Original Article

Treatment Effectiveness Analysis Of Patients With Long-Term Healing Wounds By Using Innovative Wound Coatings (Literature Review)

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Abstract

The problem of wound treatment and wound infection remains relevant throughout the history of surgery. Another problem is restoring the lost skin in diseases and injuries of various etiologies. Wound coverings (WC) are a kind of medicinal form. The use of WC can significantly increase the effectiveness of the treatment of both long-term healing wounds, such as trophic ulcers TU), wounds and burns.

Keywords: effectiveness of treatment, long-healing wounds, wound coverings, innovative mechanism.

Introduction

More than 300 types of wound coverings are currently used in clinical practice. The main requirements for RP are to create an optimal microenvironment for wound healing, high absorption capacity in relation to wound exudate, the ability to prevent the penetration of microorganisms, adequate permeability to gases, water vapour, elasticity, absence of pyrogenic, antigenic, toxic, local irritant and allergic actions.

According to its origin, RP can be conditionally divided into natural and synthetic [1,2]. Preparations of natural origin are various variants of preserved skin or dermis and amniotic membranes of humans or animals and are "golden" standard" wound coverings. According to the form of manufacture and application method, WC is divided into sponges, gelling coatings, film coatings, coatings formed during the spraying of the composition in the form of an aerosol, and combined coatings [8].

However, to date, there is not enough research on the use of innovative WC in healing long-term wounds.

As studies show, a new generation preparation containing type 1 collagen, obtained from the skin of cattle, is "Collost". For example, A.I. Shcherbakov (2006) received a positive effect by using "Collost" to strengthen colonic

anastomosis. The amniotic membrane of humans or animals can be used for therapeutic purposes. The therapeutic effect is due to its composition of several extracellular matrix components (collagen, fibronectin, glycosaminoglycans) and growth factors. RP of biological origin include coatings based on protein-polysaccharide complexes. Their advantage is non-toxicity and antigenicity; the body easily and quickly resorbs them. Complex production technology and high cost cause the difficulty of their use in domestic health care.

V.N. Balin, I.H. Karshiev, A.K. Iordanishvili (2018) showed whether the effectiveness of the use of a wound coating based on a collagen-chitosan complex containing a proliferating culture of fibroblasts, the possibility of the complete restoration of tissue structures, including the papillary layer of the skin, has been created. Various collagen-chitosan wound coatings "Collachite" - "Collachite FA" have been designed, contain the antiseptic drug "Furagin" and the local anaesthetic anilokaine and "Collachite Sh", contains an antiseptic of plant origin - shikonin. Biologically active textile dressing materials include the family of dressing materials "Activex", which has more than 20 products with various therapeutic effects [3].

Sorbents of domestic and foreign production are increasingly used to treat purulent wounds. The main functional characteristic of sorbent coatings is the ability to absorb exudate released from the injury, the amount of which can be significant [5.6]. With a sound effect, A.A. Dregalkina, I.N. Kostina (2018) used "Activtexfuragin" to prepare granulating wounds, including extensive ones, for skin plastics.

P.A. Zhelezny, M.V. Kobelkin, 115 A.O. Izyumov (2017) in experiments on laboratory animals showed that the use of RP "Lithoplast" in the treatment of burn wounds of III A degree has a protective effect on the structural organization of the initial links of the lymphatic system of the skin, improves its drainage function, helps to reduce the degree of endogenous intoxication of the body in the post-burn period [7].

T.E. Dorjiev, V.E. Khitricheev, and V.P. Saganov (2017) also used the Resorb wound coating in the treatment of purulent wounds in the I and II phases of the wound process, which contributed to reducing the main stages of the wound process by half compared to treatment with the official Levomekol ointment. The author obtained the best results using Resorb and Biatravma together [4].

These authors also justify the local application of the solution. The gel "Prontosan" is well tolerated and does not cause side effects in patients with purulent wounds and ulcers of various etiologies.

PRP gel (a gel enriched with plasma platelets) has stimulated wound healing for over 20 years in Western Europe and the United States. Autologous PRP gel consists of cytokines, growth factors, chemokines and fibrin derived from the patient's blood [10].

The mechanism of action of PRP-gel is associated with molecular and cellular induction, similar to that observed with platelet activation. D. C. Chu, A. B. Mehta, A. J. Walkey (2017) conducted a systematic review and a meta-analysis that showed that complete and partial wound healing was faster in patients who used PRP-gel than in a control group. Relatively recently, pectin-based drugs began to be used in clinical practice. In 1975, Conva Tec created a dressing based on pectin and gelatin for the treatment of venous leg ulcers - "Varihesive". In some observations, a new material so actively stimulated the formation of granulation tissue that it was necessary to cauterize excessive granulations. Recently, when searching for new means for local effects on a purulent wound, the ability of pectin to effectively suppress wound microflora and prevent superinfection of the injury by representatives of nosocomial infection was primarily taken into account. The bactericidal properties of pectin make it possible to use it as part of a pectin-gelatin complex with additives of physiologically active substances as a water-soluble film for the treatment of open wounds and burns [11]. Wang Y. W., Liu C. C., Cherng J. H., Lin C. S., Chang S. J., Hong Z. J., Liu C. C., Chiu Y. K., Hsu S. D., Chang A. H. (2019) used waste products from the production of passion fruit juice (passionflowers) as a carrier for immobilizing papain protease in the preparation of films suitable for the treatment of skin wounds. Studies on the treatment of skin wounds conducted on voluntary patients using papain-pectin films demonstrated the acceleration of wound healing without any adverse side effects, regardless of the type and depth of the wound [17].

Clinical observations have shown that patients tolerate the local use of pectins well and do not cause adverse reactions and complications. With the suppuration of burn wounds of IIIA - IIIB degree, the imposition of dressings with pectins led to rapid relief of the suppurative process. The healing time of injuries treated with pectins was 2-4 days ahead of the control ones due to the accelerated cleaning of the wound in the exudative stage of the wound process.

Currently, the use of wound coverings is based on the "principle of 'wet wound healing'" formulated by G.D.Winter, H.Maibach and C.D.Hinman in 1962–1963 [18]. It has been shown that a moist abacterial environment is optimal for maintaining a normal mitotic process in the wound: epidermocyte migration and wound epithelialization occur more actively in a humid climate rather than in conditions of exposing wounds to air and drying their surface. The moist environment provides the high activity of wound proteases, leading to rapid cleansing of the wound surface

without using enzyme preparations, which often cause allergic reactions. In addition, the drying of nerve endings is prevented, and the pain syndrome is markedly reduced.

Since the coatings do not stick to the wound surface, their change during dressings occurs painlessly without damaging the granulation tissue and the growing epithelium. Wound coverings can accelerate healing while significantly reducing the frequency of dressings - depending on the degree of exudation. They can remain on the wound for up to 7 days (sometimes even longer, up to complete epithelialization). The criterion for changing the drug is usually the spread of wound secretion beyond the contours of the ulcer or its beginning leakage from under the coating. Wound coverings can be used at all stages of healing except for severely infected wounds with severe inflammation in phase I of the wound process.

There is currently no generally accepted classification of wound coverings. According to the structural characteristics, it is possible to classify them as follows:

1) film wound coverings;
2) hydrocolloid coatings;
3) hydrofiber;
4) alginates;
5) collagen wound coverings;
6) hydrocellular coatings;
7) hydrogel coatings;
8) atraumatic wound coverings;
9) sorbent coatings;
10) combined wound coverings.

Film wound coverings (Suprasorb F, Hydrofilm, Tegaderm, Foliderm, etc.). Historically, they are the first wound coatings. They consist of a thin transparent sheet of polymer (usually polyurethane, coated, on the one hand, with polyacrylate glue). The mandatory properties of film coatings are impermeability to microorganisms, permeability to water vapour, and permeability to oxygen. Permeability to water vapour is essential since the accumulation under the film and an excess of wound exudate macerates the surrounding skin. It loosens the epidermis, which loses its protective properties against microorganisms located deep in the hair follicles, sebaceous and sweat glands. It leads to the development of contact dermatitis.

The effect of the permeability of film coatings to oxygen on the rate of healing of epidermal wounds was investigated by G.D.Winter [17]. Under the polyethene film, superficial wounds were epithelialized in 3 days in 90% of experimental animals. Under the polypropylene film, the permeability was two times lower. During the same period, complete epithelialization was observed in 70% of animals, and only 52% of wounds healed under an impermeable polyester film.

Based on the data obtained, the author concluded that the wound coating should pass oxygen well to achieve rapid epithelialization of wounds.

Hydrocolloid coverings (Varihesive, aka Granuflex or DuoDerm, Suprasorb H, Hydrocoll, etc.) entered clinical practice in the early 1980s after the appearance of the first hydrocolloid coating Granuflex - Granuflex [17,18]. Available in the form of plates and amorphous paste. The leaves contain a hydrocolloid layer in contact with the wound, fixed to a semi-permeable outer layer (usually a thin polyurethane sponge or film). Hydrocolloid sorbs the wound secret, while passing into a jelly-like state.

Thus, excess fluid is removed from the wound surface, and at the same time, a moist environment is maintained, and the atraumatic coating is ensured. The basis of the hydrocolloid is usually micro granules of the sodium salt of carboxymethylcellulose, pectin and gelatin, dispersed in an adhesive mass (usually polyisobutylene). Turning into a gel, the hydrocolloid acquires a characteristic odour and can flow out from under the coating, resembling pus. Therefore, in some coverings, reinforcement of the hydrocolloid matrix is used, which gives strength to the resulting gel. In dry form, hydrocolloid plates are practically vapour- and gas-permeable, but in the hydrated state, their permeability increases significantly and can even exceed the permeability of some film coatings [15].

Hydrofibers. Aquasel (Aquacel of ConvaTec, USA - UK) is the only representative. In clinical practice - since 1998. Available in two versions - with and without silver impregnation (Aquacel Ag). The coating consists of sodium salt fibres of carboxymethylcellulose, which, when in contact with wound secretion, turn into a transparent gel that creates a moist environment on the wound surface and ensures the atraumatic of the coating. Aquasel has a high sorption

capacity, almost twice higher than alginate coatings. In this case, the adsorption of the discharge from the wound occurs strictly vertically, which prevents maceration of the skin around the ulcer [13, 14].

Alginate wound coverings (Suprasorb A, SeaSorb, Sorbalgon, etc.) are biodegradable wound coatings produced from seaweed. Alginates are natural polysaccharides with a molecular weight of 32–200 kilodaltons. The primary source of alginates in nature is seaweed of the genus Kelp, which are contained in the form of alginic acid salts, mainly sodium alginate. Interestingly, some bacteria, for example, Ps. aerugenosa, can synthesize alginates [12, 15, 19].

Wound coverings based on chitosan. "According to a 2018 WHO statistical analysis, 5 million people lose their lives due to their injuries every year. People between the ages of 15 and 44 account for almost 50% of injury-related deaths. Injuries are responsible for 9% of all deaths worldwide. In the modern world, wounds of various genesis are perhaps the most frequent type of traumatic injury. The circumstances of injuries and the mechanism of their occurrence are incredibly diverse. For these reasons, it is necessary to constantly expand the arsenal of means and methods of treating wounds of various etiologies and introduce them into clinical medicine.

Conclusion. With the development of medical science and technology, treatment methods, pharmaceuticals, and their release forms have changed. Still, the general principles of managing difficult-to-heal wounds, taking into account the stages of wound healing, have changed little and consist in maintaining the natural healing process and effective and gentle wound care. Thus, as the literature analysis showed, despite the results of new, modern medical technological operations, treating difficult-to-heal wounds of various genesis remains an unsolved problem. Wound coatings have high requirements. They must have absorption capacity, be permeable for air, non-traumatic, safe, protect soft tissues from infection and maintain the necessary moist environment in the wound in all phases of its healing. These requirements are feasible with local wound management under dressings.

Although many works are devoted to managing difficult-to-heal wounds, a single tactic for managing such complex patients has not yet been developed. Therefore, improving the methods of treating such injuries is relevant.

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