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Review Article

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Recognizing High Risk Traumatic Wounds and Preventing Infections and Complications

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Abstract

Simple traumatic wounds are a frequent event that can usually be managed without sequelae, unless the wound is of high risk. High risk wounds have a greater propensity to become infected and complicated. Such wounds are characterized by a specific type of wound (i.e. jagged), location of the wound (i.e. lower leg); and patient's underlying medical condition (i.e: diabetes). If these wounds become infected, they have a negative impact on morbidity, mortality, quality of life, and costs. The take-away should be a wake-up call to physicians specifically and healthcare professionals more broadly that a much more aggressive and effective treatment regimen to prevent wounds from becoming infected is required. Such a regimen should likely include a comprehensive understanding of wound types, the degrees of microbial contamination, and novel ways to prevent infections through wound debridement and irrigation.

Keywords: Immunosuppressive; Patient's; Traumatic wounds

Introduction

The most common, important, and preventable challenge to wound healing is preventing infection. The failure to do so can have a significant impact on morbidity, mortality, quality of life, and costs. Traumatic lacerations account for approximately 8% of emergency room visits [1]. Preventing secondary infection is critical in these injuries so they do not become chronic or complicated wounds. Hollander's study found that those wounds that had jagged edges, stellate shape, visible contamination, injury deeper than the subcutaneous tissue, and presence of a foreign body all had an increased risk of infection, though lacerations on the head/neck were less commonly associated with development of an infection than lacerations in other locations. Most of the traumatic wounds had low bacterial counts usually less than 10 [2].

High-risk patients identified in other large studies of 23,649 and 15,000 surgical patients respectively have shown that the elderly, diabetic patients, or those with chronic renal failure, obesity, malnutrition, and use of immunosuppressive medications are all at increased risk of developing a secondary wound infection that frequently become chronic and complicated wounds [3,4].

Such wounds often become more difficult-to-treat, which, once again, result in higher costs, decreased quality of life, and increased mortality. Accordingly, a more aggressive and effective treatment approach to irrigate and debride wounds for the purpose of preventing infection is required.

It is thus important to treat this type of traumatic wound more intensely in order to prevent costly complications. As noted, the use of irrigation and debridement of an acute wound should help prevent this from occurring [5]. The goal of irrigation is to remove necrotic tissue and expose healthy, well-perfused tissue that can populate the wound bed via epithelial cell migration, rather than keeping necrotic debris which only serves as a nidus for infection that can impede wound healing. Although the technical aspects of irrigation and debridement have been argued for years, there is general agreement that irrigation and debridement is an essential component of wound care [6].

High Risk Wounds

The critical threshold of 105 bacteria/gram of tissue for an infected wound has been generally accepted as the delineation between colonization and a clinically relevant infection that may impede wound healing [7]. The type of wound, the location of the

wound, and the general health of the patient has a large influence on the probability that the wound will get infected. So much so that the Academy of Emergency Medicine and Care (AcEMC) and the World Society of Emergency Surgery (WSES) came out with a position paper on the management of traumatic wounds. This paper stated:

It is useful to provide an initial stratification of the risk of infection for all the traumatic wounds. The risk assessment should be based on the following:

- Type of wound
- Location of the wound
- Characteristics of the wounded patient.

To simplify and optimize the management of patients in the emergency department, the following fields of stratification of the risk of infection were identified: type of wound, location of the wound, and characteristics of the patients. In (Tables I-III) the suggested items for risk assessment are summarized[8].

Straight stab wounds	low risk
Tears/bruises/contusion wounds	high risk
Puncture wounds	high risk
Wound with crush injuries	high risk
Bite wounds	high risk
Wounds contaminated with feces	high risk
Wounds contaminated with soil and dirt, or mineral oil	high risk
Wounds with the presence of foreign bodies	high risk
Wounds with edge diastasis	high risk
Engagement of deep tissues, exposed fracture	high risk

Table I:Infection risk assessment Based on the type of Wound.

Well vascularized tissue (head, neck, scalp)	low risk
High concentration of normal flora (mouth, genitals, armpits)	high risk
Poorly vascularized (hand, foot, lower and upper limb)	high risk

Table II:Infection risk assessment based on the location of the wound.

Child	low risk
Young	low risk
Adult	low risk
Elderly (>65 years)	high risk
Immunocompromised (treated with steroids, immunosuppressive agents, splenectomised, HIV ...)	high risk

Vascular disease	high risk
Diabetic	high risk

Table III:Infection risk assessment based on the characteristics of the patient.

Tables I-III Modified from: Management of traumatic wounds in the Emergency Department: position paper from the Academy of Emergency Medicine and Care (AcEMC) and the World Society of Emergency Surgery (WSES) 2016.

Preventing Infection in High Risk Wounds

Quinn followed 2,663 consecutive patients with traumatic lacerations who completed follow-up in three emergency departments and found that the following factors contributed the most to a higher probability of an infection developing:

- Diabetes
- Wound contamination
- Length of wound greater than 5 cm
- Location on the lower extremity
- Time from injury to wound closure does not increase the risk

Quinn further concluded that improvements in irrigation and decontamination over the past 30 years may have led to an improvement in outcome in the treatment of traumatic wounds[9]. Singer has estimated that there are 7-9 million traumatic lacerations reported in the US emergency departments each year[10]. Recent updates in the management of traumatic lacerations and other traumatic wounds have revealed new data that may help prevent these lesions from becoming infected, therefore preventing further chronic problems.

Bite wounds are another common traumatic wound that has a high infection rate. Almost half of all Americans will receive a bite wound sometime in their life and they account for approximately 5% of the traumatic wounds seen in the emergency department[11]. Jaindi found that when these bite wounds would get infected, they frequently become a difficult wound to treat[12].

In another emergency department study of the 103 adult patients who were treated for traumatic wounds requiring sutures, they identified clinical wound infections in almost one of six wounds sutured at their site[13].

Otterson's and other review revealed that data suggest the following[14]:

- Repair of simple lacerations on the trunk and extremities with absorbable sutures could be considered a viable alternative to non-absorbable sutures [15].
- Results have been indefinite if sutures coated with antimicrobial triclosan help reduce infection [16].
- Irrigation to help remove debris, bacteria, and dead tissue has a beneficial impact on care.
- Developments in irrigation technology has demonstrated
- Low pressure appears to be safer and more efficacious than high pressure [17].

- In a study with open fractures that compared the use of castile soap to normal saline, the castile soap group had the larger number of reoperations [18].
- Rates of infection were higher in a povidone iodine study versus normal saline in patients with simple traumatic lacerations treated in an emergency department [19].
- The use of antiseptics for prophylactic or therapeutic indications in wound treatment is possible for the following objectives [20]:
- Prevention of infection of acute wounds, e.g., after trauma, bite, or gunshot wounds.
- Prevention of postsurgical wound infections (surgical site infections, SSI)
- Decolonization of wounds colonized with multi-drug resistant organisms.
- Treatment of clinically manifested wound infections, including so-called critical colonization.
- Preparation for debridement or wound cleaning of chronic wounds in outpatient facilities.
- Aqueous solutions with chlorhexidine gluconate (CHG) are an attractive antiseptic because of the quick onset of action when used for intrawound irrigation. CHG was noted to be safe at a concentration of 0.05%, which is nontoxic to wound healing or granulation tissue and was found to maintain the viability of in vitro canine joints[21-23].
- Edmiston has found that general, orthopedic, cardiothoracic, and obstetrical surgical studies have documented the safety of CHG in elective surgical procedures.
- Additional studies on irrigation demonstrate that earlier irrigation improves bacterial clearance: irrigation within 3 h decreases bacterial load by 70%, versus 52% at 6 h and 37% at 12 h[24].
- In pediatric traumatic wounds it is especially important to use thorough irrigation, which serves to clean the wound and facilitate complete inspection[25].

Contemporary health care emphasizes patient centric medicine and studies show patients would rather endure more intensive expensive care to prevent infection and its complications. In order to determine patient preference concerning treatment of traumatic lacerations at the emergency department, Singer conducted a prospective observational survey. This was conducted at one urban university and suburban emergency department. They found that patients preferred the best medical outcome which avoided infection, had the best function, least pain, and cosmetic result rather than the cost, compassion of staff, length of stay and inconvenience and time lost from work or school[26].

The location of traumatic wounds is extremely important in the resulting outcome. Patients who sustain injuries of the lower leg are not only plagued with an increased rate of infections but if a traumatic laceration occurs in the pretibial region it is associated with a mortality of about 15% [27]. The infection rate following the surgical treatment of open ankle fractures has been reported to be

between 6% and 40% [28,29]. Irrigation is a key component of the effort to prevent infection after open ankle fractures, as it serves to decrease bacterial load and to remove foreign bodies[30].

In order to prevent infection and promote wound and bone healing the initial treatment of open fractures requires thorough irrigation and debridement[30]. If surgery is required in treating an acute traumatic wound and it becomes infected, it will significantly increase the medical cost. SSIs, in general, account for over \$3 billion in healthcare costs per year, with more than 150,000 new cases occurring annually in the US. A large portion of these costs are attributed to longer hospitalizations, readmissions, and additional surgeries required for the treatment of infected patients. The risk of developing SSIs varies tremendously, with orthopedic trauma demonstrating higher rates of SSI than many other surgical specialties [3,4]. Infected patients incurred greater costs than uninfected patients in all categories of service ($p < 0.01$). The median cost for treatment during the initial hospitalization and readmission for an infected patient was \$108,782, compared to \$57,418 for treatment of an uninfected patient ($p < 0.001$). One study determined that SSIs nearly doubled the costs for treating isolated orthopedic trauma injuries. The actual costs of treating SSIs are most likely higher than many estimates since infected patients may have additional hospitalization and surgery beyond the initial readmission are frequently not figured into the costs. Whitehouse [13] found that SSIs in orthopedics increase costs by 300% and prolong hospital stay by more than 2 weeks. Therefore, results may falsely indicate that the costs for treating an SSI may be less following trauma than other types of orthopedic procedures.

As noted, many studies looked only at the initial readmission for infections and therefore may have not included the costs of treatment or further readmissions required to treat the infection. Surgical site infection is defined to occur within 30 days of an operation or within one year after surgery if an implant is placed in a patient. It is estimated that annual incidence of SSI in the United States is 1.07%, with 8000 deaths directly related to SSI- and a financial cost of treatment rising to as much as \$10 billion[1].

Conclusion

High risk traumatic wounds should be treated aggressively to prevent infections and the development of complicated wounds. High risk wounds are those that have an increased incidence of infection due to the type of wound, location, or the patient's underlying medical condition. Those wounds are associated with an increased morbidity, mortality, poorer patient quality of life, and greater costs. A great deal more can be done to reduce wound infections though a more aggressive and effective treatment regimen to prevent wounds from becoming infected in the first place, including a comprehensive understanding of wound types, the degrees of microbial contamination, and novel ways to prevent infections through wound debridement and irrigation.

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