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Wound care and emergency medicine

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Wounds are a daily challenge in emergencies and in emergency departments [1]. Acute wounds are ranked as the second reason to seek emergency care in the United States (11%) and the leading reason (13%) to visit an emergency department in France [2]. Half are related to the head, one third to the upper extremities and 13% to lower extremities. But chronic wounds can also be seen in an emergency setting in the case of acute complications (e.g. bleeding, infection) or because they are carried by a patient admitted to the emergency department independently from the wound. If their management requires a joint competency in wound care, approaches will differ, both technically and from a more general perspective. The objective of this educational work is to provide caregivers, physicians, nursing staff and first aid responders with the fundamentals to manage more appropriately acute or chronic wounds identified in acute phases.

1. WOUNDS AND WOUND-HEALING

1.1 Skin microbialflora

It is customary to describe the skin in three layers: hypodermis, dermis and epidermis with its commensal flora [3]. This microbial flora can be the starting point of an infection if germs are introduced into and under the skin by trauma or via a needle, more particularly if the patient has an impaired immune system. Other germs are sporadic with strong pathogenicity or resistance (at the hospital site). These germs are brought by dirty hands or hosted in more intimate places and deposited on the skin by rubbing or washing.

After trauma causing the wound, the commensal flora of the epidermis covers and consistently contaminates the wound. In the case of acute wounds, additional external germs and other foreign bodies are added. It is essential to clean the wound mechanically to remove the debris with an aqueous solution. This cleaning may require the use of an antiseptic. Ideally the wound should be covered with wet compresses or dressings allowing a non traumatic removal (e.g. vaseline interface) pending an appropriate treatment [4]. Healing is a science in itself. We describe two typical ways to heal normally [5;6].

1.2 Normal wound-healing by first intention

Normal wound-healing by first intention is with suture. It can only succeed in the absence of an infection with virulent microbes (e.g. bite) and the removal of damaged tissues. The final suture enables exchange from edge to edge without blood-serum collection (which favors infection with poor aesthetic result).

1.3. Normal wound-healing by second intention

It is the result of spontaneous development of the acute or chronic wound in three phases: debridement, granulation and epithelialization [6]. After immediate hemostasis, the inflammatory reaction follows very quickly, conveying a struggle of immune defenses against the aggressor (heat, redness, pain, swelling, etc.). If the inflammation persists and the germ is present on or under the skin, there is confinement of the contaminated area into an abscess. This abscess will be discharged to the outside, sometimes aided by surgical incision or in a vessel with sepsis. If the wound is open, the - natural - purulent debridement [7] of the wound will continue over a variable period assisted by a stereotyped bacterial cycle favorable to healing. Oral and sometimes parenteral analgesia is occasionally necessary during first treatment. The use of antiseptics or antibiotics must be reasoned as it can disturb this "bacteria life-cycle" by the selection of resistant organisms and thus favors infection or its spread beyond the wound [4-8].
Controlled wound healing is then followed by a granulation phase to restore dermis then a recovery phase or epithelialization [7]. Dryness kills cells and the importance of wound-healing in a controlled humid environment [9] allows a sufficient moist level, limits pain [4] increases the rate of healing by reducing costs while avoiding maceration and the emergence of the scab, a natural dressing. Once the debridement is complete, wound care is carried out every two or three days with a non-adherent dressing respecting, at the withdrawal, the new fragile epidermis layer. When the skin is restored, scarring begins over several months of evolution with sometimes the occurrence of complications [6].

2. ACUTE WOUNDS

2.1. Initial evaluation in prehospital or at the emergency department

Acute wounds are often precipitated by trauma. It is required to ensure that the patient's anti-tetanus vaccination is up-to-date [10]. In prehospital setting or at the reception of the patient in the emergency department, the challenge is to assess the severity of the injury, which is not always an easy task. Although "healing" is the natural course of any wound, the role of the patient and caregivers (medical staff, family) is to support the healing process in order to reduce complications and allow rapid rehabilitation of the skin and the victim while limiting the irremediable alteration of this shell that reflects our personal image.
The importance of the classification of a wound in the emergency department is not always easy, more so outside the hospital in a context of emotional and physical stress related to recent trauma. The difficulty is increased in case of multiple lesions which functional or vital prognosis can be variable, requiring to prioritize serious wounds care, hence the relevance of first aid skills. Is the wound considered simple as long as the dermal layer is preserved? Interviewing the patient with collection of detailed medical history is systematic, followed by an inspection noting the location, appearance and importance of dilapidation.
In everyday life, the challenge of the first few minutes is to recognize serious wounds (complicated or complex) by their polymorphic layout or particular locations. Certainly, cuts and abrasion are obvious wounds, but is the crush injury recognized early enough? Without being apparent, the skin is deeply affected, by induced ischemia, in its capacity to regenerate itself. Also the initial assessment of a wound could not be made by a simple "glance" by the first-aid attendant in order to be classified as simple.

In fact, the definition of a "simple" wound is definitely a post-hoc definition. If many wounds in prehospital require simple care, sometimes allowing some disdain by the caregiver who prefers to focus on other more vital injuries of a poly-traumatized patient, other wounds are considered serious at the outset and require medical contact. As such, wounds of the trunk, perineum, neck usually call for a medicalized pre-hospital care. This is also the case of complex wounds of the eyes, face, scalp, members that sometimes impose hemodynamic rescue gestures such as bleeding control, or functional for example emergent relocation of a member. These wounds managed by the present medical staff or the first actors of emergency medical aid require a medical regulation in the event of a prehospital setting, and all the way to a regulated hospital destination to be most appropriate towards specialized service.

2.2. Initial cleaning, a fundamental step

To wash the wound allows for a better assessment [5]. Cleaning should be thorough and remove as much as possible dirt and any foreign bodies from the wound. Washing is carried out with water or saline solution without increasing the risk of infection [11], sometimes in combination with a decontaminant (scrub solution or soap such as Marseille soap). Weiss et al. [12] reported in 2013 the first prospective study with good methodological evidence comparing the use of controlled tap water (TW) to that of the sterile sodium chloride solution (SS) for the initial cleaning (500 mL) of suturable uncomplicated wound from less than nine hours and occurring in the emergency department. Out of 663 patients admitted over 18 months, the rate of infection (scar abscesses, erythema, important exudate, no hyperthermia> 38°C) for one month was 6.4% in the SS group versus 3.5% for the TW group of which slightly more than the half of small wounds (less than 3 cm) more difficult to irrigate. Moreover, few studies are found [13;14] which compare the use of an antiseptic against saline solution for cleaning acute wounds. It does not show a significant difference in the rate of infection by using or not antiseptics.
Knowing the etiology of the lesion is essential to anticipate certain risks such as infection or a profound alteration of the dermis, and even beyond, even if the wound is apparently small or superficial. The most typical cases are animal bites, punctiforms, with possible in-depth germ inoculation (e.g. Pasteurella) [15], certain chemical burns that will progress after the initial assessment or wounds caused by stabbing (sharp knife, scissors, needle, etc.) or shooting.
If the wound opening is not upright, in the absence of a reliable visual control, the depth and subcutaneous detachment must be assessed using a pen or sterile swab. When in doubt or impossibility of performance (competence, means and precarious condition) the medical advice is required, for example by calling the medical regulation of the regional emergency medical assistance service (e.g. 112 or 991).
After evaluation, an antiseptic is optionally applied according to the risk of infection, taking into account the aspect of the etiology and the patient. When waiting in the emergency room or in pre-hospital structure, the lesions are covered with a moist dressing or allowing non-traumatic removal (e.g. compress moistened with saline solution, sterile water or mineral water or interface) to avoid pain or recurrence of bleeding when

removed. The application of cold roll gauze over the dressing can also reduce pain and bleeding while waiting.

2.3. What to do based on major types of wounds?

Superficial wounds are treated with an interface (e.g. Urgotul®, Mepitel®, Adaptic®) or a hydrocolloid (e.g. Comfeel®, Algoplaque®). Superficial skin shreds (epidermis) are repositioned on the wound to reduce healing time and allow a better scarring quality. If the lesion is slightly or not oozing, it may also be covered with hydrogel dressing (e.g. transparent Hydrotac®) providing a controlled moist wound healing while maintaining a visual control.
The superficial 2nd degree burn is a particular case [4]. After draining and emptying the blisters that are excised, after making sure that it is a superficial lesion by recognizing a red and painful wound bed, it is recommended to apply a non-sterile antiseptic cream (bacteriostatic) during the first days (Flammazine®, Cicazine®) except when the burn is on the palms of the hands (hairlessness) [16]. A burn should be monitored on a daily basis if in doubt about its severity (grade 2 deep or 3) which requires specialized care. The vigilance is required, after consulting with the regional emergency medical assistance service if the burns reach the face, hands, neck, perineum, or is at a circumferential member, or it affects a child. Indeed, functional and aesthetic sequelae risks are too great to neglect monitoring. Specialist advice should be sought in case of doubt.
Sutured open wounds are the simplest in terms of care and can be covered with a dry dressing after closure or by a single layer of vaseline to be renewed. Except in specific cases, the patient is allowed to take a shower the next day, without dressing. Chronic wounds and bites do not oblige wounds to be sutured.
*Decaying wounds (*e.g. bone lesions, crushing) are managed by specialists from their arrival in the emergency department. They remain covered by a moist dressing until reaching the operating room.
Infected wounds or at high risk of infection (e.g. contaminated wound, penetrating abdominal or thoracic trauma, open fractures, joint or tendon exposure, etc.) indicate intravenous (IV) prophylactic antibiotics. It is recommended to combine penicillin G with metronidazole, or penicillin A with clavulanic acid.
A wound can also become infected following a controlled or non-controlled wound healing. This corresponds to the appearance of loco-regional or general signs indicating a pathological evolution in local wound contamination: contamination intensifies to become critical, leading to an infection, stage at which the body's ability to cope with the volume the offending germs that spread beyond the boundaries of the wound is exceeded (unusual presence of nodes, chills, hyperthermia). In case of confirmed or suspected infection on acute wounds, the same IV antibiotics are recommended by World Health Organization. A combination of IV penicillin A with clavulanic acid is suitable for many situations as mentioned in the latest French national recommendations on the subject [17], and allows oral administration in the absence of serious symptoms (that is to say outside fragile context, systemic infection, complex bites, penetrating wound, etc.). Doxycyclin, pristinamycin, cotrimoxazole or clindamycin are sometimes proposed as a second choice, sometimes associated with gentamicin in case of an open fracture, joint and tendon exposure or local ischemic site.
Local and general reevaluation at 12, 24 and 48 hours (depending on the initial severity) is necessary to adapt possible antibiotics, considering also available microbiology (bacteria and susceptibility testing), the patient's course and its previous treatments. Antibiotics are necessary but not sufficient to treat an infected wound [4]. They must be involved in the proper trimming and washing the wound (active debridement). In case of an animal bite at risk of contamination with rabies, contact rabies vaccination clinics within 24 to 48 hours.

3. CHRONIC WOUNDS

3.1. A comprehensive patient care

Patients carrying chronic wounds, or at risk of developing them, are admitted each day to the ER. Elderly are the most exposed population. Chronic wound is often a sign of weakness (e.g. loss of mobility, vascular problem) undermining one of the healing phases and to be taken into account [18]. If a pressure ulcer or bedsore risk is present, holders and mobilization should be put in place to avoid complications. The immobility on a stretcher, for more than three hours can cause damage for which compensation will be extensive and uncertain.

3.2. A more specific treatment of chronic wounds

Dressings must be opened and redrawn according to the principle of healing in a moist environment [9-19]. To do this, if the wound bleeds, applying draining-absorbent dressings will be favored [20]: alginate (e.g. Algosteril®, Biatain® Alginate, Urgosorb®), carboxymethyl cellulose fibers (or CMC also called hydrofiber: Aquacel®, Urgoclean®), hydrocellular (e.g. Allevyn®,Mepilex®). If the wound is oozing (or dry) and superficial, hydrocolloids or hydrocellular interfaces are indicated. The Tulle Gras® dressings or Jelonet® are less used in the treatment of chronic wounds.
The cleaning is done with water or normal saline [4-12]. In the absence of signs of infection found, applying antimicrobial is not recommended on these colonized wounds, and especially if it is an antiseptic solution, the effect is transient and inhibited by the presence of organic debris such as fibrin, necrosis or blood. No antibiotic prophylaxis is indicated for chronic wound in the ER, unless an imminent surgical procedure is planned.

3.3. Tumor wound

Sometimes the chronic wound is a reason for admission to the emergency department because of a source of infection, bleeding or unbearable pain. Patients with advanced tumor wounds are particularly prone to this type of acute injury. These wounds are uncommon compared to other chronic wounds such as pressure sores and ulcers [21].
The evolution of a tumor wound depends on the patient's response to cancer treatment. Skin lesion in the breast is the most common, followed by cervicocephalic sphere lesions or genital damage and groin folds [22]. These potentially decaying sores bleed easily due to the friable nature of their buds. They are often smelly without necessarily being infected. They can be life-threatening by breaking a large vessel, or other complications if weakened by disease and cancer treatments.
If bleeding occurs, the origin must be rapidly identified in order to define whether it is curable or not. Various hemostats may be applied such as Pangen® or Surgicel fibrillar or hemostatic dressings historically used on bleeding wounds by wounding agents (Chitosan™, Quicklot™ Combat Gauze, etc.) [23-25]. Obviously, the hemodynamic effects should be promptly evaluated, through continuous or regular monitoring of vital signs, even for bleeding of moderate importance, given the

vulnerability of patients. Contact with the referral facility must be done very quickly if the patient's vital prognosis is affected in order to discuss the relevance of maintaining the patient's life in a palliative care context.

4. CONCLUSIONS

Wounds' management in a prehospital setting or emergency department requires special attention and adapted practices according to the type of wound and the comorbidities of the patient. Unlike other casual incidents, the patient will always have a visible scar of a traumatic wound, hence the need for immediate high-quality care in order to limit relevant aesthetic and functional sequelae.

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