RECONSTRUCTION OF DORSAL SKIN SCARS IN RATS

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UDC 615.5-001.4-031.24-003.32-032.9-091.8

KEY WORDS: skin wounds; regeneration; hair follicles

Healing of full-thickness skin wounds in the dorsal region of rats and mice always ends with the formation of an epithelized connective-tissue scar. The scar which forms is not reorganized into skin in the course of a long period of observation [2-5]. Attempts have been made by different methods to demonstrate the possibility of scar reorganization into skin [1, 9], but the results have proved contradictory [3]. Recently the writers have obtained results showing that reconstruction of scars in the dorsal region of rats and mice can take place through a single application of a technique of graded mechanical injuries (GMI), which can result in reconstruction of scars which have formed in regenerating tissues of dermal and cutaneous types [6]. Single GMI of mature scars led to a very slight degree of reorganization, and, moreover, only in single cases [7, 8]. We therefore postulated that in order to obtain reorganization of mature scars, repeated application of GMI are necessary in most cases.

The aim of this investigation was to study the principles of reorganization of scars following repeated application of the GMI method.

EXPERIMENTAL METHOD

Experiments were carried out on 69 noninbred male albino rats weighing 120-130 g. After epilation, full-thickness square wounds measuring 1.5 × 1.5 cm were inflicted on all the animals in the center of the dorsal region 1 cm caudally to the interscapular region. After the formation of a mature epithlized scar (on the 54th day after wounding) [2] the animals were divided into three groups and the first GMI procedure undertaken on the scars. GMI were applied by means of a needle, in the form of 3 full thickness puncture wounds measuring 1 mm^2 in the epithelized surface of the scar (diameter of needle 0.1 mm). In group 1 (23 animals) the scars were subjected to GMI twice, in group (22 animals) 4 times, the interval between GMI of the scars being 8 days in both groups, and in that period the injuries inflicted healed [7]; finally, group 3 (14 animals) constituted the control. In this group GMI were not carried out on the scars. All operations were performed under ether anesthesia. The dimensions of the scars were measured during subsequent periods of secondary healing and visual observations of the state of the epithelized surface of the regenerating tissues were carried out, with attention being concentrated on the appearance of hairs. Tissues for histological investigation were taken from the region of the defect and the adjacent skin, and fixed in Carnoy's fluid on the 8th and 25th days after the 2nd and 4th application of GMI to the scars (scars from animals in the control group also were fixed at the same times). She fixed material was embedded in paraplast and sections 8-10 μ were cut. The sections were stained with picrofuchsine by Van Gieson's method and with orcein.

EXPERIMENTAL RESULTS

The visual observations showed that by the time of the first GMI application the epithelized surface of the scars had the appearance of elongated four-pointed stars, oriented parallel to the long axis of the animal's trunk, and their

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 0007-4888/91/0008-1206$12.50

Fig. 1. Elastic fibers in regenerating scar 8 days after second GMI procedure. Stained with orcein and by Van Gieson's method. 400×.

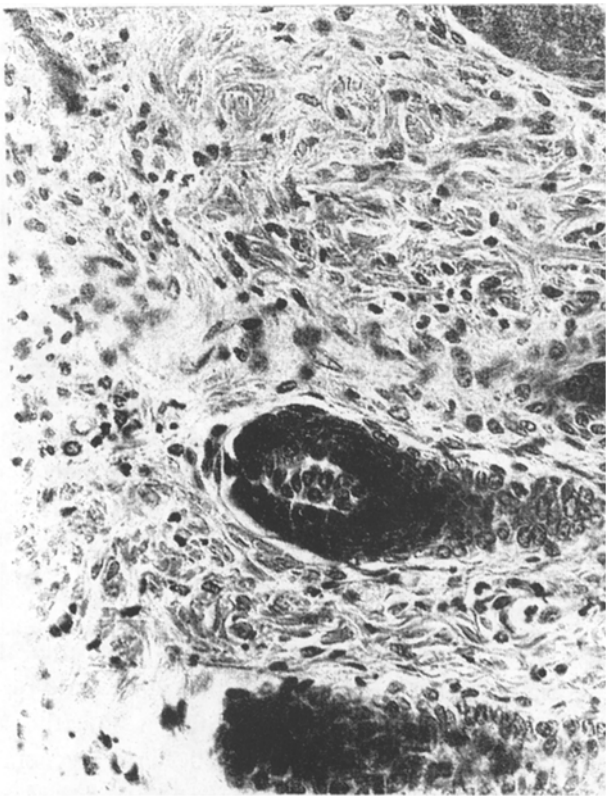

Fig. 2. Hair follicle forming in regenerating tissue 8 days after 4th GMI procedure on the scar. Van Gieson's stain. 310×.

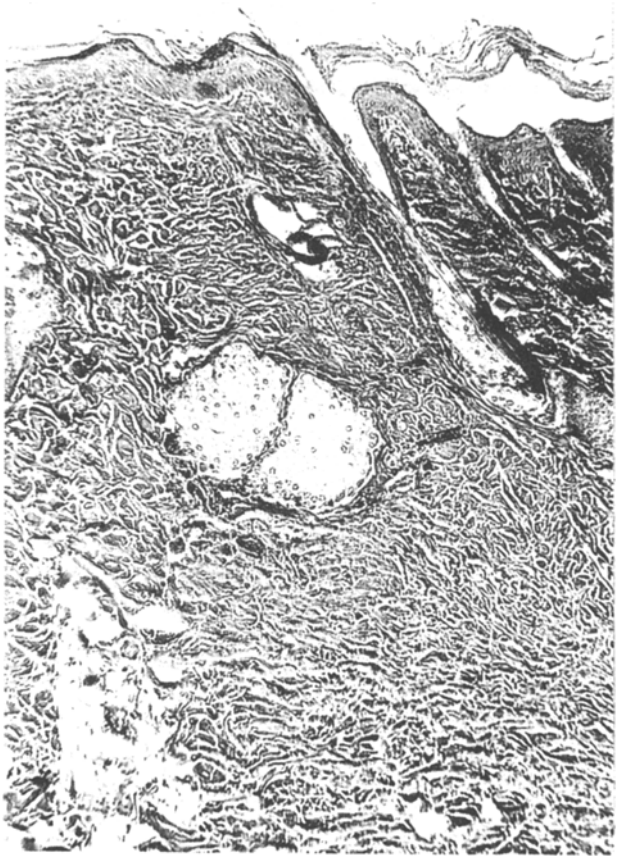

Fig. 3. Hairs and sebaceous glands in regenerating tissue 25 days after 4th GMI procedure to the scar. Van Gieson's stain. 160×.

central part (without the raise) was 1.3 ± 0.4 cm long and 0.5 ± 0.2 cm wide. The area of the scar amounted to 18-20% ofthe area of the original wound. During infliction of GMI the first time, transparent tissue fluid exuded from the puncture wounds on the surface of the mature scars, from which a thin yellow scab formed. The scab separated on the 4th-5th day after the puncture wounds, to reveal a pink epithelized surface. During each subsequent treatment, an increasing amount of blood escaped from the puncture wounds, so that a thicker, dark brown scab formed. These observations correlated with the histologic data: after the second GMI treatment of the regenerating tissues, the number of blood vessels in them increased. The area of the regenerating tissues after the second GMI procedure was reduced to 0.44 ± 0.21 cm^2 (0.65 ± 0.08 cm^2 in the control), and after the 4th GMI procedure the area of regenerating tissue was reduced by half to 0.3 ± 0.052 cm^2 (0.63 ± 0.07 cm^2 in the control).

Histologic investigation of 23 scars undergoing two GMI procedures showed that only three of them were reorganized into regenerating tissues of dermal type: collagen fibers formed a band and elastic fibers were formed (Fig. 1). The number of blood capillaries and fibroblasts in these regenerating tissues were increased compared with the scar, and the epidermis was hypertrophied and gave rise to short invaginations into the underlying young connective tissue. The remaining 20 scars were not reconstructed, and only in four of them were small areas 65-120 μ long observed, whose connective-tissue basis differed in the arrangement of its fibers from a scar: the fibers were arranged at different angles relative to the surface of the defect.

In rats subjected to four GMI procedures (group 2), on the 8th day after the last procedure, of the 11 scars investigated 4 were reorganized into regenerating tissues of dermal type and two into regenerating tissues of cutaneous type (hairs and sebaceous glands had formed in them) (Fig. 2). On the 25th day after the 4th GMI procedure, of the 11 scars studied 4 were reorganized into regenerating tissues of dermal type and 3 into regenerating tissues of cutaneous type (Fig. 3). Hence, of 22 animals, regenerating tissues of dermal type were formed in 8 and of cutaneous type in 5 animals; the scars in the remaining 9 animals were virtually unchanged. Incidentally, all the reconstructed scars had a mosaic structure, for in regenerating tissues of cutaneous type, for example, areas of dermal and scar types were found.

Thus GMI of mature skin scars in the dorsal region of rats lead to their reconstruction into regenerating tissues of dermal and cutaneous types, similar in their structure to normal skin. With an increase in the number of GMI procedures the number of reconstructed scars increased; for example, repetition of GMI twice induces reconstruction of scars in only 13.0% of cases, but repetition four times does so in 59.1% of cases.

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INFORMATION ANALYSIS APPLIED TO MORPHOMETRIC INVESTIGATION OF POSTMORTEM CHAHACTERISTICS OF THE LIVER

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UDC 61.36-091-076.5

KEY WORDS: acinus of the liver; morphometry; entropy; blood loss; intoxication.

Hepatic failure is a frequent complication of many surgical diseases and often terminates in death [3, 4, 12]. However, morphological methods used in the postmortem diagnosis do not ensure precise evaluation of the degree of liver damage, due to a definite subjective element arising when its structure is described as a system, and to the rapid development of autolysis when ordinary autopsies are done [15]. Morphometry of the liver tissue followed by quantitative information analysis of the complexity of its structure may be a promising method in such cases [2, 11].

Accordingly, in the investigation described below, the possibility of using morphometric and information analysis of the liver tissue to assess the degree of its damage quantitatively was studied on early autopsy material from patients who died.

EXPERIMENTAL METHOD

Altogether 17 early autopsies were studied. The control group consisted of five medicolegal autopsies: cardiac death was diagnosed in three cases, and trauma incompatible with life in two cases. In five cases the cause of death was

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Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 112, No. 8, pp. 219-221, August, 1991. Original article submitted October 1, 1990.