QUANTITIATIVE EVALUATION OF THE EFFECT OF DRUGS AND OTHER FACTORS ON VIABILITY OF AN ISCHEMIC SKIN GRAFT

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Ischemic damage to tissues takes place mainly through the development of an energy-deficient state in them, due to inadequacy of the blood supply, oxygenation, and the supply of energy-yielding and structural substrates, as well as disturbance of elimination of metabolic end products [6]. Under these conditions emergency therapeutic measures aimed at influencing metabolic processes, humoral homeostasis, the microcirculatory system, and neuroendocrine and central mechanisms of regulation, may alter the rate of appearance of irreversible disturbances of the structural and functional integrity of tissues and of individual organs [1, 7].

Data in the literature on the effect of different factors, drugs, and combinations of both on the viability of an ischemic skin graft are contradictory, and this makes it difficult to design pathogenetically based schemes for preventing the development of local necrotic changes after plastic operations on the skin.

In this paper the writers suggest a method of quantitative evaluation of the effect of various factors on viability of a skin graft on a vascular pedicle under the conditions of a energy-deficient state.

EXPERIMENTAL METHOD

The most suitable animals for primary determination of the antinecrotic or necrotic activity of measures to be tested are male mice and rats with a mean body weight of 18-22 g and 100-140 g respectively. Altogether 260 mice and 190 rats were used in the experiments. After anesthesia (thiopental sodium 50-70 mg/kg, intraperitoneally) the animals were fixed to the operating table by their limbs and tail. The hair was removed from the dorsal region and the skin treated with 70% ethyl alcohol. By means of a standard stencil, wetted with a 1% alcoholic solution of brilliant green, the outlines of a skin pedicle graft, measuring 10 × 20 mm in the case of mice and 12 × 52 mm in the case of rats, were traced (Fig. 1). The graft was then cut out strictly along the marked lines and separated from underlying tissues, taking

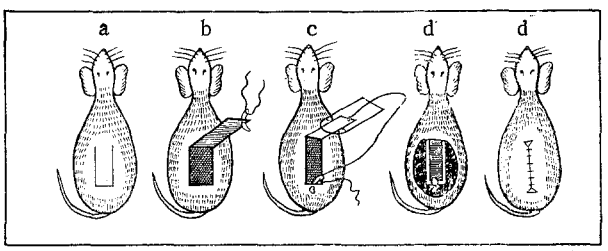

Fig. 1. Method of formation of isolated thoracic skin pedicle graft: a) epilation, marking out, and cutting of skin pedicle graft; b) separation of graft from underlying tissues and insertion of suture into its distal part; c) placing graft in polyethylene bag; d) fixation of graft enclosed in bag on floor of wound; e) suture of wound above skin graft.

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care to avoid injury to the nutrient pedicle. A silk thread was passed through the distal end of the skin flap, which was wrapped in a sterile polyethylene packet, which was laid in the wound on the maternal bed. The animal's own skin was closed above it and the wound edges drawn together with a silk thread.

In the control, 50 ± 10% of the graft on the pedicle was necrotic in the mice after 24 h and in the rats after 72 h, with the appearance of a clear demarcation line in its middle part. In animals subjected to various procedures, the line of necrosis was shifted toward the base or toward the apex of the skin graft, so that the degree of their detrimental or beneficial effect on viability of the ischemic tissues could be judged.

EXPERIMENTAL RESULTS

The suggested method is highly sensitive and enables comparative quantitative evaluation of the antinecrotic or necrotic activity of different procedures. For instance, hyperbaric oxygenation (2 atm) for 60 min after the operation increased the survival rate of the grafts in mice by 62.3 ± 8.3% ($P < 0.05$) and in rats by 41.1 ± 5.3% ($P < 0.05$) compared with animals kept outside the pressure chamber.

Physiological saline (10ml/kg body weight, intraperitoneally) did not alter the size of the viable part of the ischemic skin graft, but lithium hydroxybutyrate (260 mg/kg) increased it in mice by 54.7 ± 3.1% ($P < 0.05$) and in rats by 15.6 ± 1.2% ($P < 0.05$). Azamethonium bromide in a dose of 10 mg/kg (intraperitoneally) lowered the blood pressure of the experimental animals sharply and increased the degree of necrosis of the graft by 35.5-52.3% ($P < 0.05$). During blood loss the viability of the skin graft diminished proportionally to the volume of blood lost.

Hyperbaric oxygenation and salts of γ-hydroxybutyric acid are known to increase, whereas hypotension and hypovolemia decrease the viability of ischemic tissues [2-5]. The results obtained by the present method not only confirm this conclusion completely, but they also enable the effect of different procedures on the necrobiotic processes developing in a skin graft whose blood supply is insufficient to be assessed quantitatively.

Consequently, the suggested method can be recommended for the comparative study of drugs and other factors for their antinecrotic and pronecrotic activity. Information of this kind is essential for further improvement of pharmacologic regulation of the viability of an ischemic graft and for rendering operative treatment more effective.

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