MODERN METHODS OF WOUND CARE

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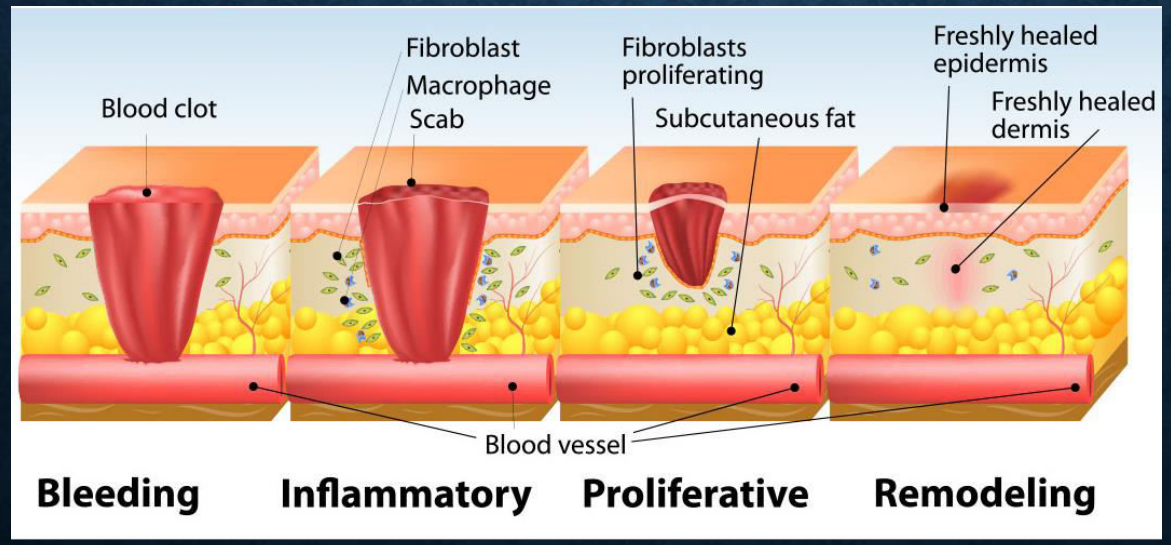
INTRODUCTION

- Dressings are the materials used to cover wounds, ulcers to provide support and to encourage healing.
- An ideal dressing material should not only accelerate wound healing but also reduce loss of protein, electrolytes and fluid from the wound, and help to minimize pain and infection.

- Wound dressings have undergone an evolutionary process from materials that simply covered the wound to materials that maintained a favorable wound moisturizing environment.
- Traditional dressings might fail to provide moist environment to the wound.
- Recently, materials that deliver active components and/or interact directly with cells or specific chemicals in the wound site.

- When a person sustains injury, it triggers wound healing.
- It comprises a complex systemic cascade of events that includes inflammation, neovascularization, collagen synthesis, granulation tissue formation, epithelialization and wound remodeling.



- Normally, wounds are expected to heal within a reasonable period of time (7–14 days), provided there are no comorbid conditions.
- With interruption to the above cascade at any of the stages of the healing process, wounds fail to heal in a timely manner, resulting in chronic non-healing wounds.

- A chronic wound may be defined as one that has not adequately re-epithelialised within 6–8 weeks.
- Although a variety of measures have been attempted in the treatment of nonhealing wounds, some wounds are refractory to all forms of treatment and result in chronic wounds.

- There are a wide variety of dressing techniques and materials available for management of both acute wounds and chronic non-healing wounds.
- The **primary objective** in both the cases is **to achieve a healed closed wound**.
- However, in a chronic wound the dressing may be required for preparing the wound bed for further operative procedures such as skin grafting.

- The present dictum is to promote the concept of moist wound healing.
- This is in sharp contrast to the earlier practice of exposure method of wound management wherein the wound was allowed to dry.

Characteristics which help decide on which product to use and where, in order to get optimal wound healing.

i. Location of wound.
ii. Depth of damage.
iii. Presence of infection.
iv. The amount of drainage.

- There are no ‘magical dressings’.
- Dressings are one important aspect that promotes wound healing apart from treating the underlying cause and other supportive measures like nutrition and systemic antibiotics need to be given equal attention.

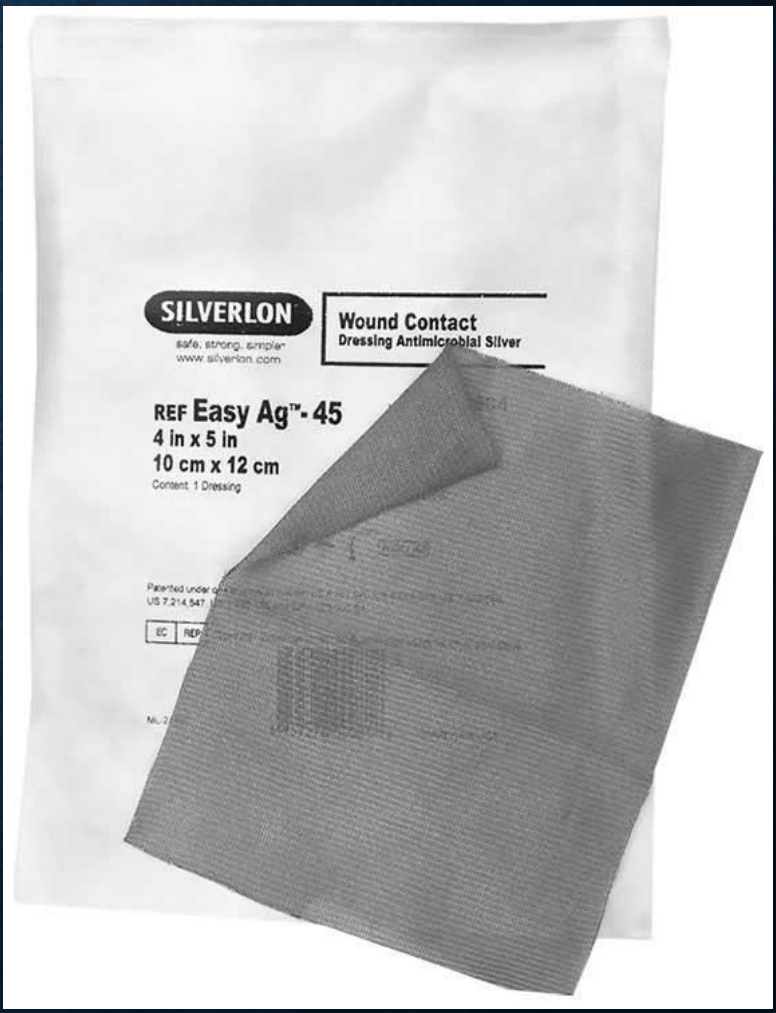
Characteristics of an ideal wound dressing:

- High moisture vapor permeability
- Non adherent
- High capacity for absorption
- Provide barrier to external contaminants
- Capable of being sterilized
- Prevents capillary loops penetrating into dressing material
- Good adhesion to surrounding skin
- Hypoallergenic
- Comfortable to wear
- Cost effective

- Traditional wound dressing products including gauze, bandages (natural or synthetic) and cotton wool are dry and used for protecting the wound from contamination.
- They are indicated for the clean and dry wounds with mild exudate levels or used as secondary dressings.
- Since traditional dressings fail to provide moist environment to the wound they have been replaced by modern dressings with more advanced formulations.

Silver Impregnated Dressings

- Silver is a topical antiseptic.
- Many forms of silver releasing products like films, foams, hydrocolloids and hydrofiber dressings are available.
- Highly reactive.



- Affect multiple sites within the bacterial cells.
- Kills bacteria by damage to cell wall, cell membranes, respiratory enzymes and ribonucleoproteins.
- Increases the susceptibility of bacteria to antibiotics.
- Effective against yeast, fungi, viruses, and MRSA and VRSA.

Honey Dressings

- Honey has antimicrobial properties and provides moist wound environment.
- It has deodorizing effect and reduces inflammation, edema and exudates.
- Glucose oxidase enzyme in honey enables release of hydrogen peroxide.

- There is subsequently release of oxygen which is responsible for antibacterial effect.
- Monocytes and macrophages require enhanced glucose uptake and glycolysis for better functioning.
- Honey provides substrates for glycolysis, helping monocytes and macrophages.

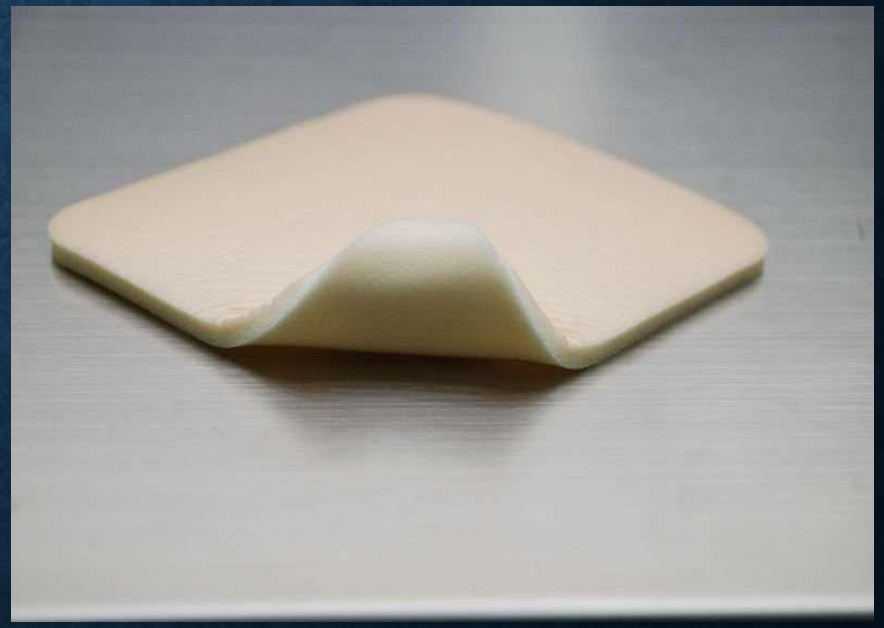
Insulin Dressings

- Insulin is known to help healing of wounds.
- 4 units of human soluble insulin is mixed with 1 mL of normal saline. This is sufficient for 10 cm^2 ulcer.
- The solution thus prepared is injected around the ulcer and in the bed of the ulcer. Some solution is poured on a gauze piece and used as a primary dressing.
- It is advisable to do this dressing twice a day.

- IGF has many similarities with insulin hormone.
- Like IGF, in in-vivo studies local insulin is known to stimulate the proliferation, migration and extracellular matrix secretion by keratinocytes, endothelial cells, fibroblasts.
- Frequent blood sugar monitoring is required.

Foam dressings

- Highly absorbent polyurethane dressings.
- Available as pads, sheets and cavity dressings.
- Create moist environment and provide thermal insulation to the wound.
- Nonadherent, easy to apply and remove.
- Meant for highly exuding wounds.



- Can be layered in combination with other materials with overlying compression bandages.
- Fluid absorption capacity varies with foam thickness.
- May be used for their cushioning effect but they are **not** a substitute for pressure relieving devices.
- May produce excessive malodorous drainage necessitating frequent dressing change.

Alginates

- Composed of soft, non-woven fibers, which contain calcium and sodium salts of alginic acid.
- When placed over a moist wound, an ion exchange reaction occurs between calcium in the alginate and sodium in the wound fluid.

- Produces soluble calcium, sodium alginate - a gelatinous mass, which helps in maintaining moist environment and facilitates autolytic debridement.
- They conform to the shape of the wound and should be cut according to the shape of wound.
- If larger they can cause peri wound maceration because of their tendency to absorb fluid across entire surface.

- They are used as fillers for undermined and tunneled wounds.
- Highly absorbent (absorbs 20 times its weight).
- They may leave fibrous debris in the wound, which is claimed to get biodegraded.

Hydrocolloids

- Composed of **Gelatin**, **pectin** **carboxymethylcellulose**.
- Serve as occlusive or semi occlusive dressings.
- Impermeable to water, bacteria and other contaminants but permeable to water vapour.
- Absorb wound exudates to form a hydrophilic gel.

- Most important advantage- Long wear time
  - Decreases the cost, inconvenience and local trauma associated with dressing changes.
- Not indicated for arterial/neuropathic ulcers, infected or heavily exuding wounds because of risk of peri-wound maceration.
- Drawback- tendency to produce malodorous exudates, which can be mistaken for infection.

Hydrofibers

- Hydrofibers are sterile sodium carboxymethyl cellulose fibers.
- Conform to the wound surface, are highly absorbent and interact with wound exudates to form a gel.
- Maintain a moist environment and allow autolytic debridement.
- Indicated for pressure ulcers, lower limb ulcers and surgical wounds.

Hydrogels

- Hydrogels are polymers, glycerin or water-based gels, impregnated gauzes or sheet dressings.
- Their high water content does not allow them to absorb large amount of exudates so they cannot be used on heavy exuding wounds.
- Have a gentle yet effective debriding and desloughing action by rehydrating necrotic tissue and removing it without damaging healthy tissue.

- Rehydrate the wound bed, reduce pain because of their cooling effect, are non-adhesive, fill dead spaces, are easy to apply and remove.
- Best suited for **dry wounds** or those with minimal exudates.
- But they require a secondary dressing.

SKIN SUBSTITUTES

Product	Content and description	Uses/advantages	Disadvantages
Epicel® (Genzyme Biosurgery), (Laserskin *	Cultured epidermal autograft (sheet)	Permanent coverage for superficial and partial-thickness burns	Two–three-week lag period between biopsy and obtaining epidermis; lacks dermal component
Integra †	Two-layered skin substitute comprising biodegradable matrix and bovine collagen, and outer silicone layer	Immediate permanent coverage for surgically excised full-thickness burns; reconstructive surgery	Requires healthy and non-infected wound base; in burns, autograft is needed after 3–4 weeks for epithelial cover
AlloDerm® † (LifeCell)	Processed human cadaver skin with a cellular dermal matrix and intact basement membrane	Intended to permanently cover full-thickness burns and deep ulcers; reconstructive surgery	In burns, may necessitate removal after 2–3 weeks; autograft is needed for epithelial cover; not suitable for infected wounds
Biobrane® † (LifeCell)	Porcine dermal collagen bonded to semipermeable silicone membrane	To cover extensive partial-thickness burns and donor sites	Temporary; not suitable for infected burn wounds

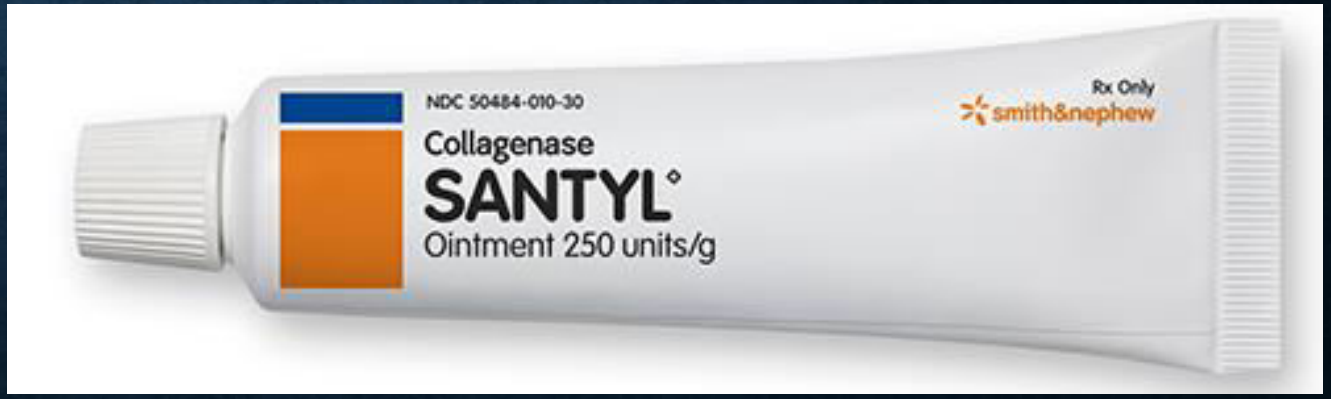
Product	Content and description	Uses/advantages	Disadvantages
TransCyte® ‡ (Smith and Nephew and Advanced Tissue Services)	Allogenic human fibroblasts cultured on nylon mesh coated with porcine collagen	To cover surgically excised full-thickness burns and non-excised partial-thickness burns	Temporary (may need skin grafting after 2–3 weeks); not suitable for infected wounds and patients allergic to porcine collagen
Dermagraft® ‡ (Advanced BioHealing)	Allogenic human fibroblasts cultured on bioabsorbable scaffold	Non-healing diabetic foot ulcers and venous leg ulcers	Not for infected wounds or ulcers with sinus tracts
Apligraf® § (Organogenesis)	Allogenic cultured skin containing keratinocytes, fibroblasts, and bovine collagen	Non-healing diabetic foot ulcers and venous leg ulcers	Not for infected wounds or patients allergic to bovine collagen
OrCel® § (Forticell Bioscience)	Allogenic cultured skin containing keratinocytes, fibroblasts, and bovine collagen	Acute and chronic deep dermal ulcers, partial-thickness burns and donor site wounds	Not for infected wounds or patients allergic to bovine collagen

DEBRIDEMENT

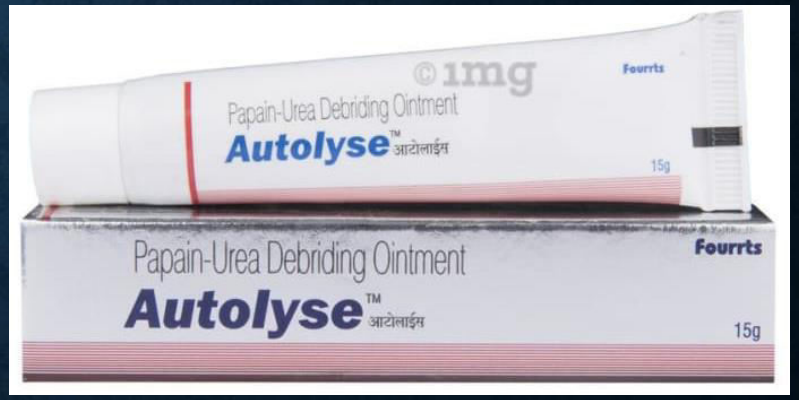
✓Enzymatic debridement

- Collagenase and papain, available as ointments have been used for this purpose.
- Aid in digesting necrotic tissue without damaging healthy tissue.

- Collagenase, is a proteolytic enzyme which specifically attacks and breaks down native collagen and is gentle on viable cells.
- It is therefore useful in maintenance phase of wound debridement, i.e., gradual breakdown of tissue.



- Papain, obtained from papaya, breaks down cysteine residues in proteins.
- It is nonselective and is associated with intense inflammatory response and breakdown of viable portions of wound bed, thereby associated with considerable pain.
- Urea is combined to increase its proteolytic action.



✓Mechanical debridement

- Cleaning of the wound with either high or low pressure, razor thin stream of water, saline or antibiotic solution.
- High pressure irrigation is effective in removing bacteria and necrotic debris from the wounds, thus lowering the rate of infection compared to low pressure irrigation.

- The only concern is that there is a risk of bacteria being driven into soft tissue by the high pressure.
- It is particularly useful in concavities of pressure sores and joint spaces and in tight spaces.
- It is indicated for use in necrotic wounds and deep burns.
- Since it preserves the viable dermal tissue it allows rapid wound healing with better cosmetic outcome.

✓ Biodebridement by medicated larvae (myiasis or maggot therapy)

- Use of larvae of green bottle fly (Lucilia serricata), for slough and necrotic tissue digestion without damaging surrounding healthy tissue.
- Their secretions contain
  - Proteolytic enzymes, which digests only necrotic debris and slough.
  - Enzymes which are bactericidal effective against MRSA and ß-hemolytic streptococcus.

- The selective debridement can be achieved within two days.
- Larvae can be left in place for 3 days but may need to be changed sooner if there is increase in pain because of change in wound pH.

The main drawbacks of this therapy are

- Local discomfort.
- Itching.
- Unaesthetic appearance.
- Cost of the therapy.
- Short half life of maggots.

Growth factors

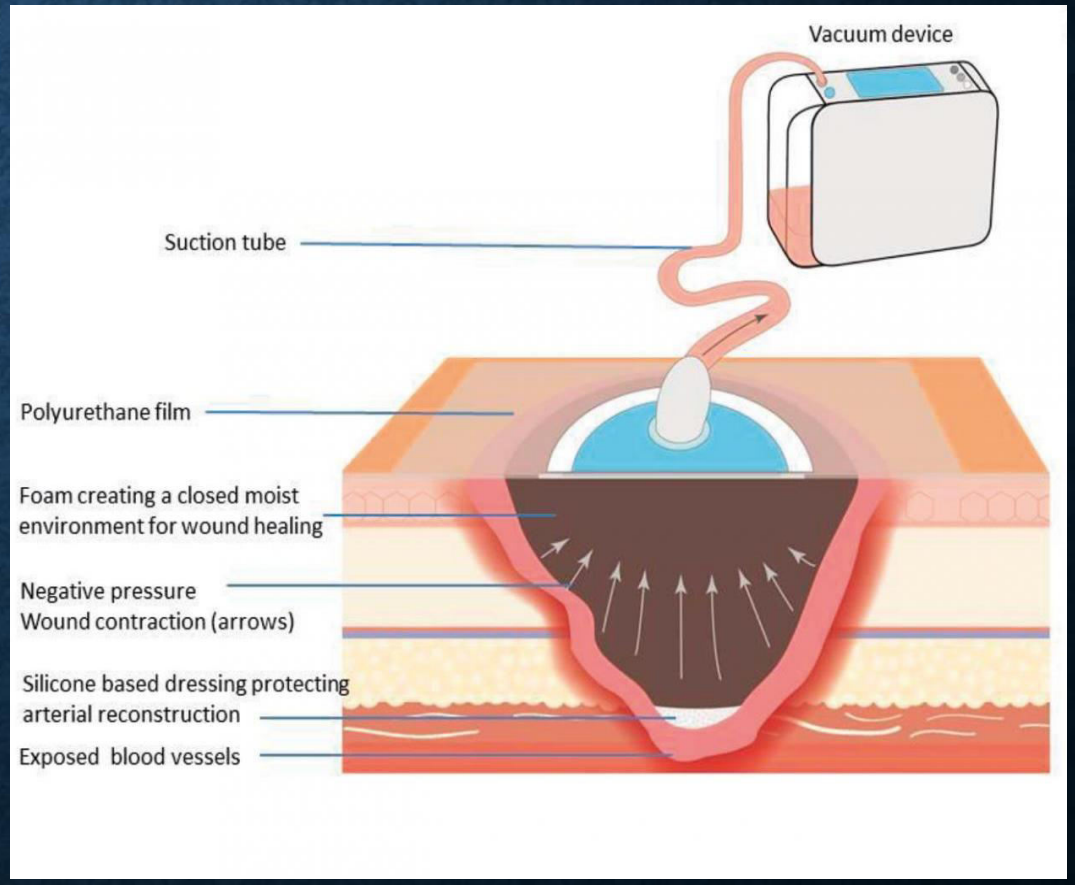
- Naturally occurring proteins in the body which control key cellular activities during normal tissue repair process.
- Can be obtained either autogenously by utilizing body's platelets or macrophages.
- Can be produced outside the body chemically or biochemically (recombinant).

- PDGF and EGF are the FDA approved topical growth factors for treatment of chronic wounds.
- PDGF promotes chemo tactic recruitment and proliferation of cells involved in wound repair.
- EGF also regulates cell proliferation, migration and differentiation through binding to receptor kinases on target cells and induce angiogenesis.

Negative Pressure Wound Therapy

- It was a novel idea to remove the exudates with the help of a suction machine.
- Intended to remove discomfort of the patient and to reduce frequency of change of dressings.

- Negative Pressure Wound Therapy unit applies gentle negative pressure to the wound through a tube and foam or sponge.
- These are applied to the wound over a dressing and sealed in place with a plastic film to create vacuum.
- The sponge is replaced every 2–3 days. Exudate from the wound is sucked along the tube into a disposable collecting chamber.



- Negative pressure improves the local blood supply and stimulates granulation.
- Lymphatic spread of infection is also reduced as there is reversal of tissue lymphatic flow with NPWT.
- Reduces bacterial colonization, diminishes edema and interstitial fluid.
- Causes tissue hypoxia around the wound edge which increases the expression of VEGF, which in turn increases angiogenesis.

- The newer machines have both irrigation, suction device.
- Instillation tube is added to the therapy unit in new versions of vacuum therapy machine to facilitate the application of topical antibiotics.
- Newer modification- Regulated oxygen-negative pressure therapy.
- Oxygen is delivered along with vacuum to prevent anaerobic infection.

Advantages of NPWT

- ✓(a) It is safe and painless.
- ✓(b) It does efficient cleaning of the wound.
- ✓(c) It reduces frequency of painful dressings.
- ✓(d) It reduces hospital stay.
- ✓(e) It has advantage of better control of infection with local delivery of antiseptics, if necessary.
- ✓(f) It prevents secondary infection in the ward.

Contraindications of NPWT

- Malignancy.
- Untreated osteomyelitis.
- Enteric/non-enteric and unexplored fistula.
- Necrotic tissue with eschar.
- Exposed blood vessels and nerves.
- Anastomotic sites.

Hyperbaric Oxygen Therapy

- It is an advanced therapeutic technique.
- Patients are placed inside a chamber, and then they breathe high-pressure pure oxygen for a short time.
- Commonly used for treatment of different types of wounds including diabetic foot ulcers, chronic wounds and post traumatic wounds.

- Oxygen influences the signal transduction pathways of multiple growth factors, including those involved in propagating angiogenesis.
- Drawbacks-
    - High cost.
    - Side effects.
    - Inaccessible equipment.

Ozone Therapy

- Advanced clinical therapeutic approach for chronic wound treatment.
- Ozone can provide a mild oxidative stress, which leads to a powerful antibacterial effect caused by oxidizing the phospholipids and lipoproteins inside the pathogens.
- Ozone raises NO level in blood, which leads to elicit the endogenous growth factors.

- Technique of giving peripheral ozone therapy is called bagging.
- The wound is exposed to ozone for up to two hours in an air tight bag.
- To avoid ozone toxicity, the level of ozone exposure should be kept under a therapeutic limit.

FUTURE OF WOUND CARE

- Tissue engineering techniques
  - Stem cells therapy.
  - Gene therapy.

Stem cells

- Have the ability to migrate to the site of injury or inflammation.
- Participate in regeneration of damaged tissue.
- Stimulate proliferation and differentiation of resident progenitor cells.
- Secreting growth factors.
- Remodeling matrix.
- Increasing angiogenesis.
- Inhibiting scar formation and improving tensile strength of the wound.

Gene therapy

- Classical gene therapy involves incorporating the gene into cells to directly influence the wound by its product of expression.
- Fibroblasts, endothelial cells and inflammatory cells are target cells for DNA uptake.
- Gene therapy was thought of in chronic wounds to provide long term growth factors by the wound cells themselves.

- Genes may be employed to
  - Augment an effect (e.g. promote healing), include genes for growth factors and their receptors.
  - Inhibit an effect (e.g. suppress excessive scarring), include genes for antibodies against specific growth factors.

Thank you