Thermography in Assessment of the Vascularity of Soft-Tissue Flaps

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•Tube pedicle grafts were raised on the back of eight rats. Infrared thermography was utilized to indirectly assess the vascularity of the grafts. The pedicle grafts were divided at seven or eleven days post-surgery and monitored thermographically. Flaps where the temperature was more than 4.5C lower than that of the surrounding skin did not survive when divided. Infrared thermography can be utilized to assess the vascularity of pedicle flaps and may be helpful in determining the correct time to divide the pedicle.

Introduction

Flaps are a versatile technique for soft-tissue reconstruction. However, whether they are random flaps, axial flaps, or free microvascular flaps, the success of the flap depends on an adequate blood supply's being established. When the flap is raised, it must have an adequate blood supply in its pedicle to maintain viability, and after transfer a new blood supply must be established from the recipient bed if the pedicle is later to be divided. Many methods have been devised to monitor the blood supply, and hence the vitality of soft-tissue flaps, but none is routinely used, for a variety of technical and clinical reasons.[1]

The infrared thermographic camera was used to detect the heat given off from the skin surface of rats, which depends on the cutaneous blood supply. Specifically, the infrared camera was utilized to monitor temperature changes in a soft-tissue flap to see if they would reflect the underlying blood supply and hence the viability of the flap.

Materials and Method

The infrared camera† utilized for temperature measurement can monitor surface temperatures between −40C and +260C, with a discrimination of 0.1C at ambient temperatures. Thus it is accurate enough to reproducibly monitor skin temperatures. Results can be displayed graphically or pictorially and can be stored on video tape.

The animal model used was a tube pedicle flap raised on the back of the Sprague-Dawley rat. Eight 250-gm rats were anesthetized with intraperitoneal nembutal (25 mg/kg) utilizing the National Research Council Guide for the care of animals. Each animal's back was shaved and a 6 cm × 2 cm tube pedicle flap was raised in the shaved area, with the flap left attached at both ends (Figure 1). The flaps were raised down to the deep fascia to include the panniculus carnosus. The flap was raised on the animal's back to prevent autocannibalism. After surgery each rat was housed individually. Infrared thermography was carried out at each stage of the procedure at a constant ambient temperature of 22.2C in an absence of air currents. In each case no thermography was carried out until the animal had been at constant ambient temperature for at least 15 min.

All rats were monitored twice daily with the thermographic camera. Two rats were left with the tube pedicle flap attached at each end to act as controls. In one rat the central area of the tube pedicle flap necrosed and was lost spontaneously after five days. In another two rats the most caudal attachment of the flap was divided after 7 days, as might occur in transfer of a tube pedicle flap. In the three remaining rats the most caudal end of the tube pedicle was divided 11 days postoperatively. The divided end of the flap was not reattached.

Results

The tube pedicle flaps of the control rats remained clinically vital for the full 14 days of this study. In one

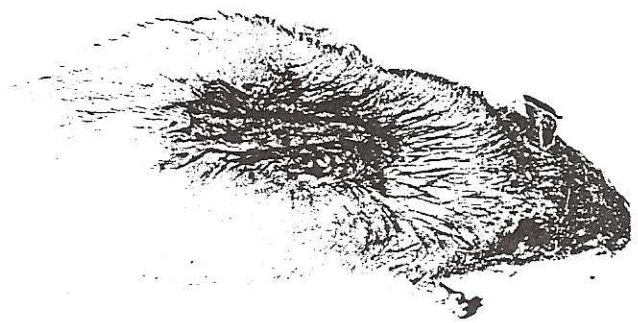

Figure 1. A tube pedicle flap raised on the back of a rat.

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† Hughes Probeye 4300 Thermographic Video System®, Hughes Aircraft Co., Carlsbad, CA 92008.