Special Article

[Simplified Wound Care/Management - Excerpts from 7th National Wound Care Workshop 2021]

Recent Advances in Wound Management

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Modern dressings and adjunctive therapies have been developed to provide a healthy wound environment for prompt recovery of wounds and decrease patient morbidity. Several advanced therapies such as electroporation, bio-electroporation, biofilm disruptors, antibiotic enhancers, bioacoustic and microscopic techniques are available for management of biofilms. Smart bandaging and dressing systems are emerging that are convenient, compatible, highly sensitive and durable. Moreover, 3D-wound care management enables a 3D picture provision for better wound management.

[*J Indian Med Assoc* 2021; **119(5):** 70-3]

Key words **: Bioacoustics, Electroporation, Modern wound care dressings, Wound care, Recent advance, 3D wound care.**

Wound management and care have tremendously evolved over the years. Modern dressings and adjunctive therapies have been developed to provide a healthy wound environment for prompt recovery of wounds and decrease patient morbidity. Depending on nature of wound the ideal dressing material should be chosen (Table 1).

In the present era, conventional antibiotics are not preferable due to compromised efficacy against biofilm. The moderator suggested that liberal debridement followed by interactive dressings (topical silver) together with systemic antibiotics and adjunctive therapies result in successful management of biofilm in wounds. Further, moderator opined that continuous use of silver colloidal wash removes biofilm effectively (Tables 2 & 3, Fig 1)[1].

Editor's Comment :

- Modern dressing materials, adjunctive therapies and smart techniques should be implemented by the clinicians for superior wound management.
- Multidisciplinary approach encompassing early intervention with multiple therapies along with nutritional assessment and its treatment is vital for best clinical outcomes.

Table 1 — *Dressing material depending on the nature of wound*

Intact skin	Thin hydrocolloids
Dry wound	Hydrogel, Nanosilver Colloidal gel
Less exudate	Thin foam and hydrocolloid
Moderate exudate	Calcium alginate with hydrocolloid,
Heavy exudate	Foam, Hydrofibre, calcium alginate with hydrocolloid
Infected wound	Antimicrobial dressing (silver nanocrystalline gel)
Deep and tunnel wound	NPWT, Calcium alginate or Hydrofibre
Chronic wound	Dermal collagen replacement and split thickness skin graft

NPWT : Negative pressure wound therapy

Negative Pressure Wound Therapy Is An Economical And Universal Wound Care Device[3,4]

Negative pressure wound therapy is considered as a cost-effective approach because of advantages such as minimal probabilities of emergency hospitalization, decreases need for re-admission or hospital stay, low incidence of septicaemia, fewer dressing changes, no drug overdose and decreased need for OPD. NPWT therapy is indicated for Chronic wounds, Acute wounds, Traumatic wounds, Subacute wounds, Dehisced wounds, Partial thickness burns, Ulcers, Flaps and grafts. Although the machine is costly, it is covered under government schemes to make it affordable to the clinicians and patients as well.

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Received on : 05/05/2021
Accepted on : 08/05/2021

Table 2 — *Advanced techniques for management of biofilms*[2]

Advanced techniques	Mechanism
Electroporation	Application of electrical field ruptures bacterial membrane.
Bio-electroporation	This technique uses antibiotic plus electroporation to act against microbes.
Biofilm disruptors (Nanosilver solution, Silicone elastomer, trypsin, sulphathiazole, Carboxamide,)	Halts the signalling pathways of bacteria, inhibit initial adhesion and cell division
Antibiotic enhancers (tyrosine)	Enhances antibiotic transportation to prevent and treat biofilms.
Bioacoustic technique	Ultrasonication (500 KHz) in combination with antibiotics increases antibiotic transportation across biofilms.
Antimicrobial photodynamic therapies	Produces reactive oxygen species when photosensitizers react with light and oxygen.
Microscopic techniques (scanning laser microscopy and atomic force microscopy)	Enables to determine biofilm formation and early diagnosis.

Table 3 — *Adjunctive therapies for wound management*

Adjunctive therapies	Properties
Monochromatic and infra-red energy	Acts as a local vasodilator by increasing level of NO, promotes blood flow and helps to carry systemic antibiotic in more effective way
Ultrasound therapy	Increases collagen deposition
Electrical stimulation	Enhances capillary density and perfusion, wound oxygenation, and speeds granulation and fibroblast activity.
Hyperberic oxygen therapy	Used for hypoxic wounds, helps wound heal inside out and causes faster healing. It is contraindicated in patients with cardiac failures and thrombosis.

Moreover, indigenous methods including Romovac or syringes used in NPWT makes it an economical treatment strategy. Additionally, it can be used in a wide variety of ulcers, has clear mechanism of action and has universal usage. Concomitant rehabilitation provides better patient tolerability, cost effective therapy and improves patient's quality of life.

Smart bandaging and dressing systems are emerging that are convenient, compatible, highly sensitive and durable. These smart techniques help to monitor temperature, determine infection and release antibiotics as per the requirement. However, aspects such as cost, availability and usability are yet to be worked upon. 3D-wound care management enables a 3D picture provision for better wound management. Contraindications for NPWT are Osteomyelitis, Ischemic wound, Malignancy of wound, fistulas (nonenteric or unexplored) etc.

The addition of fluids including antiseptics and antibiotics has been proposed and may be a way to extend the usage of NPWT. Microfabricated silicone device that can be precisely made and could allow suction to be transmitted to the wound. The addition of a perfusion circuit could also deliver cells, cytokines and fluids such as antibiotics. During NPWT variety of stem cells including those of the epidermis and dermis as well as adipose derived stem cells that have a large degree of plasticity will evolve. Even the combination of a mechanical device such as NPWT, a dermal scaffold and specific cells is being evaluated

Monochromatic and infra-red energy | Ultrasound therapy | Electric stimulation

Fig 1 — Adjunctive therapies

Debridement[5] :

The surgical debridement of wounds is evolving since many years. Life expectancy of patients with chronic conditions such as diabetes and others improved, so does the newer therapies evolved to meet the requirements of patients. Growing

understanding of biofilms came with the realization that with anaerobic species particularly developing deeper within the wound. Debridement became a pivotal fact of surgical wound care. Recent surgical instrument for wound debridement such as the direct contact low frequency ultrasound device (DCLFU), has been introduced. A vacuum sheath is added to the active tip to contain spray dispersion. It can remove all of the wound tissue including biofilm down to a healthy base. Optimal preparation of the wound prior to deployment of an advanced therapy, graft, or flap is possible. Currently it is well-established that debridement enhances wound-healing and improves the efficacy of unconventional therapies and surgical closure.

Offloading[6]:

This is crucial component of wound care if neglected successful results are difficult. Standard dressings and topical therapies can never replace the need for offloading. Total contact cast is the gold standard along with modalities such as braces, removable cast walkers, irremovable cast walkers, half shoes, modified surgical shoes, foot casts, and various felt or foam dressings. In neuropathic DFU effective offloading should be considered for surgical internal decompression.

Antimicrobial approach[7]:

Wound dressings with antimicrobial activity shall help with contaminated wounds with pathogens found in the surrounding environment, endogenous microbes. Antimicrobial agents incorporation (antibiotics, nanoparticles and natural products), have been utilized to deliberate bactericidal activity to dressings, Further development of co-administration of antibacterial agents shall improve the therapeutic outcome loading of antimicrobial agents into nanodevices into infected wounds shall have bright prospects in wound management.

Revascularisation[8]:

Surgical or endovascular revascularisation is look upon as the standard of care in mobile independently living patients. Clinical, biochemical, and noninvasive methods as predictors of wound healing time and wound-free period after surgical and endovascular revascularisation. Wound, Ischemia, and foot Infection (WIfI) classification introduced and recommended to be used in patients with foot ulcer. The WIfI does not only grade wound depth but also the severity of ischemia and infection and thus predicts better the risk of amputation and need for revascularisation. All-inclusive assessment of nutrition and nutritional support and replacement therapy may be necessary after a successful revascularisation to promote wound healing

A strong connotation between change in ankle–brachial index (ABI) and toe–brachial index and outcomes following revascularisation has been shown. The vascular surgeon should always assess the diabetic foot first with the possibility for revascularisation, before amputation is considered. There is currently no agreement on which of these biomarkers may be used to reliably assess microcirculation after revascularisation. More evaluation is required before the implementation in daily practice the devices such as transcutaneous measurement of oxygen partial pressure (TcpO2), radioisotope clearance, photoplethysmography, indocyanine green fluorescence imaging (ICG-FI) etc.

Growth Factor Therapy :

In chronic wounds there is dysregulation of various growth factors, hence need to provide exogenous growth factors to improve clean outcomes. This therapy helps promote healing in refractory chronic wound. Many types of growth factors are available such as colony stimulating factors, platelet derived factor, fibroblast growth factor, epi-dermal growth factor, vascular endothelial-stimulating factor. These growth factors promote granulation and epithelialization in DFU[9]. Growth factor therapy in the form of spray and gels are further helping wound healing.

Cell Therapy/biological Dressing :

Biological dressings using cell therapy with fibroblast, keratinocyte, Adipose-derived Stromal Vascular Fraction (ADSVF) cells and platelet concentrate are applied in both acute and chronic wounds.In biological dressing or cell therapy use of processed collagen or hyaluronic acid derived from skin/amnion, which act like scaffold into which fibroblast keratinocyte cellular in growth takes place and heals effectively in diabetic foot ulcer. It is particularly used in DFU, venous and pressure ulcers followed by skin grafting. However, the risk of infection transmission in biological dressing is high, hence should be used carefully. High cost and availability in rural areas are the major associated challenges (Table 4)[10].

Table 4 — *Smart techniques for wound management*	
NPWT	Provides a sterile environment, reduces edema, enhances perfusion, increase granulations, decreases bacterial load which in turn result in increased wound healing rate
Moleculight i:x	Locates harmful bacteria in wound site and guide therapy
Spincare	Portable forms a nano-fibrous layer without touching and promotes wound healing by promoting proliferation
Snap WCS and PICO NPWT	It is disposable, ultraportable, can be used in ambulatory sitting, can combine dressing with application of NPWT
Dermaclip	It can be used in emergency, casualty and battle field as it is suture free technique as it is a needle free suturing
Monochromatic infrared energy	Useful for pressure ulcers, arterial ulcers, DFU and venous ulcers, As increase vasodilation by increasing local NO thereby increasing vascular perfusion A sitting of 30 minutes per day gives good results
Foot massage device	Used in neuropathic wounds, It has shoes plus vibratory motor with remote control Patient benefits from numbness and pain

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