

UNIT NO. 2

ACUTE WOUND AND MANAGEMENT

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ABSTRACT

Acute wounds are a common presenting complaint of patients in the primary care setting. These can result from a variety of mechanisms ranging from lacerations and abrasions to stings, bites or burns. The management of acute wounds involves a proper evaluation with history, physical examination, and adequate management with local wound care, and consideration for the need for specialist review or systemic treatment. The general principles of wound management and special wounds like bite wounds and stings will be discussed.

Keywords:

Acute Wounds, Wound Management, Primary Closure, Secondary Closure, Animal Bites, Human Bites, Insect Stings

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INTRODUCTION

A wound is sustained when there is disruption of normal anatomy and integrity of tissue function.^{1,2} An open wound is created when physical injury results in a tear or cut in the skin, whereas blunt trauma causes a closed wound (i.e. contusion).³ Acute wounds typically follow through a timely healing process that restores tissue integrity, anatomy and function.^{1,3} They usually heal within 4 to 6 weeks and any wound that fails to do so would constitute a chronic wound.^{2,4} The definition of acute wounds includes surgical incisions and traumatic injuries⁴ such as lacerations, abrasions, stings, bites or burn injuries. The focus of this article would be on wounds sustained through traumatic injuries.

After initial insult, a series of physiological processes kicks in in sequence, namely haemostasis, inflammation, proliferation, and remodelling.³ Haemostasis is achieved via platelet aggregation, fibrin clot formation and various coagulation pathways. An inflammatory response is initiated soon after haemostasis via local infiltration of neutrophils and macrophages to prevent infection and promote wound healing. It also changes the micro-environment to encourage subsequent proliferation, but successful repair would require resolution of the inflammation.³ New granulation tissue and matrix material proliferates to fill up deficiencies in the soft tissues, and the differentiation of fibroblasts into myofibroblasts pulls the wound edges together, resulting in contraction to reduce the size of the wound.³ Eventually, type III collagen matures into type I collagen to increase soft tissue strength and integrity.⁵ “Normal healing” requires adequate blood supply, and a lack of inflammation and infection or residual debris.⁵

HISTORY

History taking should involve determining the mechanism of injury, excluding life-threatening conditions that may require more immediate attention than the acute wound itself, and determining the presence of any risk factors that may complicate wound healing or result in higher risks of wound infection.⁵ Hence, a complete history, including patient's past medical history, especially significant comorbidities that may impair healing such as diabetes and peripheral vascular disease, and tetanus immunisation history should be sought. The time of injury to presentation is also an important point to note as this would affect the decision regarding the type of wound closure (either primary, delayed or secondary).⁵ Wounds older than 6 hours are more prone to infection.^{2,6}

PHYSICAL EXAMINATION

It is essential to evaluate and ensure that the patient's vital signs are stable before attending to the wound. Similarly, any actively bleeding wound that may compromise a patient's haemodynamic status should be managed as rapidly as possible with simple haemostatic measures like applying direct pressure. Apart from volume loss from haemorrhage, healthcare providers should also keep in mind that any wounds involving more than 10 percent of the body surface area may also result in loss of excess extracellular fluids⁵ and may require intravenous replacement.

When examining a patient with acute wounds involving the extremities, it is important to assess for any neurovascular or deeper structural involvement such as tendon or bony injuries.⁵ If deeper structures are involved, specialist consultation and surgical intervention may be required.⁴ The location and dimensions of the wound and type of tissue involved should also be assessed and documented. The degree of contamination should be noted during the assessment as well. It is essential that all wounds be assessed through the full range of motion as, without doing so, deeper structural injuries may be missed.

MANAGEMENT

The most important goals of wound management are to achieve functional closure with restoration of normal function, maintain cosmesis, and decrease risk of infection.⁵

Proper first-aid management and wound preparation can ensure better healing and better outcomes.⁵ Cleansing of the wound can be achieved by three main methods: compression, irrigation and soaking. Cleansing with moistened gauze as

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Table 1. Common acute wounds ^{4,6}	
Incision	Injury to skin made by sharp instrument resulting in a clean cut with regular edges
Contusion	Injury due to blunt force resulting in tissue damage with bruising, without skin break
Laceration	Injury due to tearing of skin caused by blunt force, usually causing irregular edges
Puncture	Skin break caused by a pointed instrument, may be deep
Abrasion	Superficial removal of skin due to friction
Bites	Contused wounds with dirty, irregular edges caused by teeth

Table 2. Risk factors for poor wound healing ^{1,3,5}
1. Immunosuppressed states • Diabetes • Chronic steroid use, immunomodulators • Haematological malignancies or on chemotherapy • Renal failure • Immunodeficiencies 2. Poor perfusion to tissues • Peripheral vascular disease • Anaemia • Septic shock 3. Poor repair • Elderly • Malnutrition • Connective tissue disorder 4. Wound factors • Contaminated wounds • Tissue loss • Location of wound • Devitalised tissue, crush injuries • Presence of foreign body 5. Others • Socioeconomic status • Habitus • Occupation • Compliance • Other comorbidities, e.g. cardiac disease, hepatic disease, pulmonary disease

compresses helps to remove surface debris by contact while pressure irrigation provides a steady flow of solution across wound surfaces to remove deeper debris. Soaking of the wound with an over-hydrated gauze allows for physical removal of debris and hydrates the wound. The amount of solution required for irrigation depends on the wound characteristics and degree of contamination; generally, an estimated 50 to 100 mls of solution are required for every 1 cm of laceration length.⁵

Acute wounds can be closed by primary closure, delayed primary closure or through healing by secondary intention.^{4,5,7} Primary closure of wounds involves healing by first intention through closure of wound at the time of presentation. Delayed primary closure involves closure of wound at approximately 3 to 5 days later and may be used at times when there is concern of higher risks for wound infection or when presentation is delayed. The wound is left open to allow for removal of all contaminated material or tissue before closure.⁴ If appropriate, healing by secondary intention may be needed to allow wound healing and closure through physiological processes via granulation, contraction and deposition of scar tissue.^{4,5,7} Debridement may sometimes be necessary to remove devitalised tissue to promote healing.

Generally, primary closure of wounds can be performed for lacerations of the extremities for 6 to 10 hours from injury to presentation and up to 12 hours for more vascular areas like the face and scalp.⁵

Primary wound closure can be achieved using sutures, tissue adhesives, staples or steri-strips. Percutaneous sutures using non-absorbable materials such as prolene are commonly used for wounds with low to medium tension while deeper and more complex wounds would require closure in layers with absorbable sutures. Tissue adhesives are more tolerable and less painful but can only achieve closure in wounds with low tension. It should be noted that tissue adhesives have higher dehiscence rates than sutures⁵ and hence, selection of suitable wounds is essential. They should not be the method of choice for wounds with high tension or those situated over joints. Staples are normally used over areas with less cosmetic consideration such as the trunk and scalp.

The choice of dressing depends on whether the wound is closed primarily or left open for secondary closure. Acute wounds that are closed primarily should be covered with a dry sterile dressing for up to 48 hours. This allows for absorption of exudates and protects the wound from external contamination. The wound usually re-epithelialises after 2 to 3 days and dressing after this period of time is controversial.⁴ However, for acute wounds that are left open for secondary healing, moist saline dressings should be used and should be changed twice a day.⁴

The use of systemic antibiotics depends on the method of closure, risk of wound infection, and patient's risk factors for infection. Systemic antibiotics may be considered in patients

with high risk for infection and in contaminated wounds or special areas such as bites on the hands or face.⁵ On the other hand, the use of topical antibiotics is controversial. While it may provide a moist environment that would optimise re-epithelialisation, the risk of contact dermatitis needs to be considered.⁵

Tetanus prophylaxis should be considered. For high-risk wounds (i.e. wounds more than 6 hours old, contaminated wounds, foreign bodies, crush wounds, or avulsions), tetanus booster immunisation should be given to patients who have completed 3 doses of tetanus vaccination prior but have not received a booster jab in the past 5 years while both tetanus vaccine and immunoglobulin should be given (in separate areas) if the vaccination history is uncertain or incomplete.^{5,6,9} The first dose of tetanus vaccine should be given at presentation and followed up with the complete regime at subsequent dates. For low-risk wounds, a tetanus vaccine booster should be administered in those who have completed the 3-dose vaccination but have not received a booster for the past 10 years.^{5,6,9} Those with uncertain and incomplete vaccination history should receive a tetanus vaccination with subsequent follow-up for the complete course.^{5,6,9}

Specific conditions:

(a) Animal and human bites

The most common animal bites sustained are due to dogs, accounting for up to 80 to 90 percent of animal bites.^{10,11} The second most common bites are due to cats, followed by human bites which are the third most common cause of mammalian bite injuries.^{10,11} The risk of infection of any bite wound depends on a few factors: this includes the location of the bite, type of wound (punctures, avulsions, tears or abrasions), and host factors such as immunosuppressed states, age, chronic alcoholism and presence of comorbidities such as diabetes mellitus.¹⁰ Cat bites usually result in puncture wounds that penetrate into deeper tissues and hence have a higher infection rate of 30 percent to more than 50 percent, more than double the infection rate for dog bites.¹⁰ Human bites have an overall infection rate of about 18 percent.¹¹ The location of the bite wound may significantly increase the infection risk, and bites involving the hands, especially over the metacarpo-phalangeal joints, have more than double the infection risk compared to bites elsewhere.¹⁰ This is due to the complex anatomy of the hand which has multiple small compartments and a lack of subcutaneous tissues to separate the skin and the bone that increases the likelihood of spread and development of abscesses.^{10,11}

Of special concern is the clenched-fist injury, also known as "fight bite", sustained by someone punching another in the mouth with a clenched fist, resulting in a puncture wound over the metacarpo-phalangeal joint. This is the most serious of bite wounds on the hand when human bites are involved.¹⁰ This injury appears benign and, hence, commonly results in delay in seeking medical attention until infection develops.

Table 3. An assessment of the wound attributes should include assessment of the following:⁵

- Location of wound
- Wound colour
- Dimensions of wound
- Edges of wound
- Layers of skin involved
- Exposed tissues
- Description of skin around wound, e.g. erythematous, gangrenous, indurative, lymphangitic, associated contaminants
- Function of surrounding tissues or organs
- Neurovascular status, e.g. capillary refill time, distal pulses, sensation

Table 4. Suture types⁸

Absorbable					Non-absorbable		
Braided		Monofilament			Braided		Monofilament
Vicryl	Vicryl rapide	Monocryl	Fast absorbing gut	Chromic gut	Ethibond	Silk	Ethilon (nylon), Prolene (polypropylene)

Management of animal and human bites

The initial management of bite injuries is the same as with other acute wounds: obtaining a history and associated risk factors for infection or poor wound healing, ensuring the stability of the patient and excluding other life-threatening injuries before attending to the wound. Basic first aid and initial management would include a thorough cleansing of the wound and haemostasis.

There are some areas for special consideration when dealing with bite wounds: the need for specialist referral for wound debridement, primary or delayed closure, removal of foreign bodies such as teeth, and the need for antibiotics.

The primary closure of bite wounds is controversial. It is generally accepted that cat bites,¹² wounds that present after 24 hours, deep puncture wounds, wounds involving the hand, and wounds that appear infected clinically should not be sutured.¹⁰ Clean facial wounds sustained from dog bites may be closed primarily after proper wound cleansing and with antibiotic prophylaxis,^{10,11} due to concern of cosmesis.^{6,13} Elevation of

limbs is essential to reduce oedema in wounds involving the extremities.

The use of systemic antibiotics after bite wounds is also controversial for wounds without clinical evidence of infection.⁶ However, antibiotics are recommended to be given in patients who are immunocompromised, have more risk factors for infection, delayed presentation more than 8 hours, and who have bite wounds that are primarily closed, puncture wounds, cat bites, bites to hand and wounds with devitalised tissues.^{10,11} When empirical antibiotics are started, the drug of choice needs to be of broad spectrum and should cover for oral flora which include anaerobes such as *Bacteroides* and aerobes such as *Staphylococcus*, *Streptococcus*, *Eikenella corrodens* (human bites) and *Pasteurella multocida* (animal bites).^{10,11,14} Amoxicillin-clavulanic acid or second-generation cephalosporins are good choices. If allergic to penicillin, doxycycline (except in children and pregnant women) or azithromycin can be used.¹³

The need for specialist review should be considered as most

Table 5. Tetanus immunisation schedule for adults with wounds

History of tetanus vaccination	Low-risk wounds	High-risk wounds
Unknown vaccination status or < 3 doses	Tetanus vaccine	Tetanus vaccine and tetanus immunoglobulin
Completed 3 doses	Tetanus vaccine booster if last tetanus toxoid dose was more than 10 years earlier	Tetanus vaccine booster if last tetanus toxoid dose was more than 5 years earlier

significant bite wounds will require proper irrigation and debridement. The presence of both erythema and swelling after a cat bite to the hand significantly predicts the need for hospitalisation to institute more aggressive treatment.¹² Those with systemic infection, severe cellulitis, other significant comorbidities (such as immune-compromised states, peripheral vascular disease), any other bites to hand, bites requiring reconstructive surgery or failed outpatient therapy should also be considered for inpatient management.¹⁰

(b) Insect stings

Insects that sting come from the Hymenoptera family, which comprise 2 subgroups: the vespids (e.g. hornet, wasp, yellow jacket) and apids (e.g. honeybee and bumblebee). Most of the allergens are due to phospholipase A, hyaluronidase and other vasoactive peptides and amines in the venom.^{15,16} The incidence of anaphylaxis due to insect stings is estimated to be 0.3 to 3% in the general population.¹⁶

The common reaction to insect stings is a local reaction resulting in pain, swelling and erythema that is limited to the sting site. Sometimes, more extensive local reaction can occur resulting in progressive swelling, erythema and pain. Anaphylactic reactions may occur and are more commonly seen in young individuals under 20 years of age and have double the incidence in males as compared to females.¹⁶ Rarely, toxic reactions to the venom may occur, especially after multiple simultaneous stings (e.g. more than 50 stings).

Management of insect stings

For the localised reaction with erythema and swelling limited to the sting site, cold compresses and analgesia would suffice. More extensive reactions would require anti-histamines and systemic steroids if the symptoms are debilitating and extensive. It is generally unnecessary to administer tetanus in insect stings.¹⁶

Patients with anaphylaxis should be managed in the same way as anaphylaxis from any other cause, i.e. with intramuscular epinephrine, anti-histamines and systemic steroids. The airway

should also be assessed and managed as deemed appropriate.

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LEARNING POINTS

- Acute wounds become chronic wounds if they fail to follow through a timely healing process to restore anatomy and function within 4-6 weeks.
 - Evaluation of a patient with acute wounds involves a thorough history taking and physical examination.
 - Risk factors for infection include immunosuppressed states, poor perfusion to tissues, patient factors resulting in poor repair, wound factors, and other factors such as socioeconomic status, occupation, body habitus and presence of other comorbid illnesses.
 - Wounds with higher infection risk or neurovascular involvement should not be closed primarily.
 - Patients with haemodynamic instability, wounds with deeper structural involvement (such as neurovascular or tendon injury), wounds that needs surgical intervention, and wounds involving more than 10 percent of the patient's total body surface area should be referred for further evaluation.
 - Animal and human bites have high infection risk and usually require washout and wound debridement.
 - Insect stings can result in local or systemic reactions, and a systemic reaction with anaphylaxis should be managed with epinephrine, anti-histamines and steroids.
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