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Management of Traumatic Wounds in Horses

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Abstract

The aim of equine wound treatment is rapid healing with optimal functional and cosmetic outcome. Meticulous evaluation, surgical treatment following Halstead's principles and logical choice of dressings create the physiological conditions for healing. Many traumatic injuries that are treated by primary closure break down and then heal by second intention. Initially this occurs by accident, but with experience this is anticipated, allowing time and money to be saved. Owners should be warned about the long duration and high cost of treatment at the outset. This paper reviews the principles of equine wound treatment.

Introduction

Horses commonly sustain wounds owing to their instinct to flight, and in the way we confine and use them in close proximity to fixed obstacles. Management of traumatic wounds is therefore one of the most common challenges facing veterinarians working with horses. Treatment must be planned on an individual level, influenced not only by clinical, but by financial and logistical factors. Rapid healing with optimal functional and cosmetic outcome is the aim of treatment. This lecture reviews the important principles of initial wound assessment, surgical treatment and aftercare.

First Aids

First aid is often administered by the owner prior to seeking advice; inappropriate early treatment is a common problem. So, owner education is a critical part of success. See www.vethelpdirect.com for an example.

First aid should (a) prevent further damage to the animal, and (b) prevent further contamination. Arterial haemorrhage should be stopped by placement of a clean bandage or cotton wool/nappy, preferably sterilised. Heavily contaminated wounds should be cleaned with fresh running water, avoiding water-logging the tissue by minimising time spent flushing. Antiseptics, unless extremely dilute, are best discouraged.

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Assessments

It is tempting to rush to the wound, but the history, including initial treatment, should be ascertained and a full clinical examination undertaken. Systemic disease or haemorrhagic shock, indicated by high body temperature or heart rate respectively, requires other treatment considerations. It is easy to overlook smaller wounds, especially puncture wounds of the lower limb. If these have synovial involvement then the treatment and prognosis change drastically.

Tetanus prophylaxis is indicated with any open contaminated wound. In vaccinated animals with wounds less than 12 hours old, booster vaccination results in rapid antibody production well before toxin is produced. Where wound age or vaccination status is questionable, tetanus antitoxin should be supplied (1500 – 3000 IU) in combination with vaccine.

The use of analgesics is best minimised the early treatment phase unless signs of severe pain are already present. In this way, undiagnosed synovial sepsis or fractures are more easily identified over the subsequent hours and days.

Initial Evaluation

Thorough evaluation often requires sedation, but conservative doses should be used if the animal has suffered major blood loss. Twitches, whilst extremely useful for short periods of restraint in selected animals, should never be used for longer than 15 minutes at a time. Not only does the sedative effect wane, but permanent damage to the upper lip can occur and the welfare of the animal is unacceptably breached. Chemical restraint, sometimes in combination with short periods of physical, is ideal for most cases.

Bacteriological swabs should be taken from within the wound before palpation and cleaning. Detailed regional anatomical knowledge is required to gauge the likely structures involved, especially joints. The complexity of the wound can be estimated visually, but it should be copiously lavaged with sterile saline prior to sterile exploration. Whether sterilised blunt metal probes or fingers are used, the temptation to dive straight in must be resisted! The size and possible involvement of deeper structures, as well as the owner's budget, needs to be ascertained. Finally, the decision is taken to start treatment 'in the field', or to refer treatment at a veterinary hospital.

Generous bandages must always be applied to limb wounds prior to transport; where significant lameness is present indicating possible fracture, an appropriate splint should also be applied as well as analgesics. Broad-spectrum parenteral antibiotics should be supplied; in the field, oral potentiated-sulphonamides or enrofloxacin are the easiest to supply to owners. With contamination, fracture or risk of synovial sepsis, ceftiofur or penicillin-gentamicin are more appropriate.

Definitive Evaluation

The author typically obtains radiographs of limb wounds as the first stage, obtaining a minimum of 4 views in order to identify bone fracture. This has legal implications if general anaesthesia is subsequently carried out, since anaesthetising an animal with a non-displaced fracture would run a higher risk of catastrophic failure during recovery. A blunt metal probe may be placed simultaneously into the wound to help gauge depth and position. Ultrasonography can facilitate the assessment of some wounds better than radiography and is therefore complimentary. Synovial sepsis can be confirmed by aseptic synoviocentesis using an approach away from the wound itself and/or by injection of sterile saline. Lowered viscosity turbid synovial fluid with elevated protein ($\geq$ 40 g/L) and white cell count ($\geq 5 \times 10^9$/L) are indicative of sepsis.

In the final stage of definitive evaluation, the wound is clipped and the skin prepared for aseptic surgery, taking care not to contaminate the wound with hair. After flushing the wound with sterile saline solution, full exploration with a sterile finger and blunt probe can be carried out. Wounds often have extensive subcutaneous pockets; lifting or altering the limb position can facilitate their measurement.

Relatively minor and/or accessible wounds can often be evaluated and treated in sedated patients, bearing in mind that local anaesthesia is usually required for suturing. Regional nerve blocks are preferable to the topical application of local anaesthetic because the latter is cytotoxic and impairs healing. For larger wounds, or where deeper structures are involved, latter stages of evaluation and treatment are more safely and thoroughly performed under general anaesthesia.

Choosing Treatment

Wounds heal in several ways and selecting the most appropriate method from the beginning is arguably the hardest skill to learn. There are 3 choices:

I. Primary wound closure: suited to fresh wounds with minimal contamination or tissue loss. Care must be taken to follow Halstead's principles (see below).
II. Delayed primary wound closure: suited to heavily contaminated/infected wounds with minimal skin deficit, *e.g.* over the body. The wound is decontaminated as much as possible before packing with sterile dressing material. After regular changes, primary closure is carried out 4 – 7 days later, once infection is controlled and the inflammatory response is at its peak.
III. Second-intention healing: after initial cleaning and evaluation, the wound is left to heal by the normal physiological process of granulation, epithelialisation and wound contraction. Vets often feel considerable pressure to suture wounds, but many skin wounds on the body heal excellently by second intention.

Occasionally, wounds are encountered that cannot be treated economically with any chance of a successful outcome, due to their severity and (usually) involvement of deeper vital structures. These cases should be humanely destroyed.

Surgical Treatment

Halstead's surgical principles list haemostasis, gentle and accurate anatomic dissection, débridement, dead space closure and minimal wound tension, as the main factors in successful surgery of wounds. They have not altered since they were coined over 120 years ago. Débridement is the first stage of surgical wound treatment, during which as the majority of devitalised tissue and bacterial load is removed. Soil and other foreign material dramatically increase the chances of wound infection; it has to be removed, even if embedded in vital structures *e.g.* tendon.

Continuous flushing with sterile saline in combination with curettage and sharp excision is the simplest method of débridement. A 19G needle and syringe can deliver a water pressure of 8 PSI (0.5 ATM) which when applied to tissues can reduce bacterial load 100-fold. Mechanical pumps can deliver much higher pressures, but can also drive contamination deeper. The *Versajet*[1] is a new and highly effective mechanical device for débridement without this side effect. Obviously devitalised tissue should be removed, but care should be exercised not to remove so much as to make reconstruction impossible; devitalised skin is often preferable to no skin at all.

Subcutaneous pocketing often conceals contamination; wounds should be extended to allow full visualisation and débridement of the hidden tissue. These extensions created in surgery are normally sutured, depending on tension and wound reconstruction factors. Exposed cortical bone should preferably be covered with a tissue flap, even if the tissue flap appears devitalised. Sequestration usually takes 3 to 4 weeks to become apparent; owners should be warned about the risk and cost of this wherever exposed bone is noted.

Involvement of deeper structures, such as joints and tendon, must be ascertained and treated during surgery. Joints and bursae should be flushed with sterile saline, either by through-through needle lavage, or preferably endoscopically. The specific treatment of tendon, ligament and bone injuries, vary with location. Where anticipated, surgeons should familiarise themselves with the techniques described in the literature prior to embarking on surgery.

Suture Technique

In clean fresh wounds over the body, subcutaneous dead space should be minimised using a simple continuous pattern with ≥ 3 metric absorbable material. Skin should be closed using simple interrupted sutures with ≥ 3.5 metric monofilament suture. In contaminated wounds, the presence of subcutaneous sutures increases risk of infection; these are better treated by delayed primary closure or second intention healing. Wounds with severe skin deficit and tension have no choice but to heal by second intention.

Wherever practical, fresh wounds in the distal limb are best managed by primary closure because second intention healing is poor in horses compared to ponies, resulting in large slow healing granulating wounds. Clients should be warned about the significant risk of wound breakdown and the high costs of managing open wounds in the distal limb. Avoiding excess skin tension and minimising movement is the key to success, since failure commonly occurs due to these two factors. Fastidious aseptic technique and wound débridement is needed. A Robert-Jones bandage with splints, or half-limb cast, should be applied postoperatively to minimise movement.

Managing Excess Tension

Skin should never be sutured under high tension. Ideally it is sutured under moderate tension, reducing the open wound area but without placing undue tension on the edge. The remaining open wound heals by second intention. Moderate tension can be managed using a small number of vertical mattress sutures placed ~ 1 cm away from the wound edge. These can be threaded through 1cm sections of drip tubing to further spread tension. The wound edges are then be sutured normally. Several surgical techniques are described to reduce skin tension at the wound edge and facilitate primary closure, *e.g.* parallel stab incisions, 'Z' and 'H –plasty', but in the author's hands are rarely indicated.

Drains

Drains allow continued débridement through the discharge of cellular debris and prevent seroma formation within tissue plains. They should be considered for any open contaminated wound, especially where dead space is encountered during treatment. They are normally left in place for 2 to 4 days, after which they can prompt a foreign body response, manifesting as an increase in discharge after initial decrease. Because they provide a direct route for invading bacteria, they should be covered wherever possible. Penrose drains are used most commonly, but closed suction drains are also useful and are superior to the former in removing exudate. Drains should enter and exit wound spaces through separate portals, one of which should be placed from the most dependent part of the wound.

Dressings

Dressings are most commonly used on the limbs of horses, although stent bandages and adhesive dressings can be used on the body. On the limb, dressings include (i) a primary layer in direct contact with the wound surface, (ii) a secondary layer, which protects the primary and absorbs exudate, and (iii) a tertiary layer, which is the outside visible surface of the dressing and protects it from the environment. Secondary layers are usually cotton wool based whilst tertiary layers broad somewhat stretchy cotton or plastic based bandage.

Choice of primary wound dressing is an important part of wound treatment, and can change day to day. Primary dressings are classified as occlusive or semi-occlusive. Occlusive dressings, such as *Allevyn*[1] and hydrocolloids, promote a moist wound environment, encouraging granulation and epithelial migration. They are best limited to the earlier phase of wound healing, unless there is contamination and/or extensive fluid discharge which would contraindicate their use. Semi-occlusive dressings, such as *Melolin*[1], have a non-adherent layer in contact with the wound, with an absorbent layer directly above it to remove exudate. These promote a drier wound environment if changed regularly. Dressings are also classified as adherent or non-adherent. Adherent dressings, such as cotton gauze, rapidly stimulate excess granulation and are probably best avoided in horses. Occasionally, granulation tissue (GT) fails to form, usually over exposed cortical bone. In such cases, the bone must be very gently handled, only using sterile saline for lavage. Granulation is stimulated traditionally by using an occlusive

primary dressing, those containing alginate, or more recently by using a topical gel containing acemannan and carrageenan (CarraVet[2]).
One problem often seen in chronic granulating bandaged wounds is infection, often by antibiotic-resistant *Pseudomonas* spp. Excess smelly yellow exudate forms over the granulation bed. Parenteral antibiotics are ineffective, whilst topical antibiotics are frequently toxic, inhibit wound healing and rapidly stimulate bacterial resistance. The most useful dressings for this situation contain silver. The author uses silver dressings where possible from day 1; they are currently the most expedient method of controlling wound infection with no recorded instance of bacterial resistance.

Managing Chronic Granulating Wounds

Unlike ponies, horses have a weak inflammatory phase of wound healing in the distal limb, resulting in chronic inflammation and excess GT production. Wounds of the distal limb which are treated by second intention healing frequently require prolonged bandaging and control of excess GT. Regular débridement, topical corticosteroid and skin grafting are all used to this end. Latterly, a degree of desiccation can also help. These factors are all used at various times to help stimulate the acute inflammatory response, encouraging epithelialisation and inhibiting further granulation. Recently, the use of silicone dressings like *Cica Care* [1] has been described, effectively preventing excess GT formation from occuring.

Proud GT is best removed by sharp excision using a No. 11 scalpel blade, anticipating copious capillary haemorrhage. Sufficient GT should be removed to provide a flat wound bed level with the epithelial margin.

A number of corticosteroid wound preparations are commonly available. They should be conservatively applied only over the GT, avoiding the epithelial margin. The author tends to use short acting corticosteroids, such as hydrocortisone, applied once per 7 – 14 days. This is because long acting preparations can inhibit epithelialisation, slowing healing. However, any corticosteroid gel is better than none.

Skin grafting is a potent stimulant of acute inflammation. Grafts are classified according to source, thickness and size. They can be full- or partial- thickness epidermis. Sheet and mesh grafts require specialist equipment, are rarely used and are not discussed further here. By contrast, island grafts are very commonly used and require no specialist equipment. For successful grafting, the recipient bed must provide ideal conditions for graft adherence and vascularisation. Healthy non-infected granulation tissue flush with the skin edges is needed.

Pinch grafts are the simplest type, requiring only fine sharp-ended forceps, No. 11 blade and hypodermic needle. Strict adherence to aseptic technique is required throughout. The donor site, typically lateral neck or caudal flank, is clipped and aseptically prepared. Local anaesthetic is infiltrated in an inverted L-pattern. The skin is elevated using the hypodermic needle and the tip removed using the scalpel to yield an approximately 2 x 1 mm diameter epidermal graft. Care should be taken to keep the graft small and thin, not penetrating the subcutaneous tissue. Each is carefully placed on a sterile saline-soaked swab, collecting around 5 at a time, and then inserted into the recipient granulation tissue bed at a downward angle of 45°. This normally corresponds with a depth of 2 – 3 mm. Grafts should be placed at ~ 3 mm intervals, starting at the

lowest position because significant haemorrhage is always encountered. With care most of the grafts will remain in place. After covering the entire granulation bed, the wound should be carefully bandaged and movement minimised; box rest is mandatory. The donor site is kept clean and heals by second intention. Typical survival rates range from 50 to 75 %.

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