Identification, diagnosis and treatment of wound infection


Abstract
The early identification of the subtle signs of increased bioburden in a wound enables timely and appropriate treatment and therefore improved patient outcomes. The rising costs of antimicrobial dressings and the growth in antibiotic-resistant organisms increase the need for correct diagnosis. Indiscriminate use of antibiotics is a significant contributory factor in bacterial resistance. This article describes a new tool devised by a professional working group of tissue viability nurse specialists which is designed to help healthcare professionals to identify and manage bacterial burden in wounds. It is hoped that this will assist prompt diagnosis and help to reduce patient morbidity with appropriate and timely interventions.

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intervention available to healthcare professionals treating infected wounds, but they are expensive. Silver dressings cost £26 million of a total spend of £116 million for wound dressings on NHS prescription from October 2008 to September 2009. Silver dressings accounted for 11% of issued items, but 22% of spend (National Prescribing Centre 2010). A Cochrane review found there was not enough good quality evidence to support the use of silver dressings (Palfreyman et al 2006). However, a meta-analysis by Lo et al (2008) identified that, despite the need for further research, there is evidence to support their use, with some research demonstrating that silver dressings have a positive effect on chronic infected wounds. When compared with standard dressings, antimicrobial dressings can appear costly, but used appropriately and in a timely manner, they can provide an effective clinical outcome for patients without the need to revert to systemic antibiotics (National Prescribing Centre 2010). The key to achieving an effective clinical outcome is the correct identification of critical colonisation at the right time.

**Recognition of bacterial burden and infection**

One of the main goals of wound management is early intervention. Hence, prompt recognition of increasing bacterial burden is essential to allow timely intervention with antimicrobial dressings and other appropriate treatment. However, this may prove challenging in itself because the manifestation of increasing bacterial burden and infection is dependent on many variables, including whether the patient is immunocompromised, bacterial virulence and the size, site and aetiology of the wound (Patel 2010). The treatment process is further complicated by the growing number of antibiotic-resistant organisms. However, most practitioners are aware of the need for appropriate treatment selection to achieve the best patient outcomes.

As previously stated, assessment of bacterial burden is problematic because the effects of bacteria in a wound are dependent on the type of wound, the bacteria present in the wound and the patient’s immune response (Scanlon 2005). This requires the nurse to undertake a detailed patient assessment as well as a comprehensive wound assessment. The patient history will identify factors that may increase the risk and severity of wound infection (Box 1), while regular structured wound assessment (Box 2) will support the early identification of the signs and symptoms of infection. These can range from subtle, local signs to serious systemic signs (Box 3).

**BOX 1**

**Risk factors for wound infection**

- Circulatory or respiratory disorders that reduce blood and oxygen supply within a wound.
- Metabolic disorders, including diabetes mellitus, that interfere with the normal inflammatory response.
- Malnutrition is associated with a poor immune response.
- Immunosuppression may be a result of concurrent infections or the use of drugs such as chemotherapy, corticosteroids and immunosuppressants.
- Advancing age may lead to chronic disease and a less effective immune response.
- Wound characteristics such as acute wounds resulting from contaminated surgery or long operative procedures; wounds containing necrotic tissue or foreign bodies; and chronic wounds that are large, deep or sited near a site of potential contamination, for example the groin.
- Microbial pathogenicity and virulence. The number and virulence of bacteria within a wound can determine the severity of an infection, that is, the greater the number of bacteria, the greater the risk of infection; conversely, certain bacteria can cause infection in relatively low numbers (virulence).

Patel (2010)

**BOX 2**

**Structured wound assessment**

- Wound location.
- Wound size.
- Wound bed appearance.
- Exudate volume, viscosity and colour.
- Wound odour.
- Wound-associated pain.
- Condition of the surrounding skin.

(Kingsley and Leaper 2009)

**Working collaboratively**

The Swindon, Wiltshire, Bath and north east Somerset (BANES) (SW&B) Wound Group recognised the considerable advantages to be gained by working collaboratively throughout the Wiltshire regions with Bath Royal United Hospital, BANES Primary Care Trust (PCT), Great Western Hospital NHS Foundation Trust, Swindon PCT and Wiltshire PCT, as well as with external contributors. These advantages include:
Art & science wound care focus

▷ Development of tools to promote the continuity of care for patients in acute and primary care, especially when patients move across NHS trust boundaries.
▷ Efficient use of resources.
▷ Sharing of information and current guidance.
▷ Supporting each other on implementing the new guidance.
▷ Sharing of success and any obstacles.
▷ An ability to respond to the need for change.

The SW&B Wound Group recognised the advantages of developing a tool to support and assist in the co-ordination of care in primary, secondary and tertiary settings, which would enable a smooth pathway for patient care. There was a clear focus on what the group wanted to achieve, therefore collaboration was not difficult.

A theranostic tool (Figure 1) was designed through a series of meetings, with each member of the group having responsibility for a part of the project. Current research evidence and clinical guidance were considered, with input and guidance from other professionals, including microbiology teams, podiatrists, and infection prevention and control teams. The theranostic tool is now part of the wound policy for every site involved in the project. It is included in staff education and forms an integral part of wound assessment by clinical staff.

Theranostic tool

The term theranostic refers to the process of diagnosing and determining a therapy for individuals (World Union of Wound Healing Societies 2008). The theranostic tool is an aid to help the practitioner determine the levels of bacterial burden in a wound. It relates the increasing of bacterial burden to the patient’s immune response, thereby helping to identify abnormal states that will adversely affect wound healing. The tool guides the clinician through a spectrum from contamination and colonisation to infection (Figure 1).

Bacterial ‘contamination’ in a wound, where there is the presence of organisms but no active growth, is not considered to be relevant to clinical practice (Gray et al 2005). Similarly, in a wound healing by secondary intention, ‘colonisation’ is considered to be a healthy, stable state (Edwards and Harding 2004); these wounds usually heal without the need to use antimicrobial dressings as the patient has an effective immune response (Leaper 1994).

Critical colonisation (Davis 1998) is the subtle state between colonisation and infection in which multiplication of bacteria delay wound healing, without the overt signs and symptoms of infection (Cutting 1998). Some wounds progress quickly from colonisation to infection and may deteriorate or stop healing as a result. Reduction in bacterial burden is necessary to prevent the development of infection and promote wound healing.

Infection is the point at which the patient’s immune response is overwhelmed by the increasing bacterial burden. Infection can be differentiated into local and systemic infection and this differentiation can be used to help determine whether topical or systemic treatment is required (Gray et al 2005).

Use of the theranostic tool can assist clinical decision making and identification of treatment options, guiding the clinician to treatment options if the patient is either at high risk – if he or she has diabetes or a compromised immune or circulatory system – or has a chronic wound. The clinician is also guided in the use of topical antimicrobials, antibiotics and the need to take a wound swab. Laboratory tests may help support a diagnosis of infection, but these must be considered in the context of regular, comprehensive assessment that includes all patient-related factors, the wound and the surrounding tissue.

Conclusion

Wound infection is the outcome of the dynamic interactions that take place between a host, a potential pathogen and the environment (EWMA 2005). In recent years, bacterial virulence and resistance, resulting largely from the indiscriminate use of antibiotics and the...
**FIGURE 1**

**Bacterial burden theranostic tool**

Use this guidance to:
- Support clinical judgement in conjunction with relevant local policies or protocols, including infection control, wound formulary and wound management.
- Help determine if a wound is contaminated and colonised, critically colonised or infected.

Note that high-risk patients, including those with diabetes or compromised immune or circulatory systems, may not display the signs and symptoms of critical colonisation or infection described below and may present with more subtle signs.

<table>
<thead>
<tr>
<th>Local signs and symptoms</th>
<th>Contamination and colonisation</th>
<th>Critical colonisation</th>
<th>Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healing</td>
<td>Wound healing progressing as expected</td>
<td>Healing has slowed or stopped (non-progressing wound)</td>
<td>Healing has stopped or wound has deteriorated or extended</td>
</tr>
<tr>
<td>Wet wound</td>
<td>Normal exudate for patient and wound type</td>
<td>Increased exudate</td>
<td>Copious or purulent exudate</td>
</tr>
<tr>
<td>Dry wound</td>
<td>Minimal or no exudate</td>
<td>Increased exudate</td>
<td>Increased exudate</td>
</tr>
<tr>
<td>Pain</td>
<td>No change</td>
<td>Increased or changed pain</td>
<td>Increased or changed pain</td>
</tr>
<tr>
<td>Erythema</td>
<td>Erythema not usually present*</td>
<td>Erythema not usually present*</td>
<td></td>
</tr>
<tr>
<td>Other factors</td>
<td>Also consider: abnormal/changed colour, discoloured/friable tissue, presence of necrotic or sloughy tissue, pocketing and bridging</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Systemic signs and symptoms</th>
<th>None</th>
<th>None</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systemic antibiotics</td>
<td>No</td>
<td>Consider antibiotics</td>
<td>Yes</td>
</tr>
<tr>
<td>Wound swab</td>
<td>No†</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management</th>
<th>Antimicrobial dressing as per local wound formulary</th>
<th>Antimicrobial dressing as per local wound formulary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimicrobial dressing</td>
<td>Standard dressing</td>
<td>Antimicrobial dressing as per local wound formulary</td>
</tr>
<tr>
<td>Other actions</td>
<td>Treat/optimise co-existing morbidities</td>
<td>Consider referral to tissue viability team</td>
</tr>
<tr>
<td></td>
<td>Assess wound for critical colonisation/infection at every dressing change</td>
<td>Treat/optimise co-existing morbidities</td>
</tr>
<tr>
<td></td>
<td>Debride sloughy/necrotic tissue†</td>
<td>Assess wound for infection at every dressing change</td>
</tr>
<tr>
<td></td>
<td>Refer to surgeons if necrotising fasciitis suspected</td>
<td>Debride sloughy/necrotic tissue†</td>
</tr>
<tr>
<td></td>
<td>Refer to tissue viability team</td>
<td>Refer to surgeons if necrotising fasciitis suspected</td>
</tr>
<tr>
<td></td>
<td>Consider referral to microbiology team</td>
<td>Refer to tissue viability team</td>
</tr>
<tr>
<td></td>
<td>Consider referral to microbiology team</td>
<td>Consider referral to microbiology team</td>
</tr>
</tbody>
</table>

* Some wounds (if chronic or <72 hours old) may have an erythematous border due to the inflammatory processes of wound healing; the erythematous border should be <1cm; † Wound swabs: screen for meticillin-resistant Staphylococcus aureus as per local policy; ‡ Keep lower limb wounds dry until assessed by a specialist (tissue viability, diabetic podiatry or vascular team) – do not attempt to debride (European Wound Management Association 2005). © Swindon, Wiltshire, Bath and north east Somerset Wound Group (2011)
increasing cost of antimicrobial dressings, has led to an urgent need for accurate methods of wound diagnosis (EWMA 2005). The early identification of wound infection allows timely and appropriate treatment, which can reduce the risk of complications and lead to improved patient outcomes, while reducing unnecessary expenditure. Recognising increasing bacterial burden is a challenge for clinicians as there are many variables that affect its manifestation (Patel 2010). A lack of knowledge and clinical experience can result in inappropriate treatment choices.

This article has introduced a theranostic tool, which was developed through the collaborative working of a group of tissue viability nurse specialists, to assist the clinician in identifying and managing bacterial burden in wounds. The tool, used together with a comprehensive patient history and structured wound assessment, guides the clinician to recognise the bacterial status of the wound.

The theranostic tool assists clinical decision making and treatment choices to promote wound healing. It is hoped that the use of this tool will aid prompt and accurate diagnosis of wound infection and reduce patient morbidity by ensuring appropriate and timely therapeutic interventions while reducing the financial and clinical implications of unnecessary treatments NS

References


