EDITORIAL

PHYSIOTHERAPY IN WOUND HEALING AND MANAGEMENT

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A wound is a disruption in the continuity of cells—anything that causes cells that would normally be connected to become separated. Wound healing is the restoration of that continuity. Several effects may result with the occurrence of a wound: immediate loss of all or part of organ functioning, sympathetic stress response, hemorrhage and blood clotting, bacterial contamination, and death of cells (necrosis). The most important factor in minimizing these effects and promoting successful care is careful asepsis, which can be accomplished using aseptic modalities and techniques when treating a wound.

The role of physiotherapy in the treatment of individuals with chronic wounds is rapidly expanding. In past years, the involvement of physiotherapy in wound care centered primarily on the use of whirlpool to cleanse and aid in the debridement of burn wounds. In current practice, physiotherapists serve as integral members of wound care teams, in which their expertise in the use of physical agents and pressure-relieving and assistive devices and their knowledge of synthetic dressing are called on daily (Koepke, 1970).

A good understanding of the physiological events in wound healing is necessary to effectively manage patients with dermal ulcers (Barron et al, 1995). Although the environment necessary to promote repair varies according to the state of the underlying tissue, wounds generally heal through the same sequence of events. The sequence begins with the acute inflammatory response, which consists of a series of overlapping events, including the vascular response, cellular reactions, and chemical mediators triggering and controlling these events.

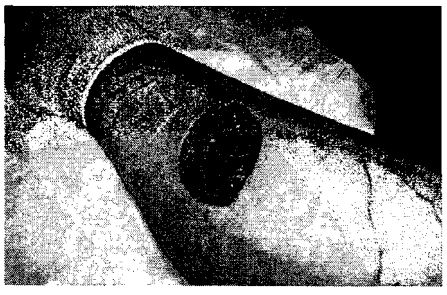

Fig 1: Deep seated wound of the leg

Phases on Wound Healing

1. Inflammatory Phase of Repair
2. Proliferative Phase of Repair
3. Maturation Phase

The inflammatory response is followed by the proliferative phase of repair. This phase involves the development of a collagen network and the "knitting together" of a full thickness wound. As the events of proliferation begin to subside, the wound enters the maturation phase of healing. This phase may continue for months or years.

Patient Evaluation

***Patient history*:** The history-gathering process provides the examiner with information that is critical in developing a treatment plan. In addition to baseline demographic information, the patient should be questioned with regard to the events that led to the development of the wound. This includes questioning relative to the mechanism of injury and events that caused the patient to seek medical attention.

In addition to the general history, the therapist should inquire about specific details that the patient may not offer voluntarily. The following questions are important because of the consequences of both the disease and the therapy that may be instituted.

1. Does the patient have diabetes mellitus?
2. Does the patient have a history of peripheral vascular disease, hypertension, or congestive heat failure?
3. Does the patient have any allergies to medication or to treatment agents?
4. Has the patient had previous treatment for this condition? If so, what were the treatments, and how successful were they?
5. Does the patient use any tobacco products?

Information is gathered concerning the patient's current complaints or symptoms. Specifically, the examiner is concerned with how current symptoms respond to varying situations. It is important to first localize the symptoms to determine whether the patient is having problems related to the wound itself or to another area. Depending on the

nature of the process that led to the development of the wound, the patient may report areas of anesthesia from a neuropathic process or rest pain secondary to ischemia.

When the major complaint is pain, it is important to determine how the pain is altered by body position or activities. Arterial problems tend to worsen with elevation and activity as demands are placed on the compromised arterial system. Pain secondary to venous insufficiency may respond in the opposite manner because elevation may assist the dysfunctional muscle pump in removing fluid from the limb, thereby easing pressure in the tissues. Numerous tests are available to the examiner to assist in determining the patient's status. The tests are of value in assessing patients with various problems, but the examiner will seldom use all of the tests with any one patient. A determination of which tests are appropriate is made after the therapist studies the patient's history, gathers subjective information, and makes some basic observations of the patient's status.

During the initial portion of the examination, the therapist should note not only the location of the wound but such characteristics as depth, drainage, discoloration, and signs of inflammation. All such information is of value in determining the cause of the lesion as well as in planning a course of management.

Staging of Wound

Wounds secondary to pressure are frequently classified into a four-state system that describes levels of destruction from the epidermis inward (Bergstron et al, 1994).

Stage I – Destruction is limited to the epidermis. Edema and an ill-defined area of non-blanchable erythema may be present.

Stage II – There is involvement of the epidermis, dermis, and subcutaneous fat, with discontinuity of skin.

State III – A full thickness of dermis is involved. Often there is undermining of deeper tissues.

Stage IV – The full-thickness involvement penetrates into the fascia. Frequently, muscle and bone are involved.

All other wounds typically are defined broadly as having *Partial Thickness* (equivalent to a Stage I/II pressure ulcer), or *Full Thickness* (equivalent to Stage III/IV pressure ulcer).

Wound Location.

Many ulcers have characteristic locations.

1. Venous ulceration, for example, frequently occurs over the area surrounding the medial malleolus.
2. Arterial ulcerations, on the other hand, frequently occur over the toes.
3. In patients with diabetes, ulcers caused by pressure and insensitivity classically are noted over weight bearing surface on the plantar aspect of the foot.

These locations are by no means absolute, and patients may present mixed problems.

Wound Drainage.

In addition to the size and depth of an ulcer, note any drainage that might be present. The amount, color, odor, and consistency of the drainage should be documented. A sudden increase in drainage can be a sign of a worsening problem or of an abscess that has spontaneously begun to drain. Most wounds will have surface colonization of bacteria. If frank signs of infection (e.g., foul odor, fever, cellulites) are present, a quantitative culture should be taken. Routine culturing of wounds is probably not necessary.

Colour and texture changes. The tissues adjacent to the wound should be evaluated for signs of trophic changes or changes in skin colour. Trophic changes (e.g., dry skin, brittle nails, hair loss) are indications of poor arterial nutrition to the area. The importance assigned to these changes should be weighed with respect to the patient's age and the part of the body being examined.

Skin color provides information relative to the functional status of the circulatory system. In the presence of arterial insufficiency, a cyanotic appearance or pallor may be noted in light-skinned individuals. The colour of the lips, mucous membrane, and nail beds provides greater information about oxyhemoglobin concentration. In chronic venous insufficiency, skin discoloration occurs because of deposition of hemosiderin, which is a pigment attached to hemoglobin that stains the tissues when red blood cells undergo lysis extravascularly. The result is a brownish discoloration of the skin.

Documenting ulcer size. Various simplified techniques exist for measuring the size and depth of ulcers. One of the easiest means of documenting ulcer diameter is to trace the wound margins using a piece of exposed radiographic film or clear acetate and an indelible-ink marker. This provides an inexpensive means of gauging the rate of healing between treatments. If the examiner has access to a computer and to appropriate software, the tracing can be digitized and the area computed electronically.

Many wounds are not superficial but instead are deep and often tracking. Monitoring the depth of a wound is important to ensure that the wound is not closing prematurely. A cotton-tipped applicator can be used for this purpose. The applicator is placed to the depth of the wound and then withdrawn and measured with a tape measure. A cotton-tipped applicator can also be used to gauge the degree of undermining present in a wound.

Another simple technique is to fill a syringe with a known quantity of water or an amorphous hydrogel. With the extremity positioned so that the wound cavity is parallel

to the floor, water or hydrogel is injected into the cavity until it is filled. Subtracting the volume of liquid remaining in the syringe from the original amount gives a fairly accurate indication of the volume of the wound.

Temperature. One means of assessing the relative severity of an inflammatory response is to monitor skin temperature in the area surrounding a wound. Many methods are available, ranging from a surface probe, known as a thermistor, to a radiometer, which measures infrared radiation from the skin. Sudden and dramatic changes in skin temperature can be indicative of developing cellulites or an infection that may require medical attention.

Girth. When the therapist is concerned with the presence of edema in an extremity or in the area about the wound, objective measurements of girth or limb volume should be taken. Circumferential measurements are easily taken with a tape measure as long as the therapist notes landmarks that will make measurements reproducible in the future. Volumetric tests are of more benefit when assessing the size of irregularly shaped areas. Volumetric tests use water displacement as a means of objectifying extremity volume. The test is easily performed by slowly lowering the body part into a filled volumeter. The water over-flow is collected and measured in a graduated cylinder.

Vascular Examination. Many wounds are secondary to vascular insufficiency. Whenever venous or arterial problems are suspected, a thorough examination of the vascular system is warranted. Such an examination is beyond the scope of this article (McCulloch, 1981).
In addition to the assessment of the vascular system, therapists should be acutely aware of the need to examine the neuromusculoskeletal system (NMSS) of all patients with chronic wounds. The immediate objective of treatment is to heal the wound, whereas the long term goal of therapy should be to return the individual to as high a level of physical functioning as possible. For this reason, assessments should be made of strength, sensation, range of motion, and neurological status.

Treatment

The primary goals of physiotherapy in the management of patients with open wounds should be;

1. to debride the wound of devitalized tissue, exercising care to minimize damage to healing tissues.
2. to cleanse the wound
3. to promote coverage of the dermal defect
4. to restore function to the tissue and surrounding structures.

To adequately accomplished these objectives, the therapist must be mindful of the normal process of tissue repair discussed previously and must use extreme care to ensure that methods of management do not impede wound healing.

Epithelialization is a requirement for wound healing. Because epithelial cells grow best in a warm, moist environment and will not migrate across necrotic tissue, it often is necessary to perform a substantial debridement of the wound. Such a debridement may require that the wound initially be enlarged to expose healthy tissue. Once the wound base is open and granulating, as would be indicated by a beefy red appearance, it should be protected from further trauma such as frequent dressing changes, dry dressings and overzealous use of topical agents. Occlusive films or hydroactive dressings become excellent wound dressings at this point.

When Debridement is indicated, several options are available. If radical debridement is required, this is most appropriately handled by the surgeon. When lesser debridement is necessary, the therapist can adequately handle this via mechanical or chemical means. Limited sharp debridement is a mechanical method available to the therapist, but care should be taken to use proper sharp instrumentation and to avoid the temperature to use disposable suture-removal or dressing kits. The instruments in such kits are not intended for debridement.

Dressings can assist in mechanical debridement, but should be used judiciously. The wet-to-dry dressing is one type of dressing that is much abused. Although such dressing can collect tissue exudates and aid in the removal of necrotic debris, the debriding power of the dry gauze is nons-elective, resulting in damage to fragile granulating tissue and pain to the patient. If such dressings are used in conjunction with chemical debridement agents, the dressings should be discontinued as the wound begins to granulate. If gauze dressings are the only option available to patients at this point, the gauze should be applied wet-to-wet with saline as the wetting agent. Because the objective is to keep the wound bed moist, more frequent dressing changes are required. The frequency of the dressing change is dictated by the state of the dressing at the time of removal. That is, if the dressing has dried, more frequent changes are indicated.

Over the years, whirlpool/saline baths have been advocated as a debriding technique (Koepke, 1970).This is commonly used in wound as a result of burns, where large surface-areas are involved. Their use is of value only in removing loosely adherent devitalized tissue from a wound. Whirlpool/saline baths have no ability to remove densely adherent necrotic debris from a wound, and, in conditions such as venous insufficiency, they are contraindicated because of the adverse effects of the dependent position.

Once a wound has been debrided, it should be carefully cleansed as often as necessary but should be protected from harsh topical agents. Whirlpool baths provide a means of gently cleansing a wounded area but may be overkill. Unless the area to be cleansed is quite large and

difficult to manage, the cleansing could just as easily be performed in a clean pan with the use of a mild soap and water. The therapist should avoid the urge to clean wounds with such agents as provodine iodine and hydrogen peroxide. These agents have great bacteria fighting properties, but they also are cytotoxic and can impede healing (Linearweaver, 1985).

A recent advance in wound cleansing and debridement is lavage. Several systems on the market provide for gentle to aggressive focal irrigation combined with suction to remove debris and the irrigation agent. Once cleansing has been accomplished, proper dressing should be applied to the wound to provide a microenvironment conducive to healing. If necrotic debris is still present, some of the dressings discussed previously that have debridement characteristics should be used. If the bed is clean with a good granulation base, occlusive dressings are indicated. Such dressing assists in maintaining moisture in the wound and in protecting the fragile tissues from external trauma. Wet-to-dry dressings have no role in the treatment of clean granulation wounds. Likewise, there is no need to apply topical medications to such wounds.

Therapists who use the best wound-care techniques available still may meet with failure if proper attention is not directed toward wound etiology. For instance, failure to address the dependent edema in the lower extremities of individuals with venous insufficiency may result in the wounds not healing or in wound enlargement. Intermittent compression may provide much needed assistance to the damaged muscle pump (McCulloch, 1981).

Individuals with arterial ulcerations offer great challenges to the wound-care clinician, especially if the problems lie within the smaller vessels. Attempts to promote vasodilatation via reflex heating and warm whirlpool baths have not been very successful. In many of these patients, vascular reconstruction is an option. In patients in whom reconstruction is not possible, wounds may never heal but instead may worsen to the point of gangrene. At such a time, amputation may be the only option.

Patients with diabetes frequently develop ulcerations on the plantar aspect of the foot secondary to pressure and insensitivity. Such ulcers are indolent because patients insensitive to the pain and continue to walk on the affected extremities. Therapists may initially need to assist the repair by placing the patient in a total-contact walking cast (Sinacore et al, 1987).[19] When the status of the patient is such that the therapist is reluctant to place a patient in a total-contact cast, one option is the use of a posterior walking splint. Although such a device does not provide pressure relief as effective as that provided by a total-contact cast, it does have the advantage of allowing wound care and dressing changes. Total-contact casts and posterior walking splints assist in relieving pressure from the ulcer, thereby allowing it to heal. If corrective measures are not taken to modify the patient's shoes, however, the breakdown will recur. Orthotic modification should be aimed at redirecting foot pressure from bony prominences.

Augmenting Wound Healing

The physiotherapist has many modalities at his or her disposal, some of which have documented evidence of accelerating wound repair. Other modalities, however, have manufacturer claims of accelerated healing rates without strong scientific evidence to substantiate the claims.

One of the most popular and successful agents used to accelerate repair is high-voltage pulsed galvanic stimulation (HVPG) or high voltage pulsed current (HVPV) (Griffin et al, 1991). Kloth and Feedar (1988) reported success in accelerating the repair of pressure ulcers in elderly through the use of HVPG. They stimulated patients five times a week for 45 minutes each session. The stimulus given was just below the thresh-old for muscle contraction and was delivered at 105 pulse per second with the anode placed over the wound. The equipment used in his study was a Dynawave Model 2 high voltage monophasic, twin-pulsed generator.

The use of therapeutic ultrasound as an adjunct to wound healing has gained interest in recent years. Dyson (1987) demonstrated the beneficial effects of low-intensity ultrasound in accelerating the events in the acute inflammatory process. Ultrasonic generators capable of producing a 3-MHz signal are best for affecting structures at the level of the dermis.

Microcurrent therapy, also called microcurrent electrical stimulation (MES), or low intensity direct current (LIDC), is another physiotherapy modality documented to be highly efficacious in enhancing healing of various wound types; indolent, ischeamic, pressure, diabetes and venous insufficiency leg ulcers (Wood et al, 1993; Barron et al, 1995; Baker et al, 1997)

Ultraviolet Rays (UVR) are electromagnetic rays between the visible rays and X–rays in the electromagnetic spectrum (400–100nm). This modality has also be document to be highly effective in the management of open wound.

Another physical agent studied for its potential positive effects in wound healings is the laser. Although some animal and human model studies have been performed, there still exists much confusion over the efficacy of low energy irradiation of wounds to accelerate healing (McCulloch, 1981; Ashford et al, 1999).

Hyperbaric oxygen therapy as an adjunct to wound healing has been studied extensively. Much of the work in this area has centered on the use of full-body hyperbaric chambers. Some studies have examined the effective of

topical hyperbaric application. Studies are inconclusive to date. Although oxygen toxicity has been reported with use of systemic hyperbaric oxygen, topical treatment has eliminated this danger (Lehman et al, 1985).

This article provided the reader with a review of the mechanism by which wound healing occurs in humans. The evaluation model presented emphasized the role of physiotherapists in the clinical decision-making process s it relates to wound healing. A series of tests and measures were suggested that can be incorporated into a patient examination. The section on treatment gave an overview of accepted methods of management, including characteristics of various dressings and their indications for use. A brief synopsis of adjunctive physical therapy modalities also was presented. This comprehensive review of basic information would benefit any therapist called on to assume a role in treating a patient's would.

Nigerian Physiotherapists should rise-up to this challenge, because more patients with different wounds and ulcers are referred to us in our various clinics on daily basis. Our approach to wound management must be evidence based and should be central on etiology. Initial comprehensive assessment and evaluation is a major key to successful wound healing, its important cannot be overemphasized. Also Nigerian therapists are encouraged to carry-out more studies in this area especially in our local environment. This is because some of our modalities and methods have been reported to be highly effective in wound healing and management with published articles in developed countries. This article is to sensitize us to carry out more studies in this area. The editorial board of Nigerian Journal of medical Rehabilitation will be gald to receive evidence based studies in this area very soon for publication consideration.

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