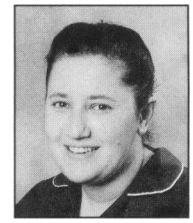
Wound Healing - from poultices to maggots.

(A short synopsis of wound healing throughout the ages).



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Pictographs, ancient surgical tools and fossilised bodies bare witness to the fact that wound care is one of the earliest forms of medicine practised by man. Unfortunately, early scientific knowledge existed alongside religious and superstitious ideas. In some societies chronic wounds such as leg ulcers were viewed as an outward manifestation of evil. Treatments often involved making the body uninhabitable to demons, e.g. by beating, starving and torturing the patient.

As societies became more civilised they began to study the effects of various medicaments on wound healing. In China, the colourful Yellow and Red Emperors compiled the first book of herbal treatments. In Egypt, a 100 page encyclopaedia of medicine (found within the Ebers papyrus) records the fact that various salves and dressings could be made from resin, honey, lard and beef. By around 600 BC surgery in India had advanced to the point that Sasruta was able to describe rhinoplasty and the cauterisation of wounds. This was particularly useful as 'nasal amputations' were a frequent punishment of the time.

Unfortunately, wound management remained something of a hit or miss affair. Those fortunate enough to be treated by the followers of the great physician Hippocrates would have had their wounds bathed in warm sea water and bound in olive leaves - with a little stretch of the imagination this regime could be likened to the modern practice of cleansing a wound with normal saline and applying a moist, non-adherent dressing. The less fortunate suffered immeasurable harm through,

> *"balsams, astringent gums, ointments and other idle inventions for mundifying, incarning, or cicatrizing of wounds" (Dictionary of Arts and Sciences, 1815)*[1]

As we approach the Millennium one would expect doctors and nurses to have a clear understanding of modern wound care practices. However, section 1 of the Oxford Textbook of Surgery (1995), opens with a quote[2] which states that,

> *'Nowhere is the gap between basic research and clinical application more glaring than in the biology of wound healing'*

Despite the plethora of research into modern wound management many practitioners continue to treat wounds with products which can harm healing tissues. For example, it is still common practice to pack cavity wounds with gauze. Electron micrographs have shown that newly formed capillary loops can grow through the weave of the gauze mesh. When the dressing is removed, the newly-formed granulation tissue can be literally ripped apart. In addition, fibres from the gauze are shed into the wound bed and have the potential to act as a foci for infection. Interestingly, saline soaks (in the form of 'wet to dry' dressings) are used as a method of debridement in some areas of America and the Third World. One can only wonder why practitioners in the UK continue to use them as a primary contact layer for a clean granulating wound.

An anonymous surgical treatise dated 1446 was recently discovered in the British library. Bound within, is a 9000-word manuscript on ulcers which showed that medieval leg ulcer management was systematic and logical. This manuscript highlights the importance of classifying the ulcer and of using bandages to treat venous ulcers. It also highlights the importance of holistic care and makes great reference to the importance of treating other illnesses, giving analgesia (albeit in the form of cannabis and alcohol) and improving the patients nutritional status. In view of the fact that many modern day patients with leg ulcers have not had their ulcers diagnosed and therefore appropriately treated, it would seem that we still have a lot to learn from our ancestors.

Most practitioners will be aware that the use of antiseptics as an aid to modern wound healing is the subject of heated debate. Antiseptics were developed in the latter half of the 19th Century and the early part of the 20th Century by Lister, Fleming and others. A review of the literature of 1915 showed that the surgeons of the day believed that antiseptics were responsible for saving the lives of many people,

particularly the wounded soldiers of the Great War[3]. Indeed, whilst lecturing on war wounds, Bowlby, Surgeon in Ordinary to the King, said,

> *".... and if I am told that the antiseptics I have employed to the skin and to the wound have played no part, and that sterilised water would have done as well, I should reply that I know by experience that until we did use antiseptics very thoroughly we did not get these results, and that the wounds which have been treated in the manner described have done consistently better than those of previous years."*

Despite this glowing testimony modern research has questioned the ritualistic use of antiseptic solutions. For example, a much quoted paper by Leaper and Simpson[4] indicates that hypochlorites, e.g. Eusol (Edinburgh University Solution of Lime) were particularly toxic to fibroblasts, granulation tissue and permanently damaged the micro circulation. They, therefore, suggested that all topical antiseptics should be used with caution[5,6]. It is interesting to note that Fleming was very aware of the side effects of antiseptics. He stated that,

> *".. It is necessary, in the estimation of the value of an antiseptic, to study it's effect on the tissue more than it's effect on the bacteria".*

Although some research would appear to support the fact that antiseptics are cytotoxic, unequivocal, empirical evidence on the use of the same is not available. However, most wound care experts feel that the evidence is strong enough for them to recommend physiological saline (0.9%) as the cleansing agent of choice.

Prior to the invention of the 'Gamgee' dressing (1880) most wounds were dressed with oakum - a fibrous mass of unpicked old rope. Thomas states[7] that this,

> *"must have represented a significant hazard to the patient from prior contamination by chemical, physical and microbiological agents."*

Although cotton wool was readily available the greases present in its natural state rendered it virtually non absorbent. Samson Gamgee discovered that he could remove the hydrophobic components of cotton wool through a bleaching process. Gamgee tested the clinical effectiveness of his invention by applying it to one small wound[8].

Nearly 120 years later Gamgee-type dressings are still used in the treatment of large and or heavily exudating wounds. Although these dressings are relatively cheap their cost effectiveness can be questioned on two counts. The first is that they are not an 'ideal' primary wound contact layer (see Table), i.e they adhere to and shed fibres into the wound bed and they do not maintain a moist wound healing environment. The second is that they readily allow 'strike-through' of exudate which effectively creates a path for organisms to colonise or infect healing tissue.

TABLE

Key Components of the Ideal Dressing[27]

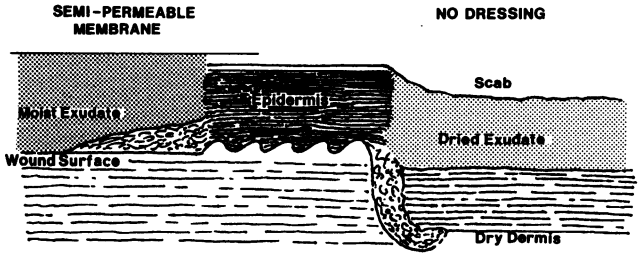
- Maintains a high humidity at the wound - dressing interface
- Removes excess exudate and toxic components
- Allows gaseous exchange
- Allows no leakage of exudate
- Maintains wound temperature
- Impermeable to bacteria
- Free from particulate and toxic contaminants
- Does not disintegrate when moist
- Allows trauma-free dressing change
- Comfortable for the patient

During World War I Lumiere developed 'tulle gras' (paraffin gauze). As paraffin is an excellent carrier for medicaments, e.g. antibiotics, medicated variations soon appeared. Common examples include Sofra-Tulle and Fucidin-Intertulle. Early studies indicated that medicated tulles could reduce the risk of sepsis and promote healing. However, later studies began to highlight serious side effects such as contact dermatitis and the emergence of resistant strains of micro-organisms[9,10].

Although paraffin gauze is sold as a low adherent primary contact material, most nurses would argue to the contrary. Unless changed frequently Paraffin gauze dries and become incorporated into the granulating tissue. It is not uncommon for patients to suffer considerable pain as the dressing is gently prised from the wound bed (irrigating the dressing with water or saline is of limited benefit as paraffin is hydrophobic in nature). In some instances the pain can be severe enough to warrant the use of narcotic analgesia or Entonox[11]. If the dressing has adhered its removal will inevitably result in the removal of new granulation or epithelial tissue. Visible evidence of trauma includes the characteristic criss-cross pattern which is present

on the wound bed and bleeding[12]. In the light of these problems and the emergence of more sophisticated wound management products the use of tulle is in general decline.

The concept of moist wound healing is commonly attributed to the work of Dr. George Winter in 1962[2]. Winter's research unequivocally proved that wounds heal two to three times quicker in a moist environment. Under dry conditions the bed of an open wound rapidly dries out and forms a scab. New epidermal cells burrow under this scab until they locate a moist environment, so extending the healing phase. Once they find a moist environment they will migrate across the wound. Today a moist environment can be created by a rapidly expanding array of modern wound care products. These include hydrocolloids, alginates, hydrogels and hydropolymer foams. The type of product chosen usually depends on the depth of tissue damage, the type of tissue in the wound bed and the level of exudate.



Necrotic tissue in the wound bed will significantly delay and in some cases prevent healing. If the limb is viable, the necrotic matter must be removed. Sharp debridement is the quickest method. However, in instances where sharp debridement is not appropriate various topical applications can be effective. These include hypochlorites, enzymatic agents, hydrogels and larvae.

Hypochlorites, e.g. Eusol, are non selective. They will remove viable as well as non viable tissue. Despite this and the pre stated adverse effects some surgeons find hypochlorites useful in the preparation of an area for grafting. However, the Welsh Centre for the Quality Control of Surgical Dressings in Bridgend[13] calculated that it would take about 100 ml of Eusol to dissolve 1 gram of slough. In their opinion this can be achieved more effectively by modern wound care products, e.g. hydrogels.

Enzymatic products such as streptokinase/ streptodornase act to liquefy slough. However, the topical application of streptokinase has been shown to result in a significant production of anti-streptokinase antibody. The production peaks at one month and then declines over a six month period. It is suggested that it may be prudent to avoid the use of topical streptokinase in patients who are at risk of coronary artery thrombosis. It is also suggested that if a thrombolytic agent is required within six months of administrating topical streptokinase/ streptodornase, intravenous streptokinase should be withheld in favour of an alternative thrombolytic agent[14,15].

Hydrogels actively rehydrate devitalised tissue by donating water to the desiccated matter. The rehydration process creates a moist environment which facilitates autolysis. The efficacy of hydrogels is reduced in the presence of excess exudate. In this instant it is better to use a product such as an alginate which will use (absorb) the exudate to produce a gel.

Although the use of larvae (Biotherapy) may seem radical to some, the use and effectiveness of the same has been known for hundreds of years. Indeed in the 1st quarter of this century larvae of the common green-bottle (Lucilia Sericata) was widely used in the management of infected and necrotic wounds. Their use simply declined with the advent of the widespread use of antibiotics in the 1940s[16]. The first therapeutic use of maggots is credited to J. F. Zacharias, a Confederate medical officer during the American Civil War. Zacharias reported that,

"Maggots in a single day would clean a wound much better than any agents we had at our command" [17,16].

During World War I Baer, an orthopaedic consultant, had occasion to treat two wounded soldiers who had been left lying on the battlefield for a week. Baer found that although the soldiers' compound fractures and abdominal wounds swarmed with maggots the wounds were granulating and free from infection. Later, as a clinical professor of orthopaedic surgery, Baer decided to use maggots to treat several cases of intractable osteomyelitis. The wounds healed in six weeks[18].

The use of larvae became very popular in the 1930's, so much so that the larvae of the green-bottle fly were produced commercially by Lederle. Many papers highlighting their therapeutic effectiveness, particularly in the management of oestomyelitis, appeared in the medical journals[19,20,21].

Although the use of antibiotics resulted in a decline in the use of larvae, papers reporting the beneficial effects of myiasis appeared from time to time[22,23]. In latter years the emergence of antibiotic-resistant strains of bacteria has lead to a renewed interest in larvae.

Larvae are thought to combat wound infection in one of two ways. The most popular theory is that they ingest micro-organisms which are then destroyed in their gut. However, a few of the early papers refer to the fact that larvae exude a broad spectrum antibacterial substance known as allantoin[24,25]. Unfortunately, the clinical significance of allantoin has not been fully investigated[16].

Sterile larvae, which are approximately 2 mm long, are introduced into the wound using an aseptic technique. The larvae produce a powerful mix of proteolytic enzymes which liquefy necrotic debris. The liquefied material is then re-absorbed and digested. Under favourable conditions, larvae rapidly increase in size, reaching 8 - 10 mm when fully grown. The larvae are removed after a maximum of 3 days. Thomas[16] states that larvae are a potent therapeutic tool and must be used with caution. The main contraindications would appear to be wounds with a tendency to bleed.

In the past dressing materials were used to clean and protect wounds, today they are used to enhance wound healing by creating the ideal environment for the natural wound healing processes to take place. Futuristic dressings offer something different. Through a process known as Tissue Engineering, dressings containing growth factors, extracellular matrix proteins (collagen, fibronectin and tenascin) and human dermal fibroblast cells are being developed. Some of these dressings actually seed fibroblasts into non healing wounds. As one would suspect these dressings are expensive - approximately £300.00 per piece. However, they can be applied on an out patient basis and the subsequent saving on a hospital admission may make them a very cost effective option.

Of course, in Ireland we do not need 'fancy' dressings as many people possess 'the cure'! Unfortunately, the cure can range from a poultice of poteen, cow dung, lard, grass, and marshmallow to the application of linen taken from a corpse. The fact that well educated people with chronic wounds choose to undertake 'the cure' would indicate that some aspect of modern practice (or some modern practitioners) is failing to meet their needs.

Plato stated that,

> *"the cure of the part should not be attempted without treatment of the whole"* [26]

This statement embodies the philosophy of many past and present wound management strategies. In other words wound management is more than poultices and maggots, it means ensuring the physical and psychological comfort of the patient, treating underlying disease, ensuring appropriate pain relief and applying an evidence based wound care product.

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