Environmental and Medical Aspects of the Glauconite Application

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Abstract: The possibility of the effectiveness of increasing the wound healing, increasing the strength of the scar, and reducing the signs of the wound inflammation when replacing Panthenolspray (AEROPHARM, Germany) with glauconite powder has been investigated during the process of the experimental research. Glauconite powder can be used in the treatment of infected wounds and burns.

Keywords: Wound healing, glauconite powder, treatment.

INTRODUCTION

The widespread myth is synthetic chemicals may treat almost human diseases. Thanks to this, the pharmaceutical business is one of the biggest world businesses in terms of drug turnover. The global pharmaceutical market has been growing by four to five percent annually [1]. Some synthesis drugs have the highest E-factor (25-100). (The E-factor is the ratio based on the total by-products mass divided by the mass of the target product). After consumption, the drugs usually enter the environment and may be a reason for pharmaceutical pollution [2]. Modern treatment facilities are not adapted to neutralize most pharmaceutical products. The problem of pharmaceutical pollution is current and far from being solved.

Natural substances may be an alternative to synthetic drugs. In some cases, they may be more effective, do not have side effects, or be a reason for allergic reactions and antibiotic resistance. After consumption, they transpire without toxic influences into the environment.

This approach is not new. Since ancient times, doctors have used natural mold, moss, or clay to treat injuries.

The possibility of redacting posttraumatic scar and reducing wound inflammation with the replacement of Panthenolspray (AEROPHARM, Germany) into glauconite powder will be a reason for this scientific research.

Every tenth resident of Russia receives any injuries every year, so the treatment and care be a relevant task of modern medicine [3].

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Tricilin has been used in the form of powder for the treatment of injuries. With the hypertonic solution, the medical drains can be added with up to 3% hydrogen peroxide or up to 2% chloramine, or up to 0.5% potassium permanganate, used for draining wounds purulent-necrotic cavities. It is recommended to use 10% methanide acetate ointment, 5% dioxidine ointment, dioxicol ointment, and nit acid ointment for Gram-negative bacteria in a wound (in particular Pseudomonas aeruginosa). For the treatment of the flaccid, edematous, bleeding granulation, it may be combined with 0.1-0.5 % solutions of potassium. It is recommended to use a 2% chloramine solution for long-term irrigation of the wound cavity.

The collagen has several positive appearances. Collagen medicine penetrates the zone of inflammation through the sponge and stimulates regeneration. Hemostatic collagen sponges are also used as the prospective method due to their structural compatibility with the connective tissues. Those methods are not a panacea of wound treatment [4].

Antibacterial therapy can use in 1-2 phases of wound treatment. Antibiotic ointments include polyethylene glycol, and enzymes are also used as antiseptics [5]. The sensitivity of the wound microflora has been taken into account; when the drugs have been prescribed.

Baneocin has been used for the treatment of infection connective tissues. Baneocin includes 2 bactericidal components, such as bacitracin (a polypeptide antibiotic that inhibits the synthesis of the bacterial cell wall) and neomycin (an aminoglycoside that inhibits the synthesis of proteins). Bacitracin decreases the dephosphorylation of C55-isoprenyl-pyrophosphatase, which is the most important component of bacterial cell peptidoglycan synthesis. It is active against the staphylococci in monotherapy.

Bacitracin increases the neomycin permeability of the bacterial membrane, which enhances the intracellular neomycin concentration. Due to the difference in the antibacterial action of bacitracin and neomycin, their combination overcomes the resistance of the staphylococci individual strains. Both drugs exhibit synergism in relation to many pathogens of purulent processes [6].

Over time many drugs may lose their efficiency. It is especially true of the drugs which contain antibiotics due to the natural development of antibiotic resistance. As a result, it is necessary to develop new, preferably natural friendly drugs, Aluminosilicates – glauconite is one of the examples of natural friendly materials. Aluminosilicates such as glauconite and similar smectites are mainly used internally as sorbents. The application of glauconite powder as a means to wound treatment has not been studied previously.

The wound healing method by Panthenolspray, produced by AEROPHARM, Germany, is the closest in technical essence. Panthenolspray is available in the form of an aerosol for external use in the aluminum cylinders with the protective valve and the spray nozzle (volume 130 g). This spray affects the processes of the tissue's healing and restoration of the tissues' recovery after damage. The active substance of the Panthenolspray is dexpanthenol. It turns into pantothenic acid on the skin surface. Pantothenic acid is a coenzyme A. It takes an active part in the oxidation and metabolism processes. The emollient and anti-inflammatory effects are observed after applying the drug to the skin [7].

Panthenolspray, like glauconite, is characterized by dispersion has a ready-made form that does not require nither the mixing components nor the composition shaking before applying on the wound surface.

The method of the natural, antibiotic-free powder of glauconite, which is used for powdering wounds, can increase the effectiveness of wound healing the strength of the scar and reduce the signs of wound inflammation. It would help solve the import substitution problem and reduce the cost of treatment and wound care.

METHOD

This research has been solved by comparing the wound healing parameters of the experimental and control groups of the outbred conventional rats. An equal amount of glauconite powder or Panthenolspray was locally externally applied into the surface of a linear full-layer skin wound of rats daily once at the same time.

It was assumed that glauconite as a sorbent immobilizes bactericidal components and acts as a means for antibacterial therapy [8].

It is known that glauconite from the Bondarskoye deposit in the Tambov region contains: SiO_2 (66.9...75.81 %); MgO (1.02...1.62%), Al_2O_3 (3.1...6.57%), K_2O (1.51...2.43%), Fe_2O_3 (6.87...12.0%), Na_2O (0.1...0.23%), FeO (0.28%), TiO_2 (0.12...0.34%), P_2O_5 (0.33...3.38%), MnO (0.012...0.019%), SO_3 (0.06...0.15%), CaO (1,08...5,14 %) [9]. It had been shown [10 - 12] that glauconite does not have a toxic effect and belongs to the 4 class - slightly dangerous substances in accordance with GOST 12.1.007.76 and classification of the degree of danger of chemicals.

Glauconite from the Bondarskoye deposit in the Tambov region was ground in a mortar. This operation allowed obtaining a fine powder, which consists of isodiametric particles with a size of fewer than 200 microns with rounded edges (microscopic assessment), to conduct the preclinical studies to assess the wound healing activity. Thus it was shown the glauconite's suitability for use as a powder for application to the wound surface. The glauconite substance was sterilized in a drying cabinet at 180 °C for 60 minutes then. Preclinical studies of the substance of glauconite were conducted on 16 outbred conventional male and female rats weighing 210-320 g, at least 5 animals in each group. The animals were kept in standard conditions in the vivarium of the Faculty of Pharmacy of the Voronezh State University, feeding with full-fledged mixed feed, drinking freely through nipple drinkers. When investigations had been conducted, the international principles on the humane treatment of animals were performed [13].

A 20 cm^2 coat was removed in the cervical-thoracic region with a depilatory cream a day before the experiment. A linear full-layer skin wound with a length of 5.0 cm was applied with surgical scissors under the pain relief conditions, which were achieved by the inhaled surgical anesthesia; the edges of the wound were brought together, and 2 stitches were applied at an equal distance. A sterile silk thread was used as a suture material, removed on the 5th day of the

experiment. The wounds remained open until the end of the experiment [13, 14]. The rectal body temperature was initially determined by an electronic thermometer on the fifth day. The body weight of the animals and their clinical condition were determined, feed and water consumption were monitored daily at the beginning, on the fifth day, and at the end of the experiment. Animals of the experimental group received 100 mg of glauconite powder to the wound's surface daily at the same time, topically and externally. The dose was determined based on data for a similar object - montmorillonite powder [15]. It is experimentally shown that this amount of powder is sufficient to completely cover the wound defect's entire surface. A well–known wound-healing drug, Panthenolspray, was used as a comparison drug. The scheme of its application was similar to that of the glauconite powder. The humane euthanasia was performed by overdosing on chloroform anesthesia on the 12th day. A 2×3 cm flap of the wound surface of the skin was cut out then. The tear strength of the scar was determined by the wound tensiometer [16]. The result was expressed in grams per square meter of the skin flap area (or g/mm^2), according to the recommendations of the Guidelines for Conducting Preclinical Studies of Medicines [17].

RESULTS AND DISCUSSION

All animals showed a reduction of motor activity; there was decreased feed and water consumption due to the consequences of experimental exposure and injury during the first 3 days after the simulation of the wounds.

The control group animals (the use of the Panthenolspray) showed a slight decrease in body weight ~ 1.7%, and their rectal body temperature was 37.7°C on average for five first days. Tight closure of the wound edges was revealed, there was no edema, no hyperemia, or suppuration on the 5th day after the removal of the sutures. Half of the animals had a dense scab on the wound surface, which was represented by the necrotic tissues, the other half of the animals had the beginning of the wound healing "by primary tension".

The animals from the experimental group (the use of the substance glauconite) showed a slight decrease in body weight by £ 5%, and their rectal body temperature was 38.2°C on average, which is a consequence of the wound process. Tight closure of the wound edges was revealed; no edema hyperemia was detected; the wound was dry and clean. Only one rat from all had formed a limited area of inflammation in the tissues. The inflammation had significantly decreased on the 12th day. The humane euthanasia had been performed by overdosing on chloroform anesthesia on the twelfth day, and a 2×3 cm flap of the wound skin surface had been cut out. The tear strength of the scar was determined by the wound tensiometer.

The results of wound tensiometric studies on the 12th day of the experiment showed that glauconite powder provides a significant increase in the breaking strength of the wound scar by 2 times compared to how the wound healing occurs in animals in the absence of Panthenolspray or glauconite powder. The wound healing under the glauconite powder layer was somewhat less effective than that under the panthenol spray. It increased the tear strength of the scar by 3 times.

Nevertheless, the proposed method of increasing the wound healing effectiveness, the strength of the scar, and reducing the signs of wound inflammation by using glauconite of natural origin does not contain antibiotics. It is cheap and available to any consumer. When applied topically in the form of powder, it is effective since it has a wound-healing effect that significantly increases the tear strength of the scar by 2 times and helps reduce the signs of inflammation.

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