



PROSPECTS OF THE DEVELOPMENT OF SKIN GLUE WITH NANOPARTICLES OF SILVER FOR BURN PROCESSES THERAPY

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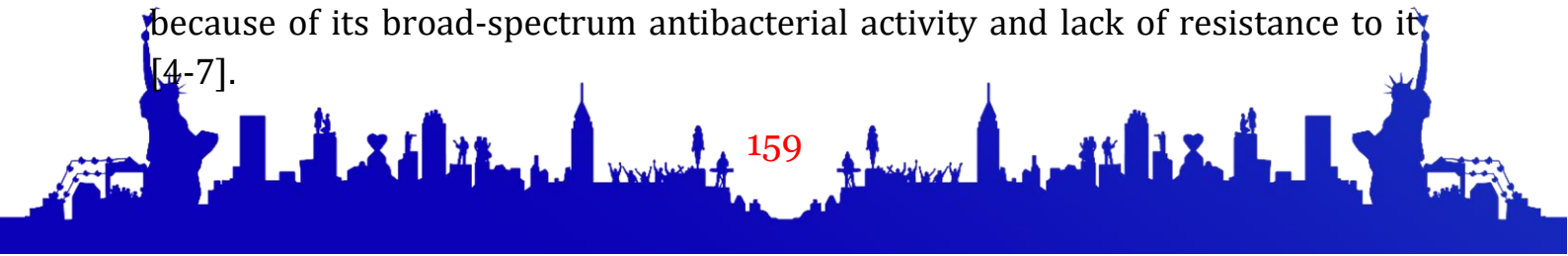
The article discusses the theoretical aspects and prospects of the pharmaceutical development of a new dosage form for use in wound treatment - skin glue with an active pharmaceutical substance - nanoparticles of silver. We reviewed the international regulation the dosage form and literature to identify prospects of pharmaceutical development.

Abstract: traditionally, medical patches are used to protect against contamination and infection (in some cases, treatment) of various types of skin damage. The usual adhesive-based plasters are outdated because they have a number of disadvantages, which, first of all, include the inconvenience of use. They are replaced by soft dosage forms known as skin adhesives or liquid patches, which are not only convenient to use, but also have various biological functions. Liquid plasters with silver nanoparticles can become a convenient medicine for the neutralization of a burn wound. Silver nanoparticles are one of the most studied objects of nanotechnology. They are able to overcome some of the existing mechanisms of bacterial resistance, and are also able to fight intracellular pathogens. Also, silver nanoparticles are quite small and are able to penetrate cell membranes and influence intracellular processes from the inside. The use of a local silver-based liquid patch for wound infection creates convenience for use and increases the effectiveness of the drug.

Keywords: nanoparticles of silver, liquid patch, efficacy, skin glue.

Introduction: The skin is the largest human organ, providing an initial physical barrier against the invasion of harmful external agents. Liquid bandages can be a good choice for emergency trauma care as they can temporarily stop bleeding, prevent bacterial infection and promote wound healing [1-3].

Silver is an excellent antibacterial agent, and much attention is paid to it because of its broad-spectrum antibacterial activity and lack of resistance to it [4-7].





The mechanism of silver action on a microbial cell is that the cell membrane of the microbe absorbs silver, and as a result its cell remains viable, while some of its functions are disrupted, for example, division (bacteriostatic effect) [8].

Silver nanoparticles, like other nanoparticles, are characterized by unique properties associated with a high ratio of their surface to volume, which determines the greater effectiveness of their action. Silver particles with a size of 9-15 nm are most effective for the destruction of pathogenic microorganisms. They have an extremely large specific surface area, which increases the area of contact of silver with bacteria or viruses, significantly improving its bactericidal effects. Thus, the use of silver in the form of nanoparticles makes it possible to reduce the concentration of silver by hundreds of times while preserving all bactericidal properties [9].

Materials and methods: for theoretical substantiation, a scientific search was carried out in order to identify prospects for the development of a liquid patch with silver nanoparticles. Patent search was carried out, as well as the study of modern domestic and foreign scientific literature presented in the databases pubmed.com, cyberleninka.ru, eLibrary.ru, doaj.org. Anti-burn drugs were considered on the basis of data from the State Register of Medicines, as well as foreign databases, an analysis of registered drugs, medical products in the form of skin glue were carried out.

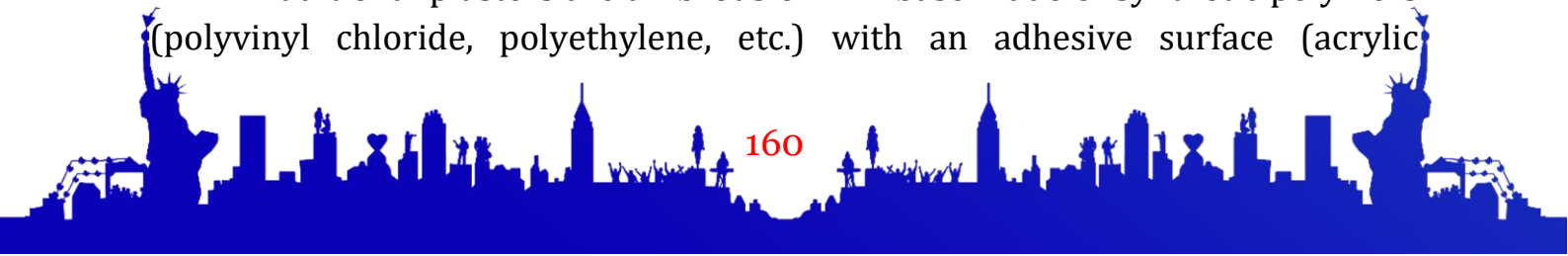
The aim of this work is to study and identify the prospects for the development of a new dosage form in the form of a liquid patch with silver nanoparticles for use in the treatment of burn processes.

The main part. Burn injuries are the most important medical and social problem of modern society, due to their prevalence, high mortality, significant indicators of temporary labor losses and primary disability [10].

Worldwide, burns are on the 4th place among the most common types of injuries, following road accidents, falls and violence. According to WHO, approximately 6 million people seek medical help with burns every year. At the same time, the frequency of burns in OECD countries currently reaches 1:1000 of the population per year [11].

For the treatment of superficial burn wounds of various etiologies, ointments and gels are used, including those included in plasters and wound dressings [12].

Traditional plasters are a fibrous or film base made of synthetic polymers (polyvinyl chloride, polyethylene, etc.) with an adhesive surface (acrylic





polymers). On the adhesive side of the patch is an absorbent pad made of cellulose. In addition, the base of the patch and the pad are often impregnated with antiseptic substances. Such materials are used to close abrasions, cuts and chafing, protecting the damaged area of the skin from contamination, infection and further traumatization. However, traditional patches have a number of disadvantages. Firstly, they have practically no therapeutic effect. Secondly, the main contraindication to use is hypersensitivity to substances that are part of the patch. Thirdly, they are inconvenient to use: they do not hold well on the surface of the skin, require regular updating, etc. To solve these problems, new materials have been proposed – skin adhesives and liquid plasters [13].

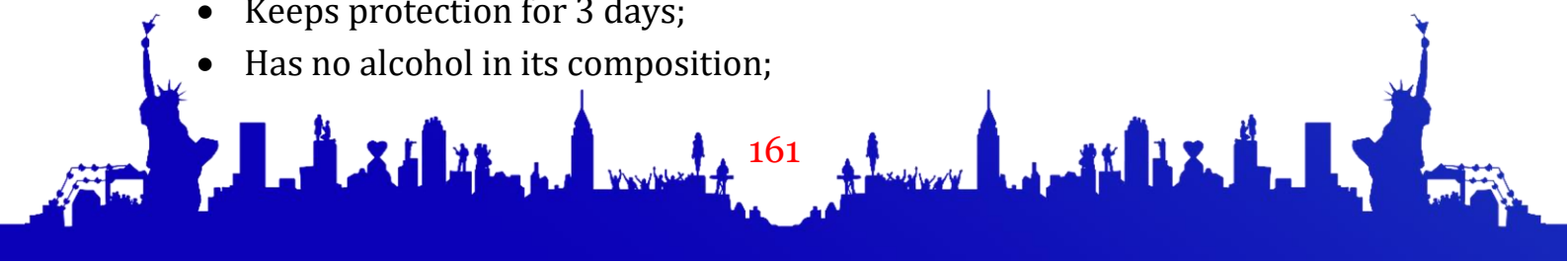
The use of skin adhesives (liquid patches) in the treatment of various burn processes is a modern alternative to the classical methods of suturing or using medical dressings. A liquid patch is a painless and effective method of closing various wounds [14-16].

When using skin adhesives, the procedure time is also reduced, there is no need for sedation in pediatric practice. Wounds closed with glue do not require follow-up, as well as removal of the seam, as with suturing [17]. Thus, it is advisable to use liquid adhesives when upper and lower extremities and joints are affected, if these areas remain dry and immobilized [18].

The main advantages of a liquid patch

In comparison with conventional patches on a fabric (or non-woven basis), a liquid patch has a number of significant advantages:

- Convenient release form (spray) — easy and quick to apply, easy to use, does not peel off and can become the basis for standard dressings;
- Water resistance — which allows you to take a shower and swim in the pool;
- Elasticity — the film is easily stretched to the desired size without being damaged, it is easily applied to any places where conventional patches cause discomfort during bending (elbows and knees), does not restrict movement;
- Microporosity — allows moisture to pass out, protects against maceration;
- Transparency — allows you to inspect the wound without the risk of infection and contamination, almost invisible;
- Hypoallergenic;
- Non-cytotoxic;
- Keeps protection for 3 days;
- Has no alcohol in its composition;





- Does not cause pain when used on inflamed, damaged areas of the skin [19].

Indications for the use of a liquid patch

Liquid patches are recommended in a wide variety of cases, let's list the main ones:

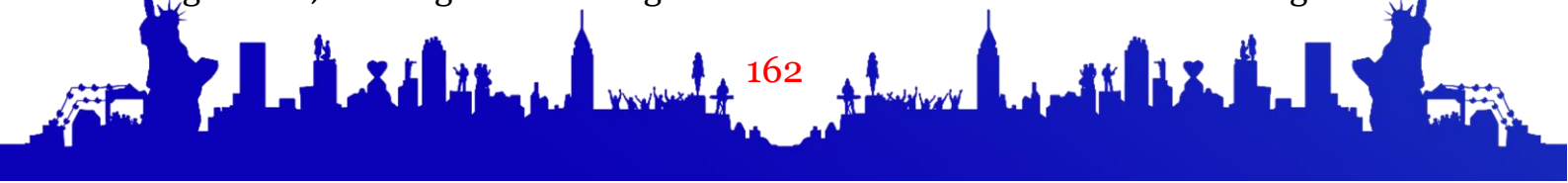
- For quick treatment of abrasions, scratches, cuts, small wounds;
- Protection of the skin surface in case of frostbite and burns of the III degree;
- In clinical practice for the treatment of injection sites, postoperative wounds, vaccinations, punctures - intra-articular and epidural, including;
- Protection of the skin in case of dermatitis (bacterial, allergic, caused by ultraviolet radiation);
- Protection of the skin from physiological fluids in the tracheostomy area;
- Protection of the skin of the perianal area;
- Protection of the skin that regenerates;
- Protection of the skin from chafing and diaper rash;
- To prevent adhesive injuries that may occur when using surgical patches.
- In addition, the liquid patch is used for newborns with diaper dermatitis, umbilical wound treatment, and is also indicated for bedridden patients to prevent ulcers in places of friction [19].

Currently, the Russian pharmaceutical industry produces no more than five names of medicines and medical products in this dosage form, while active developments in this direction are underway abroad. The greatest interest of researchers is the development of formulations based on animal proteins collagen, albumin, fibrin [20-23].

On the territory of the Republic of Uzbekistan there is not a single enterprise that produces a liquid patch, despite the fact that the production of a liquid patch is very profitable.

Names

In the Russian market, as a medicinal product, according to the State Register of Medicines, one drug in the dosage form "glue for external use" – CLEOL® (JSC PCFC Medkhimprom), as well as Glue BF-6 (table 1) (LLC Tula Pharmaceutical Factory, JSC Murom Instrument-Making Plant, JSC Vertex) is registered, relating to the dosage form of solutions for external use. Registered





in the Russian Federation as perfumery and cosmetic products, as well as a liquid patch "Afaplast® with panthenol" (LLC Argo) and a liquid, warming gel patch "Capsacin. Antlers of the maral" (KorolevFarm LLC).

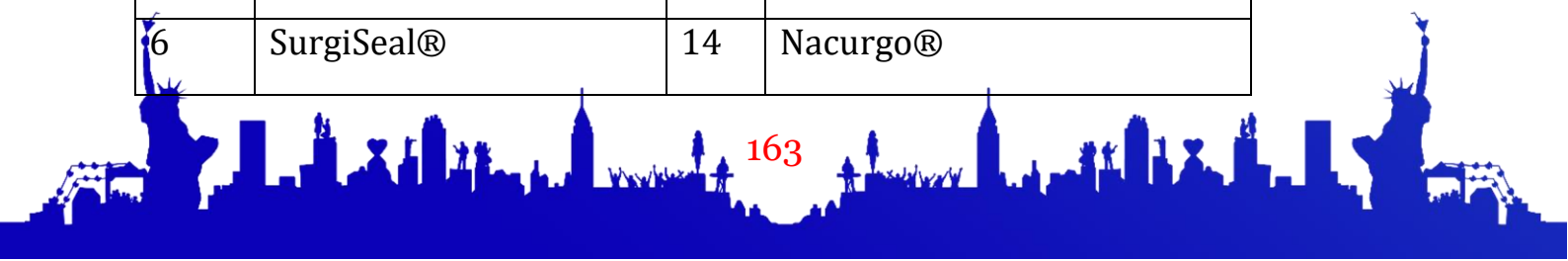
Surgical adhesives based on 2-octyl cyanoacrylate and n-butyl cyanoacrylate (Dermaflex® QS™, SurgiSeal®, FloraSeal® and Dermabond®, LiquiBand®, Indermil®, Glutitch®, GluShield®, and Periacryl), as well as polyestreamide (Nacurgo®).

By industry, liquid adhesives are produced in vials equipped with a tip with a polymer distributor on the surface of the skin or a brush, in polymer vials with a dispenser, as well as in tubes. Surgical sterile adhesives designed for gluing vessels during cardiac operations are available in the form of disposable syringes. A number of drugs are available in the form of solutions for subsequent mixing and preparation of surgical glue (Dermabond®). This approach to the dosage form is due to the drying of the finished dosage form during storage, and, as a result, a short shelf life and storage conditions restrictions. There are liquid adhesives available in aerosol packaging (Afaplast® with panthenol).

The composition of the dosage form includes a film—forming polymer, a solvent and, if necessary, other auxiliary substances - buffer salts, preservatives, antioxidants, plasticizers. Volatile organic solvents (chloroform, acetone, ethanol) are often used as solvents. Film—forming polymers - polyvinyl alcohol, acrylates, polyvinylpyrrolidone, cellulose derivatives or natural and synthetic resins (rosin, formaldehyde resin). To correct the elasticity of the resulting film, plasticizers are introduced into the composition of the dosage form — glycerol triacetate, cetyl alcohol, vegetable oils.

Table 1

№	Name of the medicine	№	Name of the medicine
1	Клей БФ-6	9	LiquiBand®
2	Афапласт® с пантенолом	10	Indermil®
3	КЛЕОЛ®	11	GluStitch®
4	Капсацин. Панты марала	12	GluShield®
5	Dermaflex® QS™	13	Periacryl
6	SurgiSeal®	14	Nacurgo®





7	FloraSeal®	15	3M Cavilon
8	Dermabond®		

Conclusion. The liquid patch has a good prospect in the creation of medicinal compositions. These medicines can be used in any age group. Further study of the dosage form is required for the development of modern domestic technology. After the development of the technology for the production of liquid plasters, an increasing demand for them in the Uzbek market should be expected.

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