Reparative histogenesis of skin: Reaction on the application of L-cysteine of argentum nitrate gel

Margarita B. Petrova*, Natalya V. Pavlova, Elena A. Kharitonova, Nadezhda V. Ilyashenko
Department of Biology, Tver State Medical Academy, Tver, Russia; *Corresponding Author: biologiatgma@mail.ru

Received 8 October 2012; revised 16 November 2012; accepted 6 December 2012

ABSTRACT
The effect of L-cysteine of argentum nitrate gel on the wound process of experimental animals is investigated. The results show that the nano-gel, being bacteriostatic, accelerates the course of inflammation phase resulting in fast cleansing of the wound surface and stimulation of the granulation tissue formation. The main cell elements of this tissue—fibroplasts are characterized by the state of functional excitation. The time of wound healing with the use of L-cysteine of argentum nitrate gel was reduced by three days, and the index of wound repair acceleration was about 20%.

Keywords: L-Cysteine of Argentum Nitrate Gel; Skin; Healing Process; Wound Repair Stimulation; Fibroplasts

1. INTRODUCTION
The human organism possesses powerful protective mechanisms for the maintenance of intrinsic medium homeostasis. Conservation of the cutaneous covering integrity and its fast recovery after various injuries is an important component of this system. Traumatic processes are accompanied by a number of complex morphological, immunological and biochemical changes at the molecular, cellular, organ and organismic levels [1,2]. There are a large number of different methods and ways for wound healing stimulation, and the exploration of this field is still continuing because the notion of wound healing is extending with the current progress in medicine, biology and technical sciences [3-6]. A great deal of attention is devoted to the development of wound covering for the therapy of burns and radiation-thermal injuries with the aid of polyvinyl alcohol gel compositions having supramolecular structure [7]. In the present work we focus on the estimation of the effect of L-cysteine of argentum nitrate gel (synthesized at the biochemical laboratory of Tver State Medical Academy, patent RU No. 2423384) on the wound process in animal skin and mucous injuries.

2. METHOD
The study was made with 102 white male rats of the “Wistar” line (were coming from “Research Center of Biomedical Technologies of Russian Academy of Sciences”, Moscow) with an average mass of 150 g. The animals were kept on a standard diet under natural light exposure. All experimental procedures were conducted in accordance with the Rules of laboratory practice in the Russian Federation (2003) and with Principles on Good Laboratory Practice (OECD No. ENV/MC/CHEM (98)17, 1997).

Full layer skin defects having an area of 225 mm² were inflicted under ether anaesthesia at the spinal surface of the body. Daily suspension St. Aureus strain 236 corresponding to the opacity standard No. 6 according to McFarland were inserted into the bottom of the wound. Attempts to use other microorganism were unsuccessful due to their fast death resulting in contamination of wound with goldish stafylococcus. In three days the inflammation process was formed.

The rats were divided into two series. Series I (pilot) was presented by animals having wound defects treated once per day for one week with L-cysteine of argentum nitrate gel (Ag concentration of 1.28·10⁻³ mole/l). Aqueous solutions of L-cysteine with its concentration of 3·10⁻³ mol/L (app. 0.036 wt%) were used. Chemical formula of cysteine is HO₂CCH(NH₂)CH₂SH. Samples of L-cysteine (Acros company) with the content of the target product 99.99% were used. Water was bidistillated. The solutions under investigation contained AgNO₃ produced by the same company with the concentration of the target product of 99.99%. The addition of the Ag ions is related to the possible application of the product as a bactericide medicine [8].

In series II (control) the wounds were irrigated by distilled water with the same exposition. The efficiency of the gel composition action was estimated visually. The rate of wound healing was measured by the method of planimetry.

The biopsy material taken at the 7th, 14th and 21st day
of observation after injurious action were studied for the estimation of the regenerative proliferation phase by morphological methods. The tissue samples were fixed in 12% formalin (Panreac, Spain), the paraffin cuts with a thickness of 6 - 8 micrometers were stained with hematoxylin-eosin (Sigma, USA). Commonly accepted electron microscope techniques described elsewhere were used to examine the histological specimens at an ultrastructural level.

Statistical Analysis. To demonstrate statistically significant differences between groups of control and experimental animals, student’s t-test was used with p-values less than 0.05.

3. RESULTS

At the first day after operation the animals of both series visually looked sluggish with depressed appetite. During the next days of the experiment the condition of the rats received drug application was rapidly improved in contrast to the animals of the control series. The animals had good appetite, readily consumed the food, moved actively. The hair-coat covering was smooth, shiny, clean. The wounds were covered by thick scab.

The analysis of histological specimens of regenerating tissues shows that the processes of suppurative inflammation proceed less aggressively due to the influence of the gel. At the seventh day after operation of the animals treated with gel application the wound surface is covered by a relatively thin scab (Table 1) with mature granulation tissue underneath. Its cellular composition is presented by the cells of macrophage family and a large number of fibroblasts located among the vessels with vertical and horizontal orientation. Formation of lengthy epithelial wedge is noticed moving onto the granulation tissue (Figure 1).

In the control series of animals at the same time of seven-days observation the motion is lowered, the appetite is violated, feeding takes a long time, hair-coat covering is lusterless and untidy. Morphological studies have shown that the scab over the wound is thick and uneven; leukocytic bank composed mainly of neutrophilic granulocytes is pronounced underneath (Table 1).

Table 1. Parameters of different structures of wound defects seven days after operation (micrometers, M ± m).

<table>
<thead>
<tr>
<th>Series</th>
<th>Scab</th>
<th>Leukocytic bank</th>
<th>Granulation tissue</th>
<th>Reclaim extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>418.8</td>
<td>131.6</td>
<td>540.8</td>
<td>352.3</td>
</tr>
<tr>
<td>(II)</td>
<td>±418.8</td>
<td>±12.9</td>
<td>±422</td>
<td>±29.3</td>
</tr>
<tr>
<td>Pilot</td>
<td>324.9</td>
<td>106.2</td>
<td>722.2</td>
<td>623.4</td>
</tr>
<tr>
<td>(I)</td>
<td>±31.9’</td>
<td>±9.0</td>
<td>±40.8’</td>
<td>±46.9’</td>
</tr>
</tbody>
</table>

Note: *difference with control data reliable with p ≤ 0.05.
4. DISCUSSION

We believe that this is one of the mechanisms for the accumulation and excretion are developed in fibroregions. During the wound healing under the action of the nanogel all components taking part in the synthesis, rounding healthy tissues and formation of the keloid scar outgrow into a hyperergic reaction with injury of surrounding tissues. Gel applications stimulate but at a shorter time, so the proteolytic neutrofil ferments

[10]. The obtained experimental data probably will be useful in the development of a medicamental form of the drug for the regulation of physiological processes during the therapy of skin defects in surgery and traumatology.

5. CONCLUSION

The established peculiarities of the reactivity and regeneration of skin tissues may form a basis for further development of pharmaceutical means (drugs) and other methods of influence promoting the system-organ adaptation after injuries [11-14]. The obtained experimental data probably will be useful in the development of a medicamental form of the drug for the regulation of physiological processes during the therapy of skin defects in surgery and traumatology.

REFERENCES

