Original Article

A Historical Digression On The Use Of Various Wound Coatings According To Literature Analysis

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Abstract

It is a historical study of various wound surfaces' use for further improvement. More than 300 types of wound coatings are currently used in clinical practice. The main requirements for WC are to create an optimal microenvironment for wound healing, high absorption capacity for wound exudate, the ability to prevent the penetration of microorganisms, sufficient permeability to gases, water vapours, elasticity, the absence of pyrogenic, antigenic, toxic, local irritant and allergic actions.

Keywords: wound coverings, historical experience, tactics of application, excursion

Introduction

Wound coverings are a class of drugs from relatively recent ones. However, they originate in the use of them from the XIX century.

A very detailed historical analysis of the beginning of the use and further development of wound surfaces was given by Paramonova O. A. (2020) in her work "The effectiveness of the use of modern wound coatings in the complex treatment of patients with phlegmons of the face and neck".

"The lint was the main dressing material from the middle of the XIX to the middle of the XX century. It was fixed to the wound Using a bandage of cloth [2, 11]. However, the lint in the process of manufacture was contaminated with microorganisms and salted, which decreased its drainage properties. The ancestor of the antiseptic wound treatment method is the Englishman J. S. Miller. Lister. The famous bandage of J. S. Listera consisted of three layers. The layer adjacent to the wound was a silk cloth impregnated with carbolic acid. The middle layer consisted of several layers of gauze, also impregnated with carbolic acid. The upper protective layer was represented by a rubberized

airtight material, “Macintosh”. Given its adverse side effects on the patient’s wound and medical personnel, the lister dressing did not spread [1, 11].

By the end of the XIX century, in clinical practice, more than 20 antiseptic drugs were used to treat wounds: alcohol, iodoform, iodine, potassium permanganate, silver nitrate, xeroform, etc. Since the second half of the XIX century, flax, cotton, moss, peat, etc., have been used in surgery as dressing materials with absorbent properties [1, 5]. Despite its significant role, antiseptics harmed the tactics of wound treatment. From the point of view of this method, the main thing was the destruction of microbes in the wound, which pushed the issues of its surgical treatment to the background. In the first place, the use of antiseptic drugs and the bandage were put forward. It became clear that the manufacture of dressings from old linen rags and ropes is one of the causes of wound suppuration. Bandages cannot be reused to reduce the transfer of infection. [2, 6].

E. Bergman and his students (K. Schimmelbusch and others) in 1886-1891 developed organizational measures and devices for sterilizing dressing material and instruments, which contributed significantly to the development of the aseptic method in the treatment of wounds. L.P. Pelekhin, in 1868, for the treatment of purulent wounds, used gauze, linen tampons impregnated with xeroform solutions, iodoform, etc., which have absorption capacity. N.V. Sklifosovsky, in 1872 proved the draining properties of linen dressings based on the laws of physics [8]. Thus, aseptic (putrefactive) dressing began to be used [1].

The role of M.Ya. Preobrazhensky, in the development of the doctrine of bandages, is invaluable. His work “Physical antiseptics in the treatment of wounds” (1894) [5,6] shows the importance of the physical properties of dressings: hygroscopicity, porosity, absorbability, thermal conductivity, etc. In 1876, F. Esmarch developed an FFD (first field dressing). In Russia N.A. Velyaminov supported this idea only in 1885. In the army, the FFD appeared only by the beginning of the Russian-Japanese war in the form of a bandage and gauze pads. In 1880 A. Wright proposed the treatment of the wound by introducing tampons soaked in a 10% hypertonic solution of table salt into its cavity, thereby contributing to the “washing” of the wound from the depth to its surface.

The French surgeon E. Lumiere proposed the tulle gras bandage, which was made of cotton mesh impregnated in proportion with wax, paraffin and Peruvian balsam. This bandage was permeable to air and did not interfere with drainage. It is how non-adhesive bandages appeared, used in various modifications in our time [4]. In 1914-1917, ointment dressings were used. In Russia, vaseline was used for this purpose [9, 10].

After the end of the First World War, researchers from different countries concentrated on studying the wound healing process, searching for new, more effective antiseptics, and developing wound treatment methods. So, in 1929, E. Howes et al. proposed a technique for studying the strength of a wound during routine healing. They created a classification of the wound process, which consisted of three phases: latent, regeneration and reorganization of the scar. This classification is still fundamental in surgery [1, 12].

A significant event was the creation of a cytological method for examining D. Policard wound prints in 1916. It was the first objective test to assess the course of the wound process. The foundations of the wound process’s morphology, bacteriology and immunology are beginning to be laid, and biochemical changes in wound tissues are being studied. Another vital area of research was the search for new effective antiseptic agents, even during First World War A. Fleming showed that antiseptics do not always affect the causative agents of wound infection due to their inactivation by wound exudate and inability to penetrate the deep layers of the wound. In 1932, drugs of the sulfonamide series were synthesized – “chemotherapeutic agents” effective against wound infection: streptocide, sulfidine, etc. Streptocide and sulfidine powder were used as a powder for the wound surface. The wound was covered with a bandage. However, chemotherapy drugs and antiseptics did not have an excellent therapeutic effect on the microflora during necrotic processes in wound tissues.

Since the beginning of the Great Patriotic War, great importance has been attached to treating wounds with sulfonamide preparations (mainly streptocide), which were used together with bandages. The Second World War contributed to the emergence of antibacterial agents and gave a powerful impetus to the further development of the doctrine of the wound and its 27 treatments, wound dressing [10, 11, 12, 13]. When providing first aid, an aseptic pressure bandage from FFDs was used. In the subsequent stages, bandages with antiseptics were used. A.V. Vishnevsky’s school significantly contributed to the theory and practice of wound treatment [1, 10]. Applied after careful surgical treatment of a purulent focus and necessary for a long time, a bandage with an oil-balsamic emulsion (Vishnevsky ointment), along with rest, provided the wound, according to the author, a weak neurotrophic irritation due to the balsamic substance contained in the ointment. It was the primary, subsequently forgotten, the idea of creating an ointment – stimulation of healing through irritation.

The development of chemical production in the second half of the XX century and the lack of materials for dressing that were in force at that time led to the development of polymer-based dressings. In 1944 N. Owens (USA)

proposed cellulose acetate fabric as a wound dressing. H. Bloom (1945) used cellophane for wound treatment. A. Marshak (1945) used a solution of isobutyl methacrylate in toluene as an occlusive coating for the treatment of wounds. By this time, impermeable PVC and related polymer films appeared, which were used as first-aid bandages [1, 9].

In 1944, T. Winsor and G.E. Burch determined that the moisture evaporation rate from the skin surface is 234 g/m2 / 24 h at a relative humidity of 50% and t ° = 23.9 ° C. J.P. Bull et al. (1948) conducted experiments with methoxymethyl and polyamide. They obtained a porosity polymer film with a water vapour permeability of 1920 g/m2 / 24 h at 40 ° C, a pressure of 40 mmHg and a relative humidity of 95%. The advantage of the polyamide coating was its transparency, which made it possible to monitor the wound without changing the bandage. The works on polyamide film were the first tests of this type of wound coating, which was an essential step towards developing the doctrine of bandages [1].

One of the essential functions of a wound dressing is sorption capacity. In 1947 G. Blaine investigated the alginate absorption product, which was obtained as a result of the reaction of calcium ions with a soluble sodium alginate salt. Calcium alginate was obtained in the form of plates that were absorbed in tissues and could be used as a wound coating. E. Gelinsky (1954) created a dressing from a woven nonabsorbent plastic film attached to an absorbent. R.H. Rice et al. (1955) developed a Telfa bandage combining polyester film and absorbent. In the works of T. Gillman et al. (1956, 1957), the indications and contraindications to the use of this type of bandages have been clarified [8, 10].

In 1954, J.T. Scales formulated the requirements for the so-called “ideal” dressing: – high permeability and sorption capacity; - low adhesion to the wound, the ability to fix to the skin and barrier functions for microorganisms; – hypoallergenic; – the possibility of sterilization and low cost [1, 9].

In 1962, G.D. Winter established the value of the microenvironment created by the bandage for wound healing [16]. He showed that in a moist wound environment, there is an increase in the migration of epithelial cells. He also described an ideal wound dressing that provides gas exchange between the wound surface and the atmosphere. In 1970-1980, the theory of the advantage of “wet” wound healing was supported by the fundamental works of D.T. Rovee and W.H. Eaglstein et al. [14].

The second half of the XX century was characterized by a significant number of experimental works on wound healing problems. Achievements of biochemistry, molecular biology, immunology and other sciences 29 contributed to further progress in the study of inflammation and regeneration processes (V.S. Paukov, R.V. Petrov, V.V. Serov, A.I. Strukov, A.M. Chernukh, O. Alvarez, N.S. Harris, T.K. Hunt, E.E. Peacock, M.C. Robson, T.D. Turner, W. van Winkle, et al.) [13, 14, 15, 16].

Valuable scientific information about the wound healing process was obtained using electron microscopy, immunobiological, histochemical, radioisotope research methods and X-ray diffraction analysis (A.A. Paltsyn, D.S. Sarkisov, L.B. Arey, J.J. Hutchinson, K.F. Jeter, G.T. Rodeheaver, J.C. Ross, etc.). The development of vulnerology in the twentieth century is associated with the achievements of the schools of N.N. Anichkov, A.V. and A.A. Vishnevsky, S.S. Girgolava, V.V. Gorinevskaya, I.V. Davydovsky, M.I. Kuzin, I.G. Rufanov, V.I. Struchkov [8, 9, 12, 17].

Conclusion

In the second half of the 80s of the twentieth century, the range of dressings supporting a moist wound environment increases, stimulating granulation and migration of epithelial cells. Wound coverings that enable growth factors are being introduced into clinical practice. Thus, the achievements of science and production have made it possible to introduce into practice new dressings, agents and coatings for the treatment of wounds: proteolytic enzymes immobilized on matrices, sorption-active agents, dressings with prolonged antimicrobial activity, collagen-containing wound coatings.

The use of modern dressing material to one degree or another makes it possible to reduce the percentage of complications, such as reinfection of the wound, the addition of nosocomial infection. Currently, there are more than 1000 varieties of wound coverings and dressings on the market of pharmacological products. Research is being conducted in the direction of ways to improve and optimize their use to regulate the pathogenetic mechanisms of the wound process. Special attention has been paid to various types of wound coverings and dressings.

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