

Evaluation of cutaneous flap survival by IR thermography

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Abstract:

There are plenty of recent studies showing the influence of different drugs on the survival of the cutaneous flap. The effects of a topically applied capsaicin, methylprednisolon, mitomycin and gastric pentadecapeptide BPC-157 in improving skin vitality and preventing distal flap necrosis were tested in a random-pattern dorsal skin flap model.

Wistar rats were randomized into five groups, four experimental groups and a control group. A standardized full thickness dorsal random-pattern skin flap was raised on each rat and sutured back into place. A gelatin sponge was placed before suturing between the flap and its recipient bed, with 0.9% saline in the control group and with capsaicin, methylprednisolon, mitomycin and pentadecapeptide BPC-157 in the experimental groups. The flap survival was judged one

week postoperatively, and the extent of skin flap survival was compared between the experimental groups and control. Vitality of the flap and survival area was measured by infrared thermography . Infrared thermography is non-invasive diagnostic method which offers two-dimensional representation of the surface temperature of the skin. It is useful for the evaluation of cutaneous blood circulation of the skin and superficial temperature can be an indicator for the vitality of the skin flap.

The topically applied methylprednisolon and pentadecapeptide BPC-157 resulted in a statistically significant decrease in skin flap necrosis, compared with the control group ($p < 0.05$), topically applied capsaicin and mitomycin did not show statistically significant decrease in skin flap necrosis. The topically applied methylprednisolon and pentadecapeptide BPC-157 was effective in reducing ischemic necrosis in failing random-pattern skin flaps in this rat model.

The results of this study suggest that such a topical drug application might have significant effects in the reduction of ischemic necrosis in the distal parts of skin flaps, and this treatment might also have applications as prophylactic therapy for risky skin flaps. Thermography of the skin is an easy method for estimating the vitality and survival area of the skin flaps.

Key-words:

Cutaneous flap survival, infrared thermography

Introduction:

Flap is a part of the tissue divided from its background, used for covering the tissue defect in plastic and reconstructive surgery. Flap necrosis is a significant complication in all types of flap surgery. Many recent studies show the influence of different drugs on the survival of the cutaneous flap. The results of these studies suggest that topical application of certain drugs might have significant effects in the reduction of ischemic necrosis in the distal parts of skin flaps. Some studies show that topical application of capsaicin results in a significant increase of flap survival area. Pretreatment with capsaicin, which depletes neuropeptide transmitter content from primary sensory neurons, has controversial influence. In some studies it showed a significant decrease in flap survival area compared to normal animals, and in the others capsaicin-pretreatment showed increased vascularity and flap survival or it showed no difference in flap survival between experimental groups and controls. Corticosteroid treatment can improve the survival of surgical skin flaps. Venous flaps of the animals receiving daily methylprednisolone injections were noted to have statistically significantly improved venous flap survival, compared to the control group. Mitomycin is effective in depressing wound healing. Gastric pentadecapeptide BPC-157 improves burn wound healing or bone fracture healing. There wasn't found any available literature for the influence of the mitomycin or pentadecapeptide BPC-157 on the cutaneous flap

vitality, so our aim was to investigate the influence of these drugs on cutaneous flap survival.

Infrared thermography measures infrared radiation from an object. The radiation measured by the camera depends on the object temperature, ambient temperature and objects emissivity, which is one of the most important parameters in thermography. Human and shaved rat's skin exhibits an emissivity close to 1. So far has been evaluated the applicability of various thermographic techniques in diagnosis of radiation and burn injury, early diagnosis of cancer or evaluation of cutaneous flap survival. Temperature distribution of the skin can be closely related to the arterial blood supply. Superficial temperature as an indicator of cutaneous blood circulation can be visualized easily by thermography (Fig.1).

The effects of a topically applied capsaicin, methylprednisolon, mitomycin and gastric pentadecapeptide BPC-157 in improving skin vitality and preventing distal flap necrosis were tested in a random-pattern dorsal skin flap model.



Fig. 1: Thermographic image of the rat cutaneous flap

Materials and methods:

Local Ethical Committee approved experimental protocol. Fifty female Wistar rats, weighting between 200 and 250 g were randomized into five groups of 10 animals, four experimental groups and a control group. The dorsal skin of the rat was shaved. A standardized full thickness inferiorly based dorsal random-pattern skin flap (10.0 x 2.0 cm) was raised on each rat and sutured back into place. A gelatin sponge was placed before suturing between the flap and its recipient bed, soaked with 0.9% saline in the control group and with capsaicin (0.2 %), methylprednisolon (30 mg/kg), mitomycin (0.2 mg/ml) and pentadecapeptide BPC-157 (2 µg/ml) in the experimental groups. The flap survival was judged one week postoperatively, and the extent of

skin flap survival was compared between the experimental groups and control. Vitality of the flap and survival area was measured by infrared thermography. Measurement was made by thermographic system ThermaCAM SC2000 (Fig. 2). The computerised image analysis was made by ThermaCAM Researcher 2002. Statistical analysis was made by Mann Whitney test for differences between the analysed group and the control group (saline).



Fig. 2: Measurement by thermographic system ThermaCAM SC2000

Results:

The topically applied methylprednisolon and pentadecapeptide BPC-157 was effective in reducing ischemic necrosis in failing random-

pattern skin flaps, it resulted in a statistically significant decrease in skin flap necrosis, compared to the control group ($p < 0.05$) and topically applied capsaicin and mitomycin did not show statistically significant decrease in skin flap necrosis, measured by infrared thermography one week postoperatively (Fig 3).

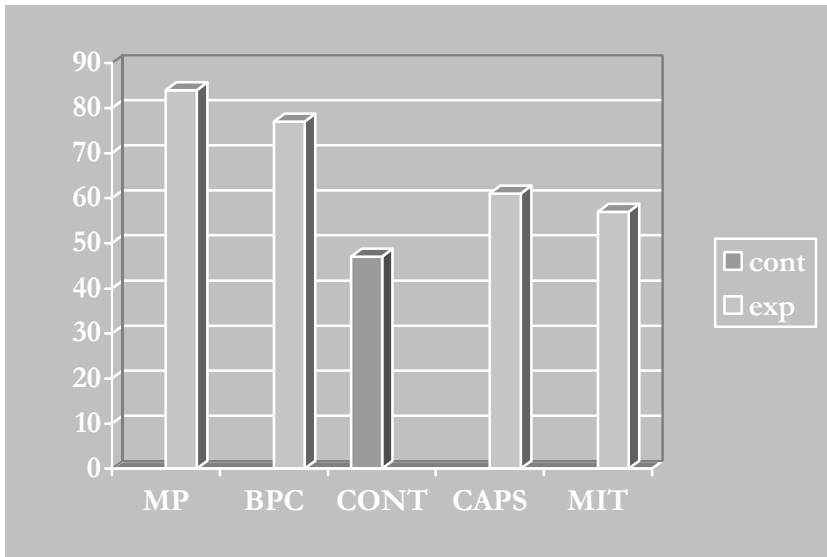


Fig. 3. Cutaneous flap survival in examined group (in millimeters): MP - methylprednisolon, BPC - pentadecapeptide BPC-157, CONT – control (saline), CAPS – capsaicin, MIT - mitomycin.

Conclusion:

The topically applied methylprednisolon and pentadecapeptide BPC-157 was effective in reducing ischemic necrosis in failing random-pattern skin flaps in this rat model. The results of this study suggest that such a topical drug application might have significant effects in

the reduction of ischemic necrosis in the distal parts of skin flaps, and this treatment might also have applications as prophylactic therapy for risky skin flaps in plastic and reconstructive surgery.

Infrared thermography is non-invasive diagnostic method which offers two-dimensional representation of the surface temperature of the skin and it is a sensitive method to detect altered temperature distribution expressed through the histograms, evaluating the vitality of the skin flap by computerised image analysis. Sufficient blood supply of the flap is a significant factor for proper wound healing and cutaneous flap survival. Thermography of the skin is an easy method for estimating the blood circulation of the skin flap, but it is limited to hair-free or shaved skin areas.

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