

Indonesian Journal of Tropical and Infectious Disease

Vol. 3. No. 1 January–March 2012

Literature Review

MODERN WOUND DRESSING FOR WOUND INFECTION: AN OVERVIEW

Novida Rizani

Department of Physics
Science & Technology Faculty
Airlangga University, Surabaya, Indonesia

ABSTRACT

When the tissue of skin is break means a wound is happens. To seal it, many choices of wound healing are available. Moist wound dressing can be better optional than the conservative ones. A bioactive agent that being added at the dressing in fact can increase healing rate of wound, moreover can subjugate wound infection caused by the pathogens, and also capable to prevent it. In this review, there are summary of modern moist wound healing, the wound pathogens, and some of sturdy bioactive agent for wound dressing. The treatment of wound infections using impregnated wound dressing by bioactive agent can also by antimicrobial agent that will striven against bacteria colonial.

Key words: moist wound healing, wound infection, wound pathogen, antimicrobial

INTRODUCTION

Skin and Wound

The skin serves as the body's interactive surface with the environment. As such, it is vulnerable to a variety of wounds, which differ by the type and severity of skin injury.¹⁰ A **wound** is a break in the continuity of a tissue of the body, either internal or external. Wounds are classified as open or closed. An open wound is a break in the skin or in a mucous membrane. A closed wound involves underlying tissues without a break in the skin or a mucous membrane.

Any injury, unless it is very minor, may be harmful not only to the tissues directly involved but also to the functions of the entire body. Wounds that threaten life include those that produce cessation of breathing, severe bleeding shock, or damage to the brain, heart, or other vital organ.

The local effects of an open or closed wound may include loss of blood, interference with blood supply, destruction of tissues, nerve injury, functional disturbances, and contamination with foreign material. These effects often involve nearby uninjured tissues. Even superficial wounds sometimes take a week or more to heal. The healing process includes absorption of blood and serum that have seeped into the area, repair of injured cells, replacement of

dead cells with scar tissue, and recovery of the body from functional disturbances, if there were any.¹¹

Open wounds are injuries to the body that range from very minor, like a scratch that bleeds very little, to severe, such as complete removal of a body part. Open wounds can also range from those that bleed severely but are relatively free from the danger of infection to those that bleed little but have a greater potential for becoming infected. Treatment options vary according to the nature of the lesion. The two most serious first aid problems caused by open wounds are a large, rapid loss of blood, which may result in shock, and contamination and infection of exposed body tissue. Promotion of wound healing with minimal disfigurement and prevention of infection remain the goals of treatment.^{10,11}

MODERN MOIST WOUND DRESSING

Alginates

Alginates are biodegradable dressings derived from seaweed. These highly absorptive dressings are soft, nonwoven, and nonadhesive, and conform to the shape of the wound. When in contact with drainage, they form a gel. Alginates (calcium or calcium/sodium) have an active ion

exchange of calcium ions for sodium ions at the wound surface forms soluble sodium alginate gel that provides a moist wound environment. Calcium dressings need moisture/exudate from the wound to function, therefore they are not suitable for dry wounds or wounds with hardened eschar. Alginates are most useful for wounds with heavy exudate. Don't use them for dry or eschar-covered wounds, because they won't form a gel and may stick to the wound, causing tissue trauma when they are removed. The fibrous nature of most alginates can leave residual fibres in the wound if there is insufficient wound exudate to gel the fibres. This may precipitate an inflammatory reaction as it stimulates a foreign body response. Caution is also needed when using alginate rope dressings in very deep or narrow sinuses, as complete removal can be difficult. Studies have shown that some calcium alginate dressings promote haemostasis in bleeding wounds due to the active release of calcium ions that aid the clotting mechanism.

Some alginates assist with debridement of nonviable tissue, and some contain silver, whose broad-spectrum antimicrobial activity minimizes bio-burden—the number of bacteria present on the product. If a patient has a silver dressing, it may need to be removed before magnetic resonance imaging (MRI).

Alginates come in sheets that can be cut to size. They also come in rope or ribbon form, which is especially good for areas of undermining or tunneling. For large wounds, though, alginates can be an expensive choice.

When using an alginate, it is necessary to cover the wound with a secondary dressing to hold the product in place and to protect the wound from outside contaminants. Leave the alginate in place for one to three days, until it begins to gel and shows evidence of breakthrough drainage. The way alginates absorb exudate is dependant on the make up of the alginate, for example some retain their integrity and can be removed in one piece; others disintegrate and need to be irrigated away from the wound bed. Before reapplying the alginate, the wound must be irrigate thoroughly with sterile normal saline solution.

Foams

Foam dressings are made from polyurethane, which may in some cases have been heat-treated on one side to create a semi-permeable membrane. This allows the passage of exudate through the non-adherent, semi-permeable surface into the insulating foam. This type of dressing is nonadhesive and comes in various sizes, shapes, and degrees of thickness. Foams are available in sheets or cavity filling shapes. Most foam dressings are available in bordered or non-bordered formats, which latter to be used if the patient has a skin sensitivity to adhesives.

Several advantages of foams are highly absorbent, cushioning and protective, insulate and conform well to body surfaces, provide thermal insulation. They facilitate a moist wound environment and absorb excess exudate to decrease the risk of maceration. Some lock fluid within the core of the dressing, others transform into a gelling

foam. Foam dressings are also available with charcoal impregnation for malodorous wounds.

Foams may be used as a primary or secondary dressing, to promote autolytic debridement, and to inhibit hypergranulation. When using a foam dressing, make sure it's one to two inches larger than the wound. Depending on the level of exudate, foams can be left in place for up to seven days. They indicate when they need to be changed through the spreading discolouration that appears on the dressing. Foam wound cavity dressings reduce dead space in the wound, conform to wound shape and absorb large amounts of exudate, therefore reducing the need for frequent dressing changes. Cavity foam dressings require secondary dressings or tape/bandage to keep in place. Care is needed when adhesives are used to fix dressings in the elderly, as their skin is often fragile and prone to breakdown. Tubular retention bandages to fix dressing in place are a safer option in the elderly.

Hydrocolloids

Hydrocolloids are moisture-retentive dressings, which contain gel-forming agents such as sodium carboxymethylcellulose and gelatin. Although the name begins with the word hydro, these dressings do not contain moisture, but instead form a 'seal' at the wound surface. This prevents the normal daily evaporation of moisture from the skin. Many dressings combine the gel-forming properties with elastomers and adhesives which are applied to a carrier such as foam or film to form an absorbent, self-adhesive, waterproof wafer. Hydrocolloid dressings contain hydrophilic colloidal particles in an adhesive compound laminated to a flexible wafer. In the presence of wound exudate, hydrocolloids absorb liquid and form a gel, the properties of which are determined by the nature of the formulation. In sheet form the polymer outer layer can be either semi-occlusive or occlusive. Like foams, they come in numerous sizes, shapes, and levels of thickness. Some have tapered edges that are less likely to curl up.

Hydrocolloids have minimal absorptive capabilities. They help keep the wound moist and promote autolysis of necrotic areas. Don't use them on wounds that are infected or have heavy exudate. To avoid damaging fragile skin by removing the dressings too frequently, keep them in place for as long as possible, but no longer than seven days. Hydrocolloid interaction debrides by autolysis and can reduce dressing frequency to up to seven days wear time depending on the amount of exudate and the type of hydrocolloid dressing. Hydrocolloids are also available in paste and powders for increased absorption and to decrease dead space in the wound cavity. Warming the hydrocolloid dressing prior to application (while still in the packet) will make application easier and the dressing more conformable. Hydrocolloid dressings may also be cut to size to help conformability. The dressing should exceed the size of the wound by at least 2 cm. The wound itself will indicate when a dressing change is required by the accumulation of moisture within the dressing. When

removing a hydrocolloid dressing, support the surrounding skin. If the dressing is stubborn then submerge the limb in warm water in a bath or shower.

Generally, hydrocolloids with a waterproof backing are not recommended on clinically infected wounds due to the semi-occlusive nature of the dressing. There have been reports of hypergranulation with prolonged use of hydrocolloids in moderate to highly exudating wounds so wound tissue assessment is paramount when applying hydrocolloids for long periods. Hydrocolloids should be discontinued before hypergranulation occurs.

Hydrogels

Hydrogels are insoluble hydrophilic polymers with few absorptive properties, that expand in water. They are available in sheet, amorphous gel, sheet hydrogel-impregnated dressings, or gauze impregnated with various percentages of water. However, dressings generally contain between 60–70% water, which, with other constituents, is held in a viscous form known as the hydrogel. Alternatively, there are also hydrogel sheet dressings available, which contain less water.

Hydrogels designed to hydrate wounds, rehydrate eschar and aid in autolytic debridement. They add moisture to the wound bed and are nonadherent, provide a moist environment for cell migration and absorb some exudate. They're used mainly for dry and minimally exudative wounds, such as wounds containing necrotic or dead tissue. Dead tissue becomes hard and desiccated due to the loss of a blood supply and the application of a hydrogel dressing donates water to the dead tissue, softening it and aiding the body's process of autolytic debridement.

Hydrogels have marked cooling and soothing effect on the skin, which is valuable in burns and painful wounds. If stored in the refrigerator, they can provide cool relief to painful wound sites. Autolytic debridement without harm to granulation or epithelial cells is another advantage of hydrogel dressings.

Any hydrogel dressing should be large enough to cover the wound and at least 3cm of surrounding skin. It is important not to apply excessive amounts of hydrogel as this may cause skin maceration. The viscosity varies between dressings. The thick gels available which helps them stay in the cavity of the wound, while the thin gels allowing easy spread over a large area. Some amorphous gels contain propylene glycol that can cause allergic reactions in elderly skin. Amorphous hydrogels are applied liberally onto or into a wound and covered with a secondary dressing such as foam or film. Mostly hydrogel dressing require a secondary dressing to hold it close against the wound bed, either a film dressing or a hydrocolloid dressing can be used for this purpose.

If the patient is known to have skin sensitivities, then a hydrogel sheet should be used in place of a hydrogel dressing and this should be covered with padding and a bandage. Hydrogel sheet dressings can also be used in preference to hydrogel dressings if the patient has localised

pain and cannot tolerate an adherent dressing. In this case, the hydrogel sheet can be held in situ with padding and bandaging or a film dressing.

Hydrogel dressings may require changing every 2–3 days and care must be taken not to macerate the surrounding skin with excessive amounts of hydrogel. But some of them can remain *in situ* for up to three days. The patient/carers should be cautioned that on removal the dressing may have changed in colour/consistency as a result of it removing debris from the wound bed. For easy removal of hydrogels the wound is irrigated. In addition to their use in wounds the thin hydrogels are helpful in the management of lesions such as chicken pox and shingles.^{2,4,8}

Hydrofibre Dressings

Hydrofibre dressings are non-woven sodium carboxymethyl cellulose spun into white fibres and manufactured into sheet or ribbon packing dressings, which is applied dry. Aquacel, a hydrofibre dressing, maintains a moist wound healing environment as fibres convert to form a gel on contact with exudate. The vertical wicking of exudate reduces maceration of surrounding skin. Patients may occasionally mention a 'drawing' sensation as the dressing absorbs the exudate. It is used on moderate to heavily exuding wounds and must be changed when fully saturated with exudate. The dressings are claimed to be more absorbent than alginates and to promote non-traumatic dressing removal. However, these dressings may occasionally stick to the edges of a wound so it is advisable not to overlap onto the surrounding skin.^{2,8}

Hydroactive Dressings

These multilayered highly absorbent polymer dressings, some with a surface adhesive and a waterproof outer layer, are similar to hydrocolloids. However, instead of forming a gel in contact with exudate, the fluid is trapped within the dressing, to maintain a moist environment.

Semi-Permeable Film Dressings

Film dressings are adhesive, thin transparent polyurethane, which are permeable to gas but impermeable to liquid and bacteria. Films are elastic, conformable and transparent allowing inspection of the wound. As films are non-absorbent they are not suitable for exudating wounds although island dressings with a central nonstick pad are available and can absorb slightly more exudate than the simple films. Films can also be used as secondary dressings to waterproof a primary dressing such as foam. Incorrect removal of film dressings may cause trauma to surrounding skin.²

WOUND INFECTION

A wound infection happens when germs enter break the skin. These germs, called bacteria, attach to tissue causing wound to stop healing, and other signs and symptoms. Wounds can be punctures (holes), lacerations (tears),

incisions (cuts), abrasions (scrape), or burn. Deep ulcers (open sores), large burns, or bite wounds are more likely than other wounds to get infected. Wound infection can also happen in small wounds that were not treated.¹²

Terminology

It is important to have a clear understanding of the terms used for wound infection. Since 1985 the most commonly used terms have included wound contamination, wound colonisation, wound infection and, more recently, critical colonisation. These terms can be defined as:

- ❖ **Wound contamination** - the presence of bacteria within a wound without any host reaction.
- ❖ **Wound colonisation** - the presence of bacteria within the wound which do multiply or initiate a host reaction.
- ❖ **Critical colonisation** - multiplication of bacteria causing a delay in wound healing, usually associated with an exacerbation of pain not previously reported but still with no overt host reaction.
- ❖ **Wound infection** - the deposition and multiplication of bacteria in tissue with an associated host reaction.

In practice it seems that some experienced tissue viability nurses and medical practitioners use the term 'critical colonisation' to describe wounds that are considered to be moving from colonisation to local infection. The challenge within the clinical setting, however, is to ensure that the majority of practitioners recognise this situation with confidence and for the bacterial bioburden to be reduced as soon as possible, perhaps through the use of topical antimicrobials.⁷

Signs and Symptoms

The signs and symptoms of a wound infection are any of the following:⁽¹²⁾

- ❖ High or low body temperature, low body pressure, or a fast heart beat.
- ❖ Increased discharge (blood or other fluid) or pus coming out of the wound. The discharge or pus may have an odd color or a bad smell.
- ❖ Increased swelling that goes past the wound area and does not go away after five days. Swollen areas usually look red, feel painful, and feel warm when it is touched.
- ❖ Wounds that do not heal or get better with treatment.
- ❖ An old wound that bleeds easily.
- ❖ A wound that is painful, even though it does not look like it should be.

WOUND PATHOGENS

When a large number of bacteria get into wound, it can get infected. There are different types of bacteria. More than one type may infect wound at the same time. Normal

bacteria that lives on skin often enter a wound first. A break in the skin gives them a chance to enter it and cause infection. Bacteria may also come from the environment, such as soil, air, or water. If an object such as nail cause the wound, bacteria may come from that. A bite wound by an animal or person can cause infection from their saliva (spit).

The majority of micro-organisms are less than 0.1mm in diameter and can therefore only be seen under a microscope. They can be categorised into different groups, such as bacteria, fungi, protozoa and viruses, depending on their structure and metabolic capabilities.^{7,12}

Bacteria

These are relatively simple cells that can be further categorised according to differences in their shape and cell wall. Cocci (spherical shaped cells), bacilli (rods) and spirochaetes (spirals) can be arranged singly; however cocci and bacilli can also be found in pairs, chains and irregular clusters. They can be visualised using a bacteriological staining process called Gram staining; after Gram staining, Gram-positive bacteria are purple and Gram-negative bacteria are red. Species that fail to stain with the Gram reaction, such as Clostridia, require specialised stains. The growth and survival of all bacteria is dependent upon environmental factors, for example strict aerobes require oxygen whereas anaerobes are rapidly killed by oxygen. It is important to note, however, that both aerobes and anaerobes can survive in close proximity to each other and that some can survive in both conditions by growing aerobically and then switching to anaerobic metabolism in the absence of oxygen; these are known as facultative anaerobes.

Fungi

These are composed of larger more complex cells than bacteria. They are either single-celled yeasts or multi-cellular organisms with a nuclei contained within a cell membrane. Fungi can be responsible for superficial infections of the skin, nails and hair and, although they have been isolated from wounds, they are rarely pathogenic in this setting.

Protozoa

These are single celled organisms within a fragile membrane and without a cell wall. They are most significantly associated with infected skin ulcers.

Viruses

These are composed of genetic material (nucleic acid) enclosed within a protein coat or a membranous envelope. Although viruses do not generally cause wound infections, bacteria can infect skin lesions formed during the course of certain viral diseases.

It is important to remember that different micro-organisms can exist in polymicrobial communities and this is often the case within the margins of a wound.⁷

TREATMENT

Once a diagnosis of wound infection has been confirmed and antibiotic sensitivities identified, appropriate management regimens should be considered, with a high priority given to reducing the risk of cross infection. It is important to treat the patient as a whole and not the infection alone, so management strategies must be based on data derived from an holistic assessment of the needs of the individual. The main treatment objective will be to reduce rather than eradicate the bacterial burden within the wound margins. In addition to antibiotic therapy, there are two main generic groups of wound management products that have the potential to reduce the bacterial burden in the wound, these are compounds containing silver or iodine.⁷

Iodine

Iodine is an element that has antiseptic properties. It is active against a number of pathogens, so that iodine dressings can control bacteria on the surface of the wound. Iodine dressings have a maximum dosage that may be used at any one time and a maximum length of time over which they can be used. The dressing changes colour from deep yellow to white as the iodine is used, clearly showing when the antimicrobial activity is exhausted.

In wound management iodine is used in two forms, they are Cadexomer iodine - a polysaccharide starch lattice containing 0.9% elemental iodine that is released on exposure to wound exudate, and PVP-1 (Povidone iodine) - an iodophor composed of elemental iodine and a synthetic polymer.

Both have different physical characteristics that relate to the component parts and the iodine concentration of available iodine that is released when in use. Clinically iodine is indicated for wound cleansing, wound bed preparation (the stimulation and influence of specific cells involved with the immune system) and the prevention and management of wound infection.

In the past, iodine use has been limited by the fact that elemental it can be absorbed systemically, is almost insoluble and can be an irritant to the skin. Contraindications include patients with thyroid disease, patients with large or deep wounds, and patients with a known allergy to iodine. Iodine products can cause thyroid disruption. If patients have a history of a thyroid disorder, their thyroid function should be checked before and while using the product.

Silver

Recently a number of dressings containing silver have become available, although silver and silver compounds have been routinely used in clinical practice as bactericidals for over a century. Silver have a broad spectrum antimicrobial, effective against a range of aerobic, anaerobic, gram positive and gram negative bacteria as well as filamentous fungi and viruses; *Pseudomonas aeruginosa* and *Staphylococcus aureus* are some of microorganisms that silver effectively can handle. Silver interferes with the bacterial electron transport system and inhibits the

multiplication of the bacteria. However, to achieve this, silver ions have to be able to enter a cell. The chemical bonding of silver with a sulphonamide antimicrobial - sulphadiazine - has resulted in the development of a safe broad-spectrum agent for topical use (eg Flamazine). In this formulation silver is released slowly from the transport medium in concentrations that are selectively toxic to micro-organisms such as bacteria and fungi.

This type of silver product has been used successfully in the management of acute and chronic wounds. Products that can sustain the interaction of silver with micro-organisms in the exuding wound are likely to be more effective in preventing/controlling local infection as potentially more silver ions will be available to enter bacterial cells. This assumes that the concentration of silver in the solution is both correct and maintained.

Another advantage of silver is that no resistant strains have been discovered. Despite the absence of resistance in clinical practice, it has been possible to produce resistance in the laboratory setting by using sub-therapeutic levels of silver.

There is controversy about the optimal amount of silver required to achieve a balance between efficacy, toxicity and the potential for resistance. When a silver dressing is selected, the amount of available silver should be considered as well as whether the silver is released from the dressing or the bacteria is drawn into the dressing. The importance of choosing a product with a clinically relevant dose of available silver and recommends that treatment stops once the objective for selecting that dressing has been achieved.

Silver products may cause localised discoloration if they come into contact with the skin surrounding a wound; this should wash/wear off within a few days. A rare but more serious complication of using silver products is argyria, which occurs when cells absorb silver salts; this results in a permanent discoloration of the skin (called Argyria). If the silver is absorbed by internal organs it may impair their function.^{1,3,7}

Honey

Most research carried out on honey has focused on the role of manuka honey, which, like most honeys, releases hydrogen peroxide but is also believed to have an additional antimicrobial agent known as the unique manuka factor (UMF). It is widely claimed that honey is able to deodorise and debride wounds and these additional properties may be particularly beneficial in infected wounds. There are no standardised protocols for the frequency with which honey should be applied and the type of secondary dressing that should be used.³

Antimicrobial Therapy

Antimicrobial are chemical substances that have the capacity, in dilute solutions, to selectively inhibit the growth of or to kill other micro-organisms. Antimicrobial agents can be as synthetic compounds or natural compounds. Many research has proved that plants can provide strongly

recommended agents as antimicrobial which also have high activity to bear micro-organism.

Antibiotics are a kind of antimicrobial that produced by a micro-organism. Whereas it is now generally accepted that systemic antibiotics are essential for the management of clinically infected wounds, the choice of antibiotic to be used is not always apparent. Only after a comprehensive assessment process including consideration of patient characteristics, the results of microbiological investigations and the identification of both the nature and location of the wound, can the most appropriate antibiotic be identified. The routine use of topical antibiotics is not justified for colonised or infected wounds. Unfortunately, the resistance to antibiotics has become a serious problem in recent years particularly with the rise of epidemic strains of MRSA (Methicillin-resistant *Staphylococcus aureus*). The overuse of broad-spectrum antibiotics will only serve to exacerbate the situation. It could therefore be argued that all antibiotic use should be based on known sensitivities. That is why, many other antimicrobial agents are still been hunted until this seconds, whether they are from synthetic precursors or from isolated substances of natural extract.

In addition, a recent systematic review of antimicrobial agents has concluded that systemic or topical antimicrobials are not generally indicated for the management of chronic wound infections. However, there may be some value in the prophylactic use of topical antimicrobials for the initial management of acute cellulitis, whilst awaiting clarification of antibiotic sensitivity and the establishment of a therapeutic regimen.⁷

ANTIMICROBIAL AGENTS FROM PLANTS

A wide source of bioactivity compounds is plants. Finding healing powers in plants is an ancient idea. Clinical microbiologists have two reasons to be interested in the topic of antimicrobial plant extracts. First, it is very likely that these phytochemicals will find their way into the arsenal of antimicrobial drugs prescribed by physicians. Second, the public is becoming increasingly aware of problems with the overprescription and misuse of traditional antibiotics.⁶

Garcinia mangostana (mangosteen) is one of plant that have a precious substances, called mangostin, since they are known for having a very high activity as antioxidant and antimicrobial. Mangosteen it self is a small purple fruit about the size of a tangerine, which has traditionally been used to treat inflammation, dysentery, and skin disorders. It was also used to fight infection by boiling up the fleshy part of the rind, also know as the pericarp, into a tea. As early as 1855, a German scientist identified mangostin, a powerful antioxidant, known as a xanthone, which appeared to fight infection, fungus, bacteria, histamines and possibly cancer. Xanthones can be extracted from the root bark, stem bark and sap as well as rind [exocarp] of the Mangosteen fruit.⁵

Among more than 40 mangosteen xanthones found in the whole mangosteen fruit, alpha-mangosteen and gamma-mangostin have been the main subject of many studies by mangosteen researchers around the world. Scientists demonstrated that gamma-mangostin proved to be a stronger antioxidant than other compounds long known for their antioxidant properties. Medical researchers in Thailand and Taiwan discovered that gamma-mangostin was shown to have even more potent antioxidant activity than vitamin E, one of the most powerful antioxidants known to science.

Alpha-mangostin was proven to have strong antibacterial activity against *Staphylococcus aureus*. Scientists demonstrated alpha-mangostin's activity against vancomycin-resistant Enterococci (VRE) and methicillin-resistant *Staphylococcus aureus*. They found that alpha-mangostin, alone or in combination with gentamicin, against vancomycin-resistant Enterococci (VRE) and used in combination with vancomycin hydrochloride against methicillin-resistant *Staphylococcus aureus* (MRSA) might be useful in controlling VRE and MRSA infections. Further studies shown that alpha-mangostin works well with and enhances the effects of other commercially available antibiotics such as ampicillin and minocycline. In another laboratory experiment, scientists studied the antimicrobial activity of alpha-mangostin and found that it possesses strong inhibitory effects against *Mycobacterium tuberculosis* and *Pseudomonas aeruginosa*. Researchers also found that alpha-mangostin is a histaminergic receptor-blocking agent: alpha-mangostin is effective in preventing or stopping allergies.⁹

IMPREGNATED WOUND DRESSING BY ANTIMICROBIAL

Antimicrobial dressings can be used on acute or chronic wounds which are critically colonised, or when local and/or systemic infection is already compromising the wound or could compromise wound healing. When choosing an appropriate wound dressing it is vital to assess whether the wound is colonised, critically colonised or infected. The presence of microorganisms in a wound does not indicate that wound infection is inevitable; indeed, they may have a protective effect. The presence of multiplying bacteria in a wound with no host reaction is termed colonisation.

Critical colonisation has been defined as the multiplication of bacteria causing a delay in wound healing, usually associated with an exacerbation of pain not previously reported, but still with no overt host reaction. Signs of critical colonisation include: a continued delay in healing despite appropriate treatment, thick slough that does not respond to standard debridement techniques, fast returning slough after sharp or larval debridement, and malodour.

Levels of bacteria in critically colonised wounds need to be reduced to allow the wound to heal. The topical

application of an antimicrobial is probably the most effective way to do this. The development of an infection will be influenced largely by the virulence of the organism and the immune status of the patient. Patients considered most at risk are those being treated with long-term steroids and those receiving chemotherapy.

If a wound appears to be infected, it is important to confirm this and identify the causative organism(s) and possible sensitivities to antimicrobial, as antibiotic. A wound swab should be sent for microbiology, culture and sensitivity. The use of systemic antimicrobial is supported where there are clear signs of infection. This is best achieved by starting a topical antiseptic dressing as soon as the signs of critical colonisation are detected.¹

CONCLUSIONS

Many of kind modern moist wound dressings can facilitate wound treatment to be more effectively and comfortable. Healing rate also can be faster than using an conservatism dressings. However, threat of wound infection can exacerbate wound conditions and delaying healing process. Wound infection happens because of the presence of pathogens, such as bacterial, fungi, protozoa, and viruses. Some efforts that's been taken to heal and prevent these are by using additional stuff in dressing, like kind of iodine, silver, honey, or many other antimicrobial agents. Unfortunately, MRSA case shows that antimicrobial from kind of antibiotics has decending activity against some micro-organism which already having high resistance toward those agents. Luckily, nature has always provide wide of plenty antimicrobial agent source that can be taken just by extracting and isolating from plants. Mangosteen

is one of plants that have a high potential as antimicrobial agent source since they have mangostin which have a high level of antimicrobial activity, as well as antioxidant. Alpha-mangostin in fact has been reported that can wipe off apprehensive about MRSA infections. Impregnation antimicrobial agent in moist mound dressing can increase healing rate and prevent wound infection, by battling microbial colonisation.

REFERENCES

1. Ashley Flores, (2007), "Topical Antimicrobial Derrings: An Overview", *Wound Essentials • Volume 2*.
2. Carolina Weller, Geoff Sussman, (2006), "Wound Dressing Update", *Journal of Pharmacy Practice and Research*, Volume 36, No. 4.
3. Jacqui Fletcher, (2006), "Best Practice - Choosing an appropriate antibacterial dressing", VOL: 102, ISSUE: 44, PAGE NO: 46.
4. Linda Snyder, RN., (2008), "CE: Wound basics: Types, treatment, and care", <http://www.modernmedicine.com/modernmedicine/CE+Library/CE-Wound-basics-Types-treatment-and-care/ArticleStandard/Article/detail/535258>
5. "Mangosteen Xanthones: Alpha-mangostin and Gamma-mangostin", <http://naturalhomecures.net/mangosteen/science/m-to-z/alpha-mangostin-and-gamma-mangostin>
6. Marjorie Murphy Cowan, (1999), "Plant Products as Antimicrobial Agents", *Clin. Microbiol. Rev.*, 12(4): 564
7. Mark Collier, (2004), "Recognition and management of wound infections", <http://www.worldwidewounds.com/2004/january/Collier/Management-of-Wound-infections.html>
8. Pauline Beldon, (2010), "How to Choose The Appropriate Dressing For Each Wound Type", *Wound Essentials*, Volume 5.
9. "The Benefits of Mangosteen", <http://www.natural-plus-healthy.com/benefits-of-mangosteen.html>
10. Tina Andrews, 2011, <http://www.livestrong.com/article/130677-different-kinds-open-wounds/>
11. "Types & Causes of Open Wounds", <http://nursingcrib.com/nursing-notes-reviewer/types-causes-of-open-wounds/>
12. "Wound Infection", <http://www.drugs.com/cg/wound-infection.html>