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SURGICAL AIDS AS A REVIEW

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ABSTRACT

Wound healing is a complex process that is critical in restoring the skin's barrier function. This process can be interrupted by numerous diseases resulting in chronic wounds that represent a major medical burden. Such wounds fail to follow the stages of healing and are often complicated by a pro-inflammatory milieu attributed to increased pretenses, hypoxia, and bacterial accumulation. The comprehensive treatment of chronic wounds is still regarded as a significant unmet medical need due to the complex symptoms caused by the metabolic disorder of the wound microenvironment. As a result, several advanced medical devices, such as wound dressings, wearable wound monitors, and negative pressure wound therapy devices, and surgical sutures, have been developed to correct the chronic wound environment and achieve skin tissue regeneration. Most medical devices encompass a wide range of products containing natural (e.g., chitosan, keratin, casein, collagen, hyaluronic acid, alginate, and silk fibroin) and synthetic (e.g., polyvinyl alcohol, polyethylene glycol, poly[lactic-co-glycolic acid], polycaprolactone, polylactic acid) polymers, as well as bioactive molecules (e.g., chemical drugs, silver, growth factors, stem cells, and plant compounds). This review addresses these medical devices with a focus on biomaterials and applications, aiming to deliver a critical theoretical reference for further research on chronic wound healing.

INTRODUCTION

These are materials used for the dressing of wounds or injured or diseased tissues and to hold wound edges closely together during healing. These materials are collectively known as surgical aids. (1)

Historically, a dressing was usually a piece of material, most commonly cloth; however, the use of dung, leaves, and honey has also been described. (2)

Previously, it was widely believed that wounds should be kept as dry as possible to prevent infection. (3)

In 1860, the English surgeon Joseph Lister began treating his surgical gauze with carbolic acid, now known as phenol, which subsequently reduced the mortality rate among his surgical patients by approximately 45%.

In 1870, Robert Wood Johnson, co-founder of Johnson & Johnson, began producing gauze and wound dressings treated with iodine. (4)

Modern wound dressings

1990, the surgical dressings expanded into the well-recognized groups of products, such as vapour-permeable adhesive films, hydrogels, hydrocolloids, alginates, and synthetic foam dressings. Additionally, new groups of products, such as anti-adhesive, mostly silicone meshes; tissue adhesives;

barrier films; and silver- or collagen-containing dressings, were introduced. Finally, combination products and engineered skin substitutes were developed.[(5)]

Surgical dressings

Surgical dressing is a term applied to a wide range of materials used for dressing wounds or diseased tissues.[(6)]

Ideal wound dressings

- Provide an environment for tissue healing.
- Prevent maceration by permitting evaporation or absorption.
- Promote haemostasis (i.e. stops bleeding)
- Protect the wound from further damage

E.g. Mechanical damage, Microbial invasion, Dehydration, Maceration, Chemical damage, Alteration in pH.

Promote healing. Reduce heat loss. Control microbial growth by incorporation of antimicrobial drugs. Provide compression, promoting haemostasis and reducing edema. Reduce pain, increase patient comfort and improve functional use for wound site. Reduce odour. Improve appearance of the wound site. Reduce overall cost associated with wound treatment.[(7)]

Classification of Surgical Dressings

Surgical dressings are generally categorized into primary dressings and secondary dressings based on their role in wound management.

Primary Dressings

Primary dressings are materials placed in direct contact with the wound bed. They are intended to protect the wound, maintain an optimal moist environment conducive to healing, and support the wound healing process.

Examples: Plain gauze, impregnated gauze, paraffin gauze dressings, hydrogel dressings, and composite dressings.

Secondary Dressings

Secondary dressings are applied over primary dressings to hold them securely in place. In addition, they provide extra protection to the wound, absorb excess wound exudate, and may offer compression or structural support when clinically indicated.

Ex: Absorbent pads, bandages, and adhesive tapes.

Certain dressings are intended exclusively for use as primary dressings, whereas others possess characteristics that allow them to function as either primary or secondary dressings, depending on the clinical requirements and wound characteristics.

Examples of dressings that can serve both functions include**:** Composite dressings and hydrogel dressings.

Primary wound dressings

Plain gauze

Impregnated Gauze

Paraffin gauze dressings Film dressing

Primary/Secondary wound dressings

Composite Dressings

Ex: absorbent rayon or cotton pads sandwiched between porous Polyethylene films.

Hydro gel: Hydro gels are available as sheet dressings or gels.

Brands: Tegagel®, Intrasite® Hydrocolloids[9]

Hydrocolloids slowly absorb fluids, leading to a change in the physical state of the dressing &the formation of gel covering the wound

Provide moist wound environment

Provide Pain relief by covering nerve endings with both gel and exudates.

Constituents are methyl cellulose, pectin, gelatine and poly-isobutylene.

Hydrocolloids are used both acute wounds and chronic wounds and for different stages of light-to-heavy wounds

Brand: Due DERM® Secondary wound dressings

Absorbents

Surgical cotton

Surgical gauzes [(10)]

Gauze

Most readily available simple wound dressings

Non-adherent to coating

Absorbs exudates

Promoted dictation in wounds

Can be used as a primary or secondary dressing

Highly permeable

Relatively non-occlusive

Forms: squares, sheets, and packing strips.[(11)]

Bandages (Medicated bandages)

Bandages: Are use to hold dressing in place by providing pressure or supports.

Bandages may be extensive or no extensive, adhesive or no adhesive, flat or tubular or become rigid after shaping for immobilization.(12)

Types of bandages

Common Gauze Roller Bandage: it is prepared from absorbent gauze in various width & lengths. . Each bandage is in one continuous piece, tightly rolled and substantially free from loose threads.

Muslin bandage rolls: are made of heavier unbleached materials. They are very strong and are used wherever bandages do not provide sufficient strength or support.(13)

Elastic bandages

Woven elastic bandage is made of heavy elastic webbing containing rubber threads. Good support & pressure are provided by this type of rubber elastic bandages.

Crepe bandage: is elastic but contains no rubber. Its elasticity is due to special weave that allow it to stretch twice its length.(14)

Triangular bandages

Orthopaedic bandages used to provide immobilization and support in the treatment of broken bones and in certain conditions of bones and joints. Plaster of Paris impregnated gauze has been std material for this purpose. These bandages are water resistant, light weight and durable.

Orthopaedic elastic plaster bandages are plaster of Paris bandages containing elastic thread in the fabric and are intended for specialized prosthetic uses.

Cast bandages: are soft, protective padding, applied like a bandage to the affected areas. They are composed of various fibre constructions that confirms and cling, absorb moisture, and allow the skin to breathe.(15)

Adhesive tapes

Permeable surgical adhesive tapes: it is an alternative permeable woven or non- woven surgical synthetic adhesive tapes BP spread with a polymeric adhesive.

Semi-permeable surgical adhesive tapes: These are waterproof and therefore protect wound from micro-organisms and environmental conditions.

Occlusive surgical adhesive tapes: these are used to secure or cover dressing where air and water vapor is required.(16)

Sutures and Ligatures

Surgical suture is a strand or fibre reused to hold wound edges in application during healing.

A ligature is a thread or string without a needle which is used to tie blood vessels and other tissues together.

Sutures materials may be divided into two principle classes: Absorbable & non-absorbable.

Absorbable Sutures

Are those materials that are capable of being broken down or digested by the body.

Ex: Poly glycolic acid, Poly-galactine, polypropylene etc

Non-absorbable sutures

Are made from various materials such as polyesters, nylon etc. these materials incite a minimal foreign body reaction at the site of placement. They are frequently used for cardiovascular, ophthalmic and neurological procedures.

Silk: Silk is an important non-absorbable surgical suture consisting of the protein fibroin, as extruded by the silkworm. Silk sutures are easy to handle and are well tolerated by body tissues.

Dermal silk: These sutures consist of natural twisted silk with an insoluble coating of tanned gelatin or other proteins. (18)

Cotton and Linen: Sutures derived from cellulose are twisted from fibre staples, have moderately high tensile strength, and are stable to heat sterilization.

Metallic Sutures

Silver: Silver wire, foil, and other forms are used to some extent as sutures. Silver has some antiseptic action, but in some tissues it produces irritation.

Stainless steel: Stainless steel is a ferrous alloy that is resistant to chemical attack and has been widely used in the form of wire sutures, fixation plates, screws, and other surgical implants. (19)

Catgut

Catgut is a natural absorbable suture obtained by longitudinally splitting the intestinal submucosa of sheep and goats, twisting the ribbons, and joining them in the wet condition to produce a monofilament finish.

Brand names: Turgut, Progut, etc.

Catgut is available as **plain** (ivory color) and

chromic (dark brown color).

Plain catgut: Loses 50% of its tensile strength in 3 days and 100% by 15 days, and is completely absorbed in the tissue within 60 days. [20]

Uses

- To ligate small subcutaneous vessels.
- To repair wounds of the lip or oral cavity.

Chromic Catgut

Chromic catgut is treated with a chromic salt solution. Mild chromic sutures are specially treated for ophthalmic and cuticular applications.

It loses 50% of its tensile strength in 7 days and 100% by 28 days, and is completely absorbed in the tissue within 90–100 days.

Absorbable Gelatin Sponges (Gelatin Foam)

Absorbable gelatin sponge is made from animal skin gelatin (denatured collagen).

As the sponge fills with blood, platelets come into contact with it, promoting blood clotting. If soaked in thrombin, it directly acts on the coagulation process and exhibits increased hemostatic action. [21]

Surgical Equipment

Surgical Needles

Initially, stainless steel needles were used. Currently, high-nickel stainless steel is used because it provides better resistance to bending and breakage.

Round-bodied needles

- Minimize tissue trauma and are used for suturing the peritoneum, abdominal viscera, myocardium, etc.

Cutting needles

- Have two opposing cutting edges.
- Designed to cut through tough, difficult-to-penetrate tissues.
- Used in plastic surgery, especially of the face.

Reverse cutting needles

- Designed with the cutting edge on the outer convex side.
- Used for skin, oral mucosa, and tendon sheaths.

Blunt needles

- Dissect friable tissue rather than cutting through it.
- Used for suturing the liver and kidney. [22]

Surgical Meshes

Surgical mesh is a woven fabric used for chest wall reconstruction, strengthening tissues, providing support for internal organs, and treating surgical or traumatic wounds.

The most common types of surgical meshes are hernia meshes, stress urinary incontinence slings, and meshes for treating pelvic organ prolapse.

Titanium mesh has been used in some spinal surgeries.

As with any surgical implant, complications can occur, including infection, inflammation, tissue damage, and septic shock. [23]

Types of Meshes

Polypropylene mesh (Prolene mesh)

- Monofilament.
- Inert; can be used in the presence of infection.
- Good elasticity and high tensile strength.

Uses

- Hernia repair.
- Abdominal wall reconstruction.

Stainless steel mesh

- Rigid and difficult to work with.
- Causes discomfort to patients.

Polyester mesh (Mersilene)

- Least inert synthetic mesh.
- Should never be used in the presence of infection.

Transvaginal mesh (Pelvisoft®, Pelvitex®)

Surgical Staples

Surgical staples are specialized staples used in surgery instead of sutures to close skin wounds.

Basic principles

- Preservation of adequate tissue vascularization.
- Avoidance of tissue tension.
- Hemostasis.

Advantages

- Less tissue reaction.
- Accelerated wound healing.
- Greater efficiency.
- Reduced anesthesia requirement and shorter intraoperative time. [25]

Types of Staplers

- Circular staplers.
- Disposable linear staplers.
- Disposable linear cutting staplers.
- Skin staplers.
- Disposable curved cutter staplers.
- Disposable endo-cutter staplers.

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