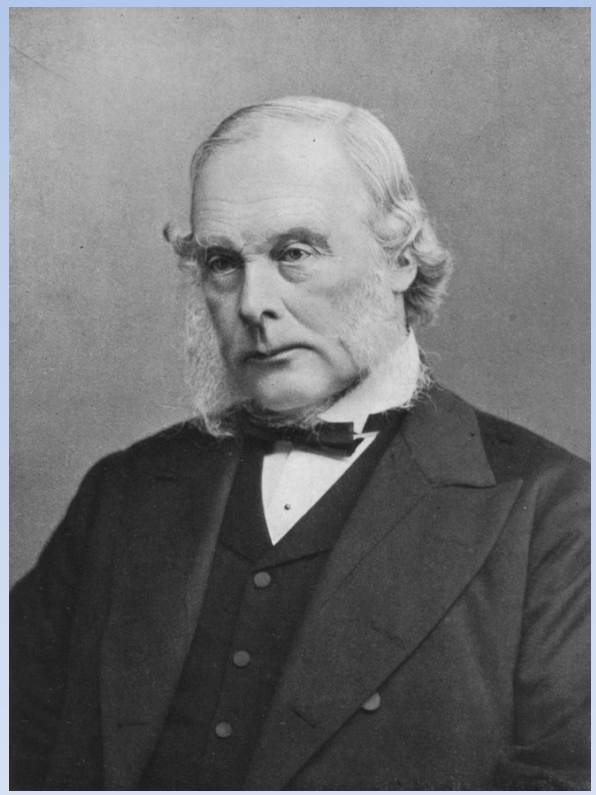
CDC Recommendations: Catheter Care

- Use of alcohol-based chlorhexidine (>0.5%) solution as the first line skin antiseptic for catheter exit site care.
  Alternatives for patients with chlorhexidine intolerance: Povidone-iodine (preferably with alcohol) or 70% alcohol
- Apply povidone-iodine ointment or bacitracin/gramicidin/polymyxin B ointment during catheter dressing change.
  Alternative: Triple antibiotic ointment (bacitracin/neomycin/polymyxin B)

Quiz Time!

Who is considered the father of modern antiseptics?

Joseph Lister MD



Name 3 Antiseptics Commonly Used in Dialysis Units

- **A**lcohol
- **B**etadine
- **C**hlorhexidine

Which Has the Longest Duration of Action?

- ❑ Alcohol
- ❑ Betadine
- ☒ Chlorhexidine

The Use of Which Agent is Associated with Fewer Infections?

- ❑ Alcohol
- ❑ Betadine
- ☒ Chlorhexidine

Pitched as a Solution for Bad Breath

ACKNOWLEDGEMENT

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