The role of wound cleansing in the management of wounds
Faculty

Speaker
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Wound Care Plus, LLC

Moderator
Melissa Warner, EVP
Wound Care Advisor
This 30-minute presentation will feature learning opportunities that will provide in-depth instruction and demonstration in wound care treatments. After this webinar, the learner will be able to:

- Identify the role of proper wound cleansing
- Discuss how to select and use non-toxic wound cleansers
- Describe advantages of collagen for managing a chronic wound
Objectives

At the end of this webinar, the learner will be able to:

- Identify the role of proper wound cleansing
- Discuss how to select and use non-toxic wound cleansers

A) The wound microenvironment
B) Is your wound cleansing practice up to date?
  - Cleansing and its role
  - Basic Cleansing Techniques
  - When not to clean a wound

C) The ideal wound cleanser
D) The use of hypochlorous acid as a wound cleanser
E) Clinical Case studies
THE WOUND MICROENVIRONMENT
The most relevant factors that influence the healing process are:

1. **Bacteria**: Chronic wound provides an ideal environment for bacterial growth. Bacterial infection is one of the most prevalent causes for poor wound healing.

2. **Proteases**: (e.g., MMPs and elastase) play a key role in wound healing but excessive expression can lead to prolonged inflammation and delayed wound healing.

3. **Biofilm**: Bacterial biofilm plays an important role in maintaining a prolonged inflammation that ultimately can lead to the failure of wound healing.

4. **Oxygen**: In chronic wounds there is a substantial imbalance between the supply of oxygen and the high-energy demand of the healing tissue. Inadequate oxygenation can slow down the wound healing process.

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The importance of pH in wound healing

Wounds with an alkaline pH have demonstrated lower rates of healing. Healthy skin has a slightly acidic pH. The pH of a chronic wound is mainly alkaline.

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The importance of acidic pH

“An **acidic environment** in a wound bed is an additional benefit that can contribute to **reboot the wound** towards healing”

- An acidic pH can contribute to creating an unsuitable environment for the growth of the pathogenic bacteria.
- A more acidic environment can reduce the activity of MMPs and restore the healing state.
- An acidic environment can reduce the growth rate of bacterial load in the biofilm.
- An acidic pH can improve the tissue oxygenation, an essential condition for a successful wound healing.

IS YOUR WOUND CLEANSING PRACTICE UP TO DATE?
Is your wound cleansing practice up to date?

“Cleansing and its role”

Wound cleansing is performed to remove surface contaminants, bacteria, non-viable tissue and excess exudate from the wound bed and surrounding skin.¹⁰

Wound cleansing can be an effective way to remove inflammatory stimulants and local barriers from the wound bed.¹⁰

An ideal wound cleanser should modulate the wound microenvironment balancing the management of key components with preservation of tissue safety.¹¹

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Is your wound cleansing practice up to date?

“Basing cleansing techniques”

Swabbing
(use items that don’t leave debris in wound bed)

Irrigation

[Images of swabbing and irrigation procedures]
Is your wound cleansing practice up to date?

“When not to clean a wound”

Dry gangrenous wounds
(want to keep dry)

Fragile granulation tissue
(may be traumatic)
THE IDEAL WOUND CLEANSER
The ideal wound cleanser

When you ask your patient about their basic wound care at home.... what is the usual (and unfortunate) answer?
The ideal wound cleanser

“Antiseptic”

- Research has shown that antiseptics have a negative impact on healing wounds (Atiyeh, et.al. Int Wound J. 2009)
- Antiseptic categories include alcohols, iodine, Chlorhexidine Gluconate (CHG), silver, hydrogen peroxide
- Antiseptics can be used in the right situations, and durations
The ideal wound cleanser

There are several broad categories of solutions that can be used:

**HYPOCHLOROUS ACID**

Hypochlorous acid is produced by the body’s immune cells in response to invading pathogens. When used as wound cleanser ingredient, it acts as a preservative by inhibiting the growth of microorganisms within the solution\(^{12}\)

**SALINE SOLUTION**

Saline solution does not generally contain a preservative, so bacterial growth can occur once exposed to opportunistic microorganisms\(^{12}\)

**SODIUM HYPOCHLORITE**

Sodium hypochlorite is familiar to HCPs as Dakin's solution (0.5% sodium hypochlorite). Dakin’s solution can be injurious to the wound tissue and can slow down wound healing\(^{12}\)

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Wound cleansing can help to achieve the goals of wound bed preparation by removing microorganism, biological and environmental debris\(^{12}\)

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The ideal wound cleanser

The characteristics of an ideal wound cleanser

- The ideal wound cleanser should be **non-cytotoxic** to tissue
- The ideal wound cleanser should **decrease colonization of the wound bed**
- The ideal wound cleanser should be **cost-effective** and **stable**
- The ideal wound cleanser should **not be an alkaline pH**
THE USE OF HYPOCHLOROUS ACID AS A WOUND CLEANSER
The use of hypochlorous acid as a wound cleanser

Hypochlorous acid is one of the major inorganic bactericidal compound of innate immunity and it is effective against a broad range of microorganisms.

Although they look similar, hypochlorous acid and sodium hypochlorite are still very different.

The cell wall of pathogens is negatively charged.

HClO can easily penetrate the cell wall and destroy the pathogens from the inner of the cell.

ClO⁻/sodium hypochlorite can not easily penetrate the wall of pathogens.

At the same concentration, the biocidal activity of HClO is 80 times stronger than ClO⁻.
The use of hypochlorous acid as a wound cleanser

<table>
<thead>
<tr>
<th>SAFETY</th>
<th>HYPOCHLOROUS ACID (HClO)</th>
<th>SODIUM HYPOCHLORITE (NaClO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HClO is naturally found in our body</td>
<td>✔</td>
<td>❌ NaClO can be injurious to the wound</td>
</tr>
<tr>
<td>It is produced by the immune cells (white blood cells) in response to invading pathogens</td>
<td>✔</td>
<td>❌ NaClO can be cytotoxic</td>
</tr>
<tr>
<td>NaClO can slow down wound healing</td>
<td>❌</td>
<td>❌ NaClO does not easily penetrates the bacteria</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EFFICACY</th>
<th>HYPOCHLOROUS ACID (HClO)</th>
<th>SODIUM HYPOCHLORITE (NaClO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HClO is 80 times stronger than NaClO</td>
<td>✔</td>
<td>❌</td>
</tr>
<tr>
<td>NaClO does not easily penetrates the bacteria</td>
<td>❌</td>
<td>❌</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>pH</th>
<th>HYPOCHLOROUS ACID (HClO)</th>
<th>SODIUM HYPOCHLORITE (NaClO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidic pH</td>
<td>✔</td>
<td>❌ Alkaline pH</td>
</tr>
</tbody>
</table>

CLINICAL CASE STUDIES: LEG ULCERS
Clinical cases (1/3)

- AGE, SEX: 48, male
- WOUND ONSET: 15 years before treatment with a *wound cleanser containing hypochlorous acid*
- COMORBIDITY: severe
  - Essential hypertension
  - Lymphoma: in 1999
  - Epilepsy
  - Valvular heart disease
  - Osteomyelitis of the knee in 2010
- CASE HISTORY BEFORE NEXODYN:
  - Traffic accident with left lower limb severe injury. Subsequent alteration of vascular architecture with the appearance of a large ulcer on the lower third of the left leg after chemotherapy, due to a car accident about 15 years ago
  - Large ulcer on the left leg (lower 1/3) treated with cycles of hyperbaric oxygen therapy. Since then, the lesion has never come to resolution.
  - From November 2011 to June 2013, the patient underwent 4 surgeries with engineered graft and skin graft without any benefit, with the exception of wound depth, becoming superficial.
## Clinical cases (1/3)

### Before and After Images

**BEFORE**

**AFTER**

**Man, 48 yo**

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**From T0 to ≈ 10 months after**

<table>
<thead>
<tr>
<th>Time (days)</th>
<th>Tissues</th>
<th>Exudate</th>
<th>Depth</th>
<th>Area (cm²)</th>
<th>VAS (pain)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Colonized</td>
<td>Hyperexudating</td>
<td>Superficial</td>
<td>250</td>
<td>7</td>
</tr>
<tr>
<td>12</td>
<td>Colonized</td>
<td>Average</td>
<td>Superficial</td>
<td>250</td>
<td>6</td>
</tr>
<tr>
<td>42 (=1.5 m)</td>
<td>Cleansed</td>
<td>Controlled</td>
<td>Superficial</td>
<td>215</td>
<td>4</td>
</tr>
<tr>
<td>183 (=6 m)</td>
<td>Re-epithelising</td>
<td>Controlled</td>
<td>Superficial</td>
<td>184</td>
<td>2</td>
</tr>
<tr>
<td>302 (=10 m)</td>
<td>Re-epithelising</td>
<td>Controlled</td>
<td>Superficial</td>
<td>135</td>
<td>2</td>
</tr>
<tr>
<td>Result</td>
<td>Improved</td>
<td>Improved</td>
<td>Unchanged</td>
<td>-46.0%</td>
<td>-71.4%</td>
</tr>
</tbody>
</table>
Clinical cases (2/3)

- AGE: 31
- SEX: male
- WOUND ONSET: 2 years before treatment with a **wound cleanser containing hypochlorous acid**
- COMORBIDITY: severe
  - Young refractory severe obesity; sleeve gastrectomy in 2010 (pre-surgery weight 227 kg; 148 kg in 2011)
  - Psoriatic arthritis
  - Very large peripheral and lower edemas on a lymphostatic basis
- CASE HISTORY:
  - Stasis ulcer that does not tolerate the bandage
  - DE grafting with improvement on 06/2013
  - Very low compliance
  - Constant infections
Clinical cases (2/3)

From T0 to ≈ 9.5 months after

Stasis ulcer that does not tolerate the bandage

<table>
<thead>
<tr>
<th>Time (days)</th>
<th>Tissues</th>
<th>Exudate</th>
<th>Depth</th>
<th>Area</th>
<th>VAS (pain)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Infected</td>
<td>Hyperexudating</td>
<td>Deep</td>
<td>300</td>
<td>8</td>
</tr>
<tr>
<td>22</td>
<td>Cleansed</td>
<td>Average</td>
<td>Superficial</td>
<td>250</td>
<td>5</td>
</tr>
<tr>
<td>155 (=5 m)</td>
<td>Cleansed</td>
<td>Average</td>
<td>Superficial</td>
<td>180</td>
<td>2</td>
</tr>
<tr>
<td>236 (=7.5 m)</td>
<td>Cleansed</td>
<td>Hyperexudating</td>
<td>Superficial</td>
<td>150</td>
<td>2</td>
</tr>
<tr>
<td>295 (=9.5 m)</td>
<td>Cleansed</td>
<td>Poor</td>
<td>Superficial</td>
<td>118</td>
<td>2</td>
</tr>
<tr>
<td>Result</td>
<td>Improved</td>
<td>Improved</td>
<td>Improved</td>
<td>-60.66%</td>
<td>-75%</td>
</tr>
</tbody>
</table>
AGE: 83
SEX: male
WOUND ONSET: 2.5 years before treatment with a *wound cleanser containing hypochlorous acid*
COMORBIDITY: severe
- Benign prostatic hyperplasia with previous TURP (Transurethral resection of the prostate)
- Hypertension
- Post-thrombotic syndrome on the right leg
- Lipotimic episodes
- Paroxysmal atrial fibrillation
- Chronic carential anaemia

CASE HISTORY:
- April 2012: hospitalization with a diagnosis of bilateral ulcers of the lower limbs by pyoderma gangrenosus and polimicromic super-infection, with severe sepsis, eurhythmic paroxysmal atrial fibrillation by wandering pacemaker at heparin in coagulant dosage, mild heart failure, anasarcal condition in severe protein-caloric malnutrition, psychomotor agitation with delirium perhaps iatrogenic in nature (carbapenem and opiates), suspected sleep apnea syndrome.
- April 2013: new hospitalization for re-grafting
Clinical cases (3/3)

**BEFORE**
Man, 83 yo
Bilateral ulcers of the lower limbs

**AFTER**

From T0 to ≈ 9 months after

<table>
<thead>
<tr>
<th>Time (days)</th>
<th>Tissues</th>
<th>Exudate</th>
<th>Depth</th>
<th>Area (cm²)</th>
<th>VAS (pain)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-455 (≈15 m)</td>
<td>Slough</td>
<td>Hyperexudating</td>
<td>Superficial</td>
<td>160</td>
<td>6</td>
</tr>
<tr>
<td>-70 (≈2 m)</td>
<td>Slough</td>
<td>Hyperexudating</td>
<td>Superficial</td>
<td>140</td>
<td>6</td>
</tr>
<tr>
<td>0</td>
<td>Slough</td>
<td>Hyperexudating</td>
<td>Superficial</td>
<td>120</td>
<td>5</td>
</tr>
<tr>
<td>Result</td>
<td>Unchanged</td>
<td>Unchanged</td>
<td>Unchanged</td>
<td>-25%</td>
<td>-17%</td>
</tr>
</tbody>
</table>

START OF TREATMENT WITH NEXODYN

<table>
<thead>
<tr>
<th>Time (days)</th>
<th>Tissues</th>
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<th>Area (cm²)</th>
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<tbody>
<tr>
<td>0</td>
<td>Slough</td>
<td>Hyperexudating</td>
<td>Superficial</td>
<td>120</td>
<td>5</td>
</tr>
<tr>
<td>190 (≈6 m)</td>
<td>Slough</td>
<td>Average</td>
<td>Superficial</td>
<td>70</td>
<td>2</td>
</tr>
<tr>
<td>275 (≈9 m)</td>
<td>Slough</td>
<td>Poor</td>
<td>Superficial</td>
<td>38</td>
<td>1</td>
</tr>
<tr>
<td>Result</td>
<td>Improved</td>
<td>Improved</td>
<td>Unchanged</td>
<td>-68.33%</td>
<td>-80%</td>
</tr>
</tbody>
</table>
Thank you to Angelini for sponsoring this webinar

We will take a few minutes to review......
NEXODYN® can support the physiological healing process

NEXODYN® is a FDA-cleared hypochlorous acid-based wound cleanser, developed for topical treatment in the field of acute and chronic wound management.

MAIN PRODUCT FEATURES

- Acidic pH (2.5 – 3.0)
- High purity (>95% of free chlorine species derived from HClO)
- Free Chlorine species: 40-70 ppm
- Long stability: 30 days from first opening

The mechanical action of the fluid flowing across the lesion can help to remove biologic and inert materials such as microorganisms, biological debris and environmental dirt.
Bacterial activity tests

The antimicrobial preservative effectiveness of HClO has been demonstrated against the organisms in the table below in *in vitro* testing (Time Kill Assay):

<table>
<thead>
<tr>
<th>Pathogenic Bacteria</th>
<th>Log Reduction / Exposure Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>99.9992% (5.11 Log$_{10}$) after 15 sec</td>
</tr>
<tr>
<td><em>Staphylococcus pyogenes</em></td>
<td>99.9958% (4.38 Log$_{10}$) after 15 sec</td>
</tr>
<tr>
<td><em>Staphylococcus epidermidis</em></td>
<td>99.9499% (3.30 Log$_{10}$) after 15 sec</td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>&gt;99.999% (&gt; 6.11 Log$_{10}$) after 15 sec</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>&gt;99.999% (&gt; 5.55 Log$_{10}$) after 15 sec</td>
</tr>
<tr>
<td>Multi-drug resistant (MDR) <em>Staphylococcus aureus</em></td>
<td>&gt;99.999% (&gt; 5.44 Log$_{10}$) after 15 sec</td>
</tr>
<tr>
<td>Extended-spectrum beta-lactamase (ESBL) producing Enterobacteriaceae</td>
<td>&gt;99.999% (&gt; 6.23 Log$_{10}$) after 15 sec</td>
</tr>
<tr>
<td>Vancomycin intermediate resistant <em>Staphylococcus aureus</em> (VISA)</td>
<td>&gt;99.999% (&gt;5.84 Log$_{10}$) after 15 sec</td>
</tr>
<tr>
<td>Multi-drug resistant (MDR) and OXA-48 producing <em>Klebsiella pneumoniae</em></td>
<td>&gt;99.999% (&gt; 5.32 Log$_{10}$) after 15 sec</td>
</tr>
<tr>
<td>Extended-spectrum beta-lactamase (ESBL) producing <em>Proteus mirabilis</em></td>
<td>&gt;99.999% (&gt;5.99 Log$_{10}$) after 15 sec</td>
</tr>
<tr>
<td>Multi-drug resistant (MDR) <em>Escherichia coli</em></td>
<td>&gt;99.999% (&gt;5.92 Log$_{10}$) after 15 sec</td>
</tr>
<tr>
<td><em>Candida albicans</em></td>
<td>&gt;99.999% (&gt;5.01 Log$_{10}$) after 15 sec</td>
</tr>
</tbody>
</table>
How to use NEXODYN®

Applying NEXODYN® on wounds is fast and simple

1. At each medication, the whole lesion area should be abundantly sprayed with Nexodyn™

2. The solution should be allowed to dry. No rinsing required.

3. A second application of Nexodyn™ can be consecutively repeated, if necessary

4. The solution should be allowed to dry. No rinsing required.

5. Following cleansing, with Nexodyn™, standard therapy can be applied as required.

Contraindications: Do not use in case of hypersensitivity to any component of the product (hypochlorous acid, chlorine and hypochlorite ion)
The right tools make all the difference for your patients!
Delivered to your patient’s home
References

(11) Main RC (2008): J Wound Care 17(3): 112-114