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Key words: burn,
treatment, medical
supplies, chitosan,
morphometry.

Received: 22.10.2013
Accepted: 29.11.2013

UDC 616-001.17-089.26: 547.995

THE MORPHOGENESIS FEATURES OF BURN WOUNDS BY APPLYING CHITOSAN MEMBRANES IN DIFFERENT AGE PERI- ODS

ABSTRACT. Background. The number of research devoted to chitosan application for burn defects treatment has increased during the last decades. However, the age-related features of skin regeneration with chitosan application are still uninvestigated **Objective.** The aim of our research was to evaluate effectiveness of chitosan coatings application to treat burns in different age periods. **Methods.** We studied the tissue morphogenesis features of the thermal damaged skin. We modeled the burn wounds of IIIb degree on the rats of experimental and control groups. And then we applied chitosan coatings on the animals of the experimental group to analyze the effectiveness of topical treatment. We analyzed the healing of burn wounds by the following morphological criteria: types of the epidermis and dermis damage; terms and features of wound cleaning; presence and degree of inflammation intensity and blood circulation disorders; quantity and quality of cellular infiltration. Other criteria were terms and degree of connective and epithelial tissue formation and levels of their differentiation and distribution; presence or absence of synchrony regenerative processes in the epithelium and connective tissue (especially features of vessel formation); presence or absence of morphological manifestations of pathological regeneration in the epithelium and connective tissue. **Results.** We found that the rate of burn healing applying chitosan coatings speeded up as they stimulated both macrophage reaction (with further inflammation reduction); cellular proliferation of fibroblasts and vessel formation. Moreover, granulation tissue and collagen fibers formed faster. Besides, epithelium regeneration and scar formation enhanced. As a result, epithelial cell migration and tissue contraction covered the wound. **Conclusion.** Application of chitosan membranes to treat thermal burns enhanced wound cleaning from dead tissue and reduced eschar, decreased the intensity of inflammatory reactions and disorders of blood circulation, improved epithelization of the wound and regulated formation of the scar tissue. Nevertheless, application of topical treatment for rats (aged 22 months) changed insignificantly the regenerate structure comparing with the animals from other groups.

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2013
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Citation:

Kornienko VV, Kalinkevich OV, Pogorelov MV, Oleshko AN. [The morphogenesis features of burn wounds by applying chitosan membranes in different age periods]. Morphologia.

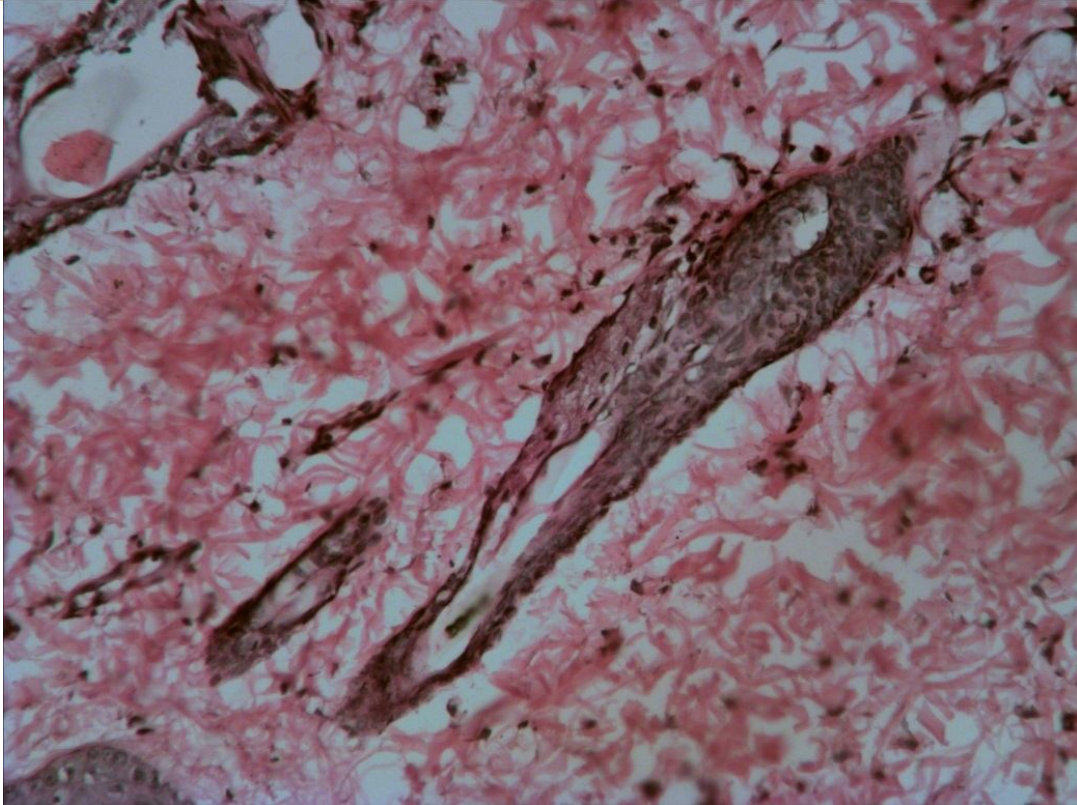


Fig. 1. Area of skin of young rat in experiment on the 3rd day after thermal injury modeling. Hematoxylin&Eosin staining. ×200.

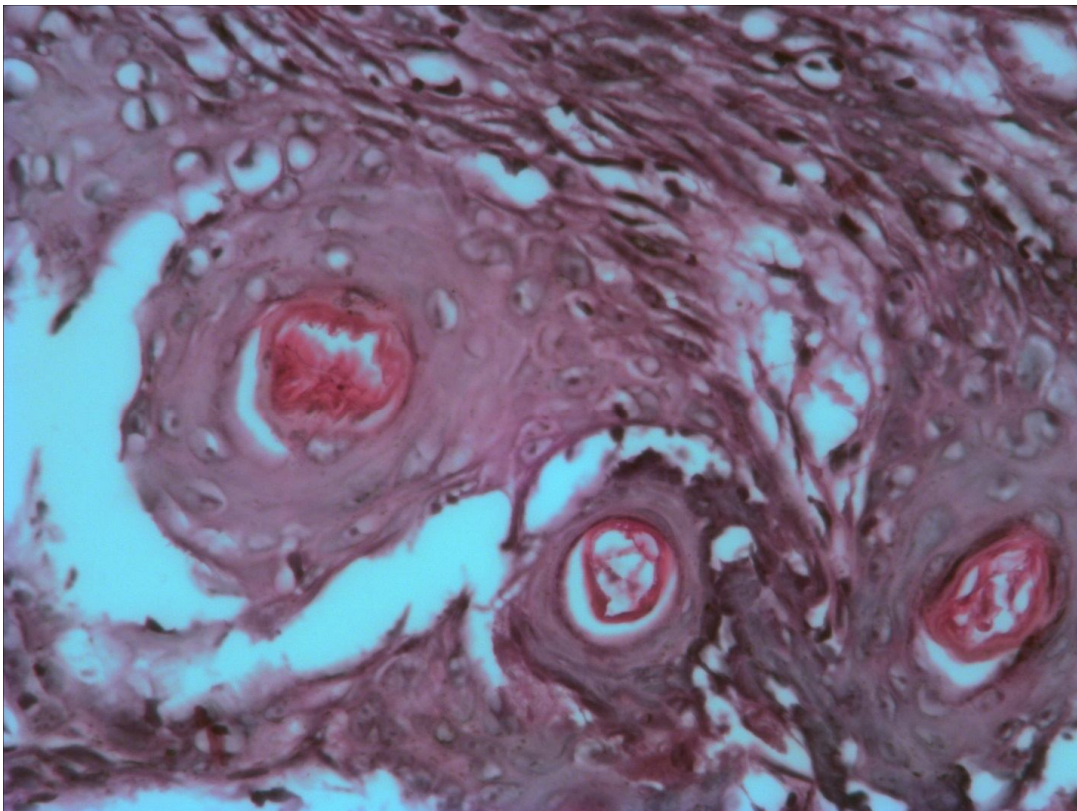


Fig. 2. Area of skin of adult rat in experiment on the 7th day after thermal injury

modeling. Hematoxylin&Eosin staining. $\times 400$.

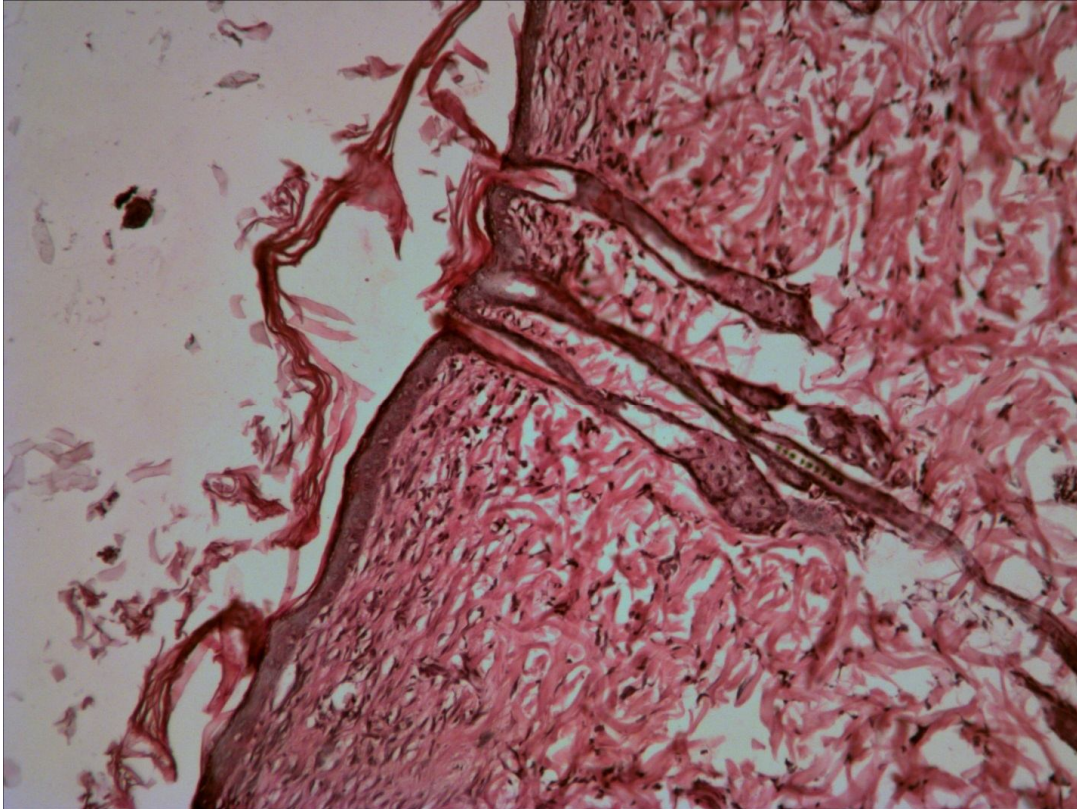


Fig. 3. Area of skin of senile rat in experiment on the 14th day after thermal injury modeling. Hematoxylin&Eosin staining. $\times 100$.

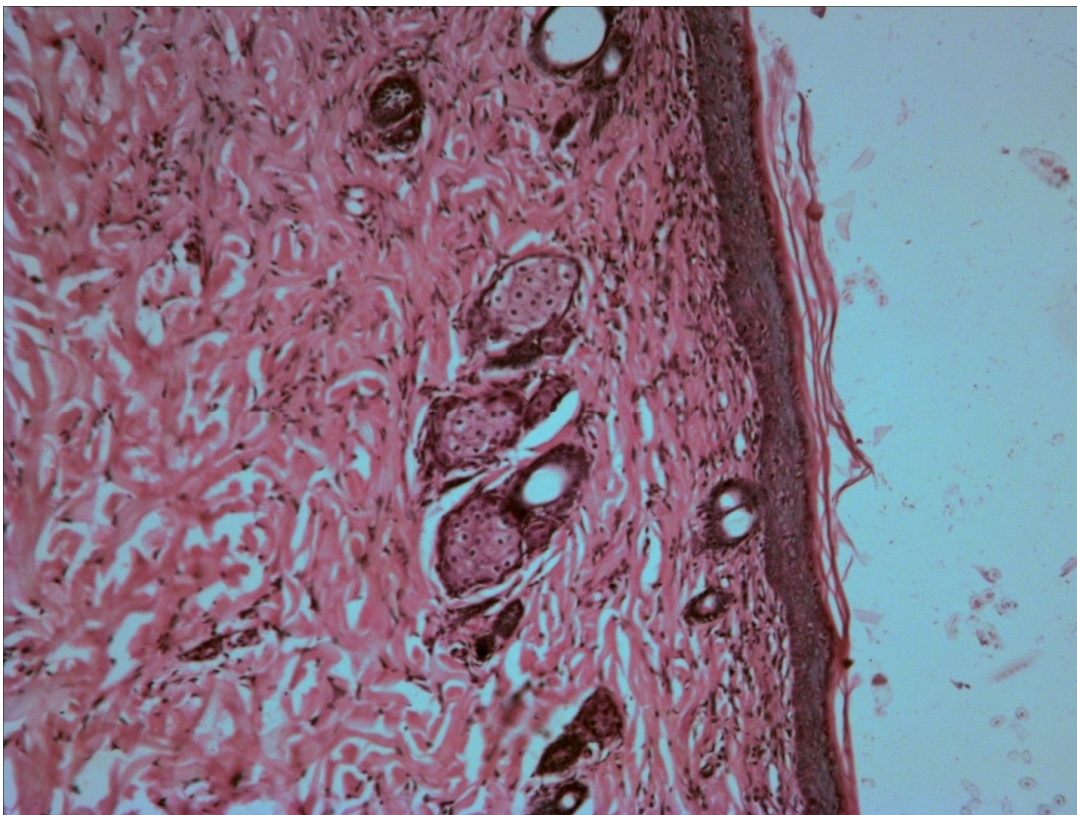


Fig. 4. Area of skin of young rat in experiment on the 21st day after thermal injury

modeling. Hematoxylin&Eosin staining. ×100.

References:

1. Fistal EYa. [Complications of Burns: classification, signs, preventive measures and treatment]. *Kombustiologia*. 2003;4:55-7. Russian.
2. Kozynets HP. [Current state of burn treatment for Ukrainian population and tasks for its enhancement and management]. *Nauk. visn. Uzhhorodskoho un-tu, seria «Medytshyna»*. 2006;27:3-6. Ukrainian.
3. Slesarenko SV. [The analysis of fetal cases in patients with burn disease]. *Vestn. neotlozhnoi i vosstanovitelnoi meditsiny*. 2004;5:638-42. Russian.
4. Povstianoi NE. [Current state of patient's treatment with thermal burns and burn complications in Ukraine]. In: [Proceeding of the XX Congress of the Ukrainian Surgeons; 2002; Ternopil, Ukraina]. *Ukrmedknyha*; 2008:97-101. Russian.
5. Chiu T. Allogenic skin in the treatment of burns. *Clin Dermatol*. 2005;23(4):376-87.
6. Kryzyna PS. [Peculiarities of inflammatory process in infectious wounds with application of hydratecellulose film and Activated Carbon Fibrous Materials]. *Buk. med. visnyk*. 2001;5(1):173-6. Ukrainian.
7. Kapytonov LM, Paramonov BA, Tataryn SN, Yvantsov VA, Emelyanov VI, Sidelnikov VA. [New wound coatings to treat burns and gunshot injuries]. *Voen.-med. zhurnal*. 2002; 4:70-3. Russian.
8. Bren L. Helping wounds heal. *FDA Consumer magazine*. 2002; 23:34-41.
9. Yamaguchi Y. Cutaneous wound healing: un update. *J. Dermatol*. 2001;28:521-34.
10. Grigoryan SKh, Grigorian AK, Nanian AS, Grigoryan ES. [A comparative study of effectiveness of various bioactive materials to treat septic wounds]. In: [Proceeding of the International Conference; 2001; Moscow]. 2001;101-2. Russian.
11. Dobysh SV, Vasilev AV, Shurupova OV. [Modern dressings to treat wounds during the regenerative phase of healing process]. In: [Proceeding of the International Conference; 2001; Moscow]. 2001;115. Russian.
12. Okan D, Woo K, Ayello E The role of moisture balance in wound healing. *Adv Skin Wound Care*. 2007;20(1):39-53.
13. Ovington L. Hanging wet-to-dry dressings out to dry. *Adv. Skin Wound Care*. 2002;15(2):79-86.
14. Galbraikh LS. [Chitin and chitosan: structure, properties and application]. *Sorosovskii obrazovatelnyi zhurnal*. 2001;7(1):51-6. Russian.
15. Harish Prashanth KV, Tharanathan RN. Chitin/chitosan: modifications and their unlimited application potential. *Trends in Food Science&Technology*. 2007;18:117-31.
16. Prokhorenkov VI, Bolshakov IN, Borgoiakova MG. [Perspectives of chitosan and its derivatives application for skin diseases]. *Sibirskoe meditsinskoe obozrevanie*. 2002;2:45-59.

Russian.

17. HaiPeng G, Yinghui Z, Jianchun L. Studies on nerve affinity of chitosan-derived materials. *Journal of Biomedical Material Research*. 2002;52(2):285-95.

18. Ishihara M, Nakanishi K, Ono K, Sato M, Kikuchi M, Saito Y, Yura H, Matsui T, Hattori H, Uenoyama M, Kurita A. Photocrosslinkable chitosan as a dressing for wound occlusion and accelerator in healing process. *Biomaterials*. 2002;23(5):833-40.

19. Wu YB, Yu SH, Mi FL, Wu CW, Shyu SS, Peng CK, Chao AC Preparation and characterization on mechanical and antibacterial properties of chitosan/cellulose blends. *Carbohydrate Polymers*. 2004;57(7):435-40.

20. Korzhevskii DE, Giliarov AV, authors. *Osnovy gistologicheskoi tekhniki [The principles of histological method]*. SPb: SpetsLit; 2010. 95 p. Russian.

21. Avtandilov GG. *Osnovy kolichestvennoi patologicheskoi anatomii [Principles of quantitative pathological anatomy]*. M: Meditsina; 2002. 239 p. Russian.

22. Paramonov BA, Poremskii YaO, Yablonskii VG. *Ozhogi: Rykov. dlya vrachei [Burns: Guidelines for Doctors]*. SPb :SpetsLit; 2000. 480 p. Russian.

23. Fistal NM. [Treatment of postoperative scars: modern topical issues]. *Bukovynskyi medychnyi visnyk*. 2009;13(3):94. Ukrainian.

24. Mironov VI, Gileva II. [Wound process: modern aspects of pathogenesis]. *Sibirskii meditsinskii zhurnal*. 2009;6:20-6. Russian.

25. Abdel-Hafez NM, Hassan Saleh Y, El-Metwally TH. A study of biomarkers, cytokines, and growth factors in children with bum injuries. *Ann. Burns Fire Disasters*. 2007;20(2):89-100.

26. Werner S, Grose R. Regulation of wound healing by growth factors and cytokines. *Physiol. Rev*. 2003;83:835-70.