Wound Infection Diagnosis and Management
AN OVERVIEW OF TOPICAL THERAPIES

MARCH 2018
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The goal of topical antimicrobial and antiseptic treatments for infected wounds is to “barricade” or “delay” the growth of pathogenic microorganisms. Because of varying designs of research evidence, studies have been widely criticized. These study design problems include inappropriate control groups, small sample sizes, and methods of gathering evidence for guideline development that are not well documented. These issues reflect the difficulty in conducting such studies when patients present with complex chronic wounds and multiple comorbidities. We review evidence-based practice regarding topical antibiotics and their clinical effectiveness for treatment of infected wounds and describe a systematic method for prevention and management of chronic wounds.
Diagnosing Wound Infection

The first steps are identifying and confirming that wound infection is present. Typically, chronic wounds are not cultured unless there are active signs and symptoms of infection. Infection may be present if any of the following are noted in the wound area, thus warranting a culture.1,2

### Indications of Infection: Classic Signs

- Erythema
- Induration
- Increased pain or tenderness at site (during dressing changes or not)
- Increased exudate, purulent or discolored
- Friable red granulation tissue
- Odor after wound cleansing
- Cellulitis
- Abscess
- Further wound breakdown or worsening, wound pocketing or bridging at the base of the wound

### Confirming Wound Infection

1. **Wound swabbing** – most common, but questioned by many authors4
2. **Serum investigations** – C-reactive protein (CRP)5
3. **Quantitative analysis** – wound biopsy1
4. **DNA sequencing technology**6

“The first steps are identifying and confirming that wound infection is present.”
DNA Sequencing Technology

Typical cultures fail to identify microorganisms in the biofilm phenotype. DNA sequencing is a diagnostic tool (patent-pending) that can code over 25,000 microbes. DNA sequencing validates the number of bacteria, antibiotic resistant genes, most common species, and any fungal species found in a comprehensive report. Turnaround time for preliminary testing is 24 hours, followed by full report in 3-5 days.⁶

The Use of Topical Therapies in Managing Infected Wounds

Antimicrobials and Antiseptics

For centuries, clinicians have applied various compounds to infected wounds, such as silver, honey, and cadexomer iodine. Compared with systemic antibiotic therapy, topical application has many advantages, as well as some disadvantages.⁷ Clinically infected wounds usually require systemic antibiotic therapy, whereas clinically uninfected wounds that are healing as expected do not require antimicrobials.⁷

Antimicrobials should never be mixed because they have a wide variety of active biocides. The antiseptic interacts with the cell surface, followed by penetration into the cell. Mixing two or more of these products in a dressing can change the chemical formula, thereby deactivating the antimicrobial or causing a cytotoxic effect harming healthy tissue.⁸ Repeated use of antiseptic and antimicrobial agents without proper indication may promote a microenvironment like those found in a chronic wound, delaying the healing process.

Bacterial Binding Dressing Technology

Dialkylcarbomoyl chloride (DACC)-based dressings work by physically binding and inactivating (as opposed to killing) the bacteria. DACC-based dressings irreversibly bind bacteria at the wound surface, then are removed when the dressing is changed.⁹ When bacteria are bound they become inactivated, their metabolism slows down, and they do not continue to replicate. To utilize DACC-based dressings several important considerations need to be addressed. The level of moisture and debris will determine the appropriate dressing selection. DACC-based dressings are available in a variety of formats for infection management moisture balance and debridement.¹⁰⁻¹²

When used as a wound bed preparation or for prophylactic use, the suggested change frequency of DACC-based dressings is four days. Wounds with signs of critical colonization or infection may require a dressing change frequency of up to 4-7 days wear time depending on the dressing.

A secondary absorptive dressing should be used to manage exudate levels and promote thermal regulation of the wound area.
<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>FORMAT</th>
<th>BACTERIAL SPECTRUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic acid</td>
<td>0.25%, 0.5%, and 1% solutions</td>
<td>Bactericidal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Active against gram-positive and gram-negative bacteria, including <em>Pseudomonas aeruginosa</em></td>
</tr>
<tr>
<td>Cadexomer iodine</td>
<td>Gel, ointment, pad</td>
<td>Broad spectrum</td>
</tr>
<tr>
<td>Cetrimide</td>
<td>40% solution</td>
<td>Active against fungi and bacteria</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NOT active against <em>P. aeruginosa</em></td>
</tr>
<tr>
<td>Chlorhexidine gluconate</td>
<td>Solution, liquid, hand rinse, sponge brush, and foam</td>
<td>Active against gram-positive bacteria, including <em>Staphylococcus aureus</em> and <em>P. aeruginosa</em></td>
</tr>
<tr>
<td>Dialkylcarbomoyl chloride (DACC)</td>
<td>Different shapes and sizes</td>
<td>Broad bacterial spectrum including MRSA and VRE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irreversibly binds and inactivates then removes bacteria at dressing removal reducing overall bioburden</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-7 day wear time with no known bacterial resistance or limits on use</td>
</tr>
<tr>
<td>Gelling Fiber Technology</td>
<td>Different shapes and sizes</td>
<td>Sustained released ionic silver action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exudate locking action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7-day wear time, 14-day antimicrobial activity time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Broad spectrum</td>
</tr>
<tr>
<td>Hexachlorophene</td>
<td>Liquid and foam</td>
<td>Biguanide that is bacteriostatic against <em>Staphylococcus</em> species and other gram-positive bacteria</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
<td>1% and 3%</td>
<td>Oxidizing agent active against many gram-positive and gram-negative bacteria</td>
</tr>
<tr>
<td>Iodine compounds/ tinctures</td>
<td>Solutions</td>
<td>Microbiocidal against bacteria, fungi, viruses, spores, protozoa, and yeasts</td>
</tr>
<tr>
<td>Medical grade honey</td>
<td>Gel, alginate</td>
<td>Broad spectrum</td>
</tr>
<tr>
<td>Silver dressings</td>
<td>Different types and properties available</td>
<td>Slowly released silver ions, broad spectrum, including methicillin-resistant <em>S. aureus</em> and vancomycin-resistant <em>Enterococcus</em></td>
</tr>
<tr>
<td>Silver nitrate</td>
<td>Swabs, solution, and ointment available</td>
<td>Bactericidal against a broad spectrum of gram-positive and gram-negative bacteria</td>
</tr>
<tr>
<td>Silver sulfadiazine</td>
<td>Cream 1%</td>
<td>Broad spectrum against <em>Candida</em> and gram-positive and gram-negative bacteria; used to prevent and treat serious burn and wound infections</td>
</tr>
<tr>
<td>Sodium hypochlorite (Dakin’s solution and Eusol)</td>
<td>0.0125%, 0.125%, 0.25%, and 0.5%</td>
<td>Vegetative bacteria, viruses, and some spores and fungi</td>
</tr>
</tbody>
</table>
Antibiotic resistance is an expanding global dilemma. There have been no new classes of antibiotics in recent decades, and we rely on the most current available agents. Infection-generating bacteria are developing resistance at a rapid rate, and this drug resistance has led many experts to declare this issue as one of the world’s most pressing health problems.

Treating or managing various types of wounds is one reason antibiotics are overprescribed. Evidence is limited but suggests that applying principles of antimicrobial stewardships (AMS) to the care of patients with wounds should help reduce the unnecessary use of systemic or topical antibiotic therapy. This approach will ensure the safest and most clinically effective therapy for infected wounds.

Optimizing Antibiotic Therapy for Wounds

Prescribe antibiotics for clinically infected wounds, along with shortest duration needed to treat infection.

Select antibiotic therapy based on clinical and laboratory data.

Revise and constrain antibiotic therapy based on response and culture and sensitivity results.

Infection Prevention Strategies for the At-Risk Patient – Surgical and early intervention for prevention based on best practice guidelines

Any break in the skin has a potential risk for wound infection. Statistics show that surgical wounds are the most common and can cause morbidity and mortality. Early intervention and prevention of infection are imperative and will reduce the likelihood of wound infections. Subsequently, development of an infection is influenced by the virulence of the organism and the immunological status of the patient. Patients being treated with long-term steroids and chemotherapy are considered at highest risk. Hence, longer hospital stays and doubling of hospital costs are warranted.
It is important to have a clear understanding of wound contamination, colonization, critical colonization, and infection.

1 **Contamination** – the presence of bacteria within a wound without any host reaction.\(^{16}\)

2 **Colonization** – the presence of bacteria within the wound that multiply or initiate the host reaction.\(^{16}\)

3 **Critical colonization** – the proliferation of bacteria in the host, resulting in delayed wound healing, but still without an overt host reaction. Usually associated with increased pain previously not reported.\(^{16}\)

4 **Infection** – the deposition and multiplication of bacteria in tissue with an associated host reaction.\(^{16}\)

Microorganisms are less than 0.1 mm in diameter.\(^{17}\) These variant groups are categorized (depending on their structure and metabolic capabilities) into bacteria, fungi, protozoa, and viruses.\(^{17}\)

1 **Bacteria** – simple cells that are further categorized by their shape and cell wall: cocci, bacilli, rods, and spirochetes. These bacteria can be viewed using Gram staining. Most importantly, both aerobes and anaerobes can survive in close proximity to each other.

2 **Fungi** – larger, more complex cells than bacteria: single-cell yeasts or multicellular organisms with a nucleus contained within a cell membrane. Superficial infection of the skin, nails, and hair may result from fungi.\(^{17}\)

3 **Protozoa** – organisms with a single-cell structure. Protozoa are most closely associated with infected skin ulceration.\(^{3}\)

4 **Viruses** – composed of genetic material (nucleic acid) enclosed with a protein coat or membranous envelope. Viruses are not generally the cause of wound infections, but bacteria can infect skin lesions formed during the course of certain viral diseases.\(^{3}\)

“Both aerobes and anaerobes can survive in close proximity to each other.”
Most Common Organisms with Wound Infection

Methicillin-resistant *Staphylococcus aureus* (MRSA) has now evolved into many different strains. It is accepted that patients with MRSA are difficult to manage with antibiotics.3

MRSA can gain access to a wound through direct contact, airborne dispersal, and self-contamination. Important factors in transmission of MRSA are direct contact and poor hand washing techniques.3

A Sequence of Wound Prevention and Management

### Assessment
- Assess patient, looking at key risk factors. (obesity, age, malnutrition, smoking, diabetes)
- Assess wound
- Identify risk and causative factors (malnutrition, body mass index, glycosylated hemoglobin)
- Set goals for prevention, healing, and nonhealing wounds

### Implement
- Plan of care involving environment, communication, and consistent team care
- Wound care treatment plan (wound bed preparation, debridement methods, bacterial balance, and optimal moist environment, and appropriate dressing to enhance wound healing)

### Teamwork
- Patient education and compliance
- Family or caregiver education and involvement
- Health care team – consistent care

Conclusion

It is essential for health care clinicians to be consistent with prevention, assessment, and identification of early wound complications. Discussion and educational materials should be available for patients and caregivers as well. The goal is to ensure sustainability, to support prevention and reduce the risk of recurrence of infection. The goal of this paper is to provide evidence-informed interventions that will help practitioners develop the skills and tools needed to ensure a best-practice approach.
References


Redefining Infection Management and Prevention

SORBACT® TECHNOLOGY:
Safe Infection Wound Management

A Proven Alternative to Silver Dressings

Dressings with Sorbact® Technology have the ability to bind bacteria without the risk of developing resistance, providing a key alternative to silver-based dressings while promoting antimicrobial stewardship.

- Quickly Binds Bacteria\(^1\)
- Naturally Safe & Effective
- Improves Healing Time
- No Known Risk of Bacterial Resistance

Leukomed® Sorbact® Post-Op
for Preventing and Managing Surgical Site Infections

Cutimed® Siltec® Sorbact®
for Superior Fluid and Infection Management

Cutimed® Sorbact® Hydroactive B
for Removal of Necrotic Tissue

Dressing Pads
Ribbon Gauzes
Swabs
Round Swabs
WCL
Gel

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