Wound types and healing part three: classification of injuries

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Louise O'Dwyer BSC (Hons), DipAVN(Surgical), DipAVN(Medical), RVN, looks at various wound types and how this affects treatment and care

THIS article looks at wound classification and how the type of wound determines the treatment and nursing care required. Articles on wound healing processes can be found in previous issues (*VN Times* 10.05 and 10.06).

The following parameters can be used to classify wounds:

• aetiology;

• nature and extent of skin deficit;

• degree of bacterial contamination;

• extent of trauma to surrounding tissues; and

• wound types.

In this article, wounds are classified and described by type.

Abrasion injuries

Abrasion wounds result from friction applied approximately parallel to the skin's external surface.

This usually results in removal of variable amounts of the epidermis, dermis and hypodermis.

In small animal practice, these wounds are commonly seen as a result of road traffic accidents – for example, where the animal has become trapped between the road surface and a moving vehicle. Such wounds are consequently heavily contaminated with bacteria, and the frictional nature of the injury means the bacteria and debris from the road surface can be deeply embedded within the upper layers of the tissue around the wound.

Abrasion wounds may also be seen as a result of poorly fitting casts and bandages, from abnormal wear of the patient's pads following prolonged contact with rough surfaces, or due to weight bearing on areas other than the pads.

Debridement

Effective debridement of these wounds is of paramount importance. Debris from the road surface is often deeply embedded within the wound, and abrasion wounds frequently result in an extensive tissue deficit. These wounds are often located on the distal limbs; therefore, reconstruction is challenging, with skin grafts or open wound management often the only options for closure.

Degloving wounds

Degloving injuries are caused when the skin is torn from the underlying tissues, usually from a limb. Mechanical degloving occurs where the overlying tissue is torn from the subdermal plexus – for example, following a road traffic accident.

Physiological degloving occurs when the skin is sheared from the subcutaneous tissues, resulting in damage to the local blood supply and causing ischemia. This leads to necrosis and the skin sloughing off over the following days. Secondary bacterial contamination frequently occurs with this physiological sloughing.

Avulsion injuries

Avulsion injuries refer to the forcible separation of tissues from their underlying attachments. These injuries frequently occur following dog bite wounds or road traffic accidents, where the skin and subcutaneous tissue is avulsed from the mandible, resulting in exposure of the underlying bone.

Shearing injuries

Shearing injuries have a similar aetiology to degloving wounds. They represent a combination of degloving and abrasion injuries and are frequently seen following road traffic accidents, with the wounds usually located on the patient's distal limb, particularly on the medial aspect of the carpus,

phalanges and tarsometatarsal joint.

Shearing injuries tend to be deeper than abrasion injuries, and may involve the underlying joints. Like abrasion injuries, large areas of tissue may be involved and will be heavily contaminated with foreign material – for example, gravel and bacteria.

Shearing wounds tend to be extensive and deep. As a result, a prolonged period of open wound management is often necessary. There may also be concurrent damage to the underlying joints and supporting soft tissue structures (tendons and ligaments), which may require external support during this period. Ultimately, prosthetic and ligament replacement may be required.

In severe cases, joint salvage may not be possible and, therefore, arthrodesis (surgical fusion of a joint) may be performed. In more severe cases, limb salvage may not be possible and amputation will be necessary.

Incision wounds

These wounds are most commonly presented in practice as intentional surgical wounds, but they can also be caused by trauma. They may be caused by a sharp object, such as a piece of glass or a metal shard, moving in a plane parallel to the surface of the skin. These wounds typically have clean, regular edges, which will gape open due to the inherent elasticity of the adjacent skin.

The skin often has relatively little involvement either side of the wound, but the incision itself may be long. There may be extensive damage to the deeper tissues, such as muscle, tendons, nerves and blood vessels, which may not be detected on first inspection. This highlights the importance of surgically exploring these wounds for signs of further damage.

Wound contamination is likely to be less than for abrasions. In addition, sharp trauma results in more bleeding, which will have an irrigating effect, reducing contamination. These wounds may be suitable for debridement and primary closure. Delayed primary closure, however, may be preferable if the wound is more than a few hours old, or there are concerns over contamination.

Puncture wounds

Puncture wounds are caused by a sharp object, for example a stick or metal railing, moving in a plane perpendicular to the skin surface. Penetrating wounds refer to those that have an entrance wound only, whereas perforating injuries refer to those with both an entrance and an exit wound.

A typical bite injury comprises the obvious puncture wound, which is usually of little significance, and the trauma to the deeper tissues, which many not be obvious initially, but is of much greater significance. Animal bite wounds, in which the skin is punctured primarily by the aggressor’s canine teeth are the most common puncture wound presentation. The skin puncture, which is often

the most obvious manifestation of the trauma, is not the only consideration. The mobile, superficial layers of the skin may have been subjected to a laceration injury, as well as the puncture wound, and the deeper, more fixed tissues may have been crushed by the teeth.

If the bite wound has been inflicted by another dog, the powerful masticatory muscles have the potential to crush tissues with a force of 150psi-450psi, with the tips of the canine teeth puncturing and lacerating the skin. Movement and shaking by the aggressor will result in additional tears and avulsion of the tissues from their attachment to deeper structures, possibly resulting in devitalisation of tissues and contamination with bacteria, deep into the subcutaneous and muscle tissues. This, therefore, predisposes bite wounds to infection.

All bite wounds, therefore, should be treated as contaminated. If left untreated, or not treated with appropriate antibiotics, the wound may become colonised by pathogens. A wound is classified as infected when the bacterial load is greater than 10^5 bacteria per gram of tissue.

Firearm injuries and snake bites are technically also puncture wounds, but have additional complications. These are mentioned in more detail later on.

Puncture wounds are generally treated by lavage, using copious volumes of saline or lactated Ringer’s solution, debridement and drainage. Puncture wounds that arise as a result of animal bites generally have pockets of dead space, which should be flushed and a dependent drain placed in them. Alternatively, the wound could be closed using walking sutures to eliminate this dead space, but only if the wound is considered sufficiently clean.

It may also be worth obtaining a bacterial swab that can be sent to a laboratory for culture and sensitivity testing, should wound healing not progress in a satisfactory manner.

Dog bite wounds are generally allowed to heal by secondary intention using appropriate wound management dressings. However, in some cases, en-bloc debridement may be performed to allow partial primary closure where there is sufficient tissue and skin available to perform this technique successfully.

Occasionally, dog bite wounds may not heal successfully and studies have indicated this may be due to inadequate lavage, debridement and drainage, which highlights the importance of these techniques in wound management.

Penetrating wounds to the thorax may result in pneumothorax, and those to the abdomen may damage viscera. Penetrating bite wounds to the thorax that go unnoticed may result in pyothorax formation.

Burns

Burns may be classified according to the depth and the surface area of the skin affected, as follows:

• first degree – epidermis only;

• second degree – epidermis and a portion of the dermis; and

• third degree – epidermis, dermis and variable proportion of the hypodermis.

Systemic complications include hyper/hyponatraemia, hyper/hypokalaemia, metabolic acidosis, pre-renal azotaemia, anaemia and septicaemia.

Burns are often extensive and reconstruction of the large skin deficits often presents a challenge. Eschar formation invariably results in large tissue deficits. It is important to remove this eschar to get back to a healthy granulation bed. Secondary bacterial contamination is common in burn wounds, but septicaemia is not.

First-degree burns will often heal by secondary intention, but second-degree burns may result in significant scarring, with possible compromise of function if the burn is close to a joint or body orifice, such as the mouth or anus.

Third-degree burns will require surgical reconstruction, such as flaps or grafts. Burns may be thermal (hot or cold), chemical (acid or alkali), electrical or radiant in origin.

Snake bites are a subset of puncture wounds, complicated by the injection of the snake’s venom. The adder is the only venomous snake indigenous to the UK, and snake bites are occasionally seen in dogs exercised outdoors on areas of heath or moorland. The snake’s venom results in local and systemic effects. Local effects cause tissue necrosis and damage to blood vessel walls, leading to ischemia and tissue sloughing.

These wounds usually involve an extremity on the ventrum. The wound is usually grossly swollen and initially oedematous. Later, there is progression to ischemia and necrosis of large areas of tissue around the puncture site.

Firearm injuries

The response of tissues to ballistic injuries is complex. The basic wound is a perforating or penetrating injury, but extensive damage is caused to the underlying tissue as the projectile moves on its trajectory. The bullet will cause stretching, compression and laceration of tissue.

Entry wounds are typically small, but the exit wounds may be large. Damage to tissue along the path of the projectile is likely to be more severe than the cutaneous wound. The pattern of trauma

is determined by the velocity of the missile. As velocity increases, the kinetic energy imparted to the tissues increases exponentially.

Some shotguns, airguns and handguns are classed as slow velocity (where the bullet travels at less than 300 metres per second). Deeper tissues are damaged by a compression wave that moves ahead of the bullet, and it is the effects of this wave that damage the tissues.

Further reading

- Baines S J (2003). Aetiology of cutaneous wounds. *Veterinary Times* Dec 2003: 8-10. Hayes G and Yates D (2003). Understanding dog bite wounds. *Veterinary Times,* Nov 2003: 16.