

Radioisotopic perfusional assessment of blood circulation changes in skin under progressive expansion – experimental model with rabbits¹

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ABSTRACT - The purpose of this experimental model with rabbits is investigating the variation of blood flow in the expanded skin versus expansion time. New Zealand breed rabbits are used. Two groups are studied: F-1 receiving expanders on the right thigh and F-2 receiving expanders bilaterally. Progressively, five expansions are performed. The first radioisotopic perfusional evaluation is performed just after the surgery and the following evaluation are performed at the second, sixth, thirteenth, twentieth and twenty-seventh post-surgical days. As radiotracer, technetium 99m are used in the chemical form of sodium pertechnetate. Scintillographic images are obtained by CGR scintillation camera. The quantitative analysis is done by calculation of the reperfusion rate.

KEY WORDS – Perfusion. Radioisotopes. Skin. Tissue expansion. Model Animal. Rabbit.

Introduction

Tissues expander is a surgical procedure aiming to expand the skin in deformities repair, which was introduced in 1978, by Radovan¹.

It is an empty silicone purse, with variable size and shape, either connected to a valve by a tube or directly connected, through which a certain volume of fluid is periodically injected.

This process aims to imitate the distension of the soft parts of tissues, which we can see in certain conditions, as periods of fattening, pregnancy, breast feeding, hematoma, and in growing tumors.

Proposition

The purpose of this experimental model with rabbits is investigating the variation of blood flow in the expanded skin versus expansion time.

Method description

White male seven-month old weighting from 2.8 to 3.2 kg New Zealand breed rabbits were used. During all the time animals were maintained in individual cages, fed with the same kind of food, within a scientifically suitable bioterium.

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Animals were randomly divided into two groups: group F-1 receiving expanders on the right thigh and using their symmetric area of the left thigh as control; group F-2 receiving expanders bilaterally, expanding only towards the right side.

Progressively, five expansions were performed and in each one 10 ml of physiologic solution were injected, starting from the surgical act, when the first expansion was performed, followed by the third, seventh, fourteenth, and twenty-first days, when the maximal expansion was reached – 50 ml.

Rabbits of F-1 and F-2 groups were studied during the surgery and afterwards in the second, sixth, thirteenth, twentieth, and twenty-seventh post-operative days.

Surgical technique

Rabbits were identified by fixing a radiography film (2.0 x 3.0 cm) with a monofilament nylon thread 4-0 on the right ear, writing numbers with surgical pen.

Two hours before the surgical act, trichotomy was performed on the study areas, then the animal was immobilized, exposing the side face of R thigh.

Endovenous anesthesia with 2.5% sodium thiopental (Thionembutal) and 0.0125 mg/ml of atropin sulfate was carried out, using the marginal ear vein as administration via. After anti-septic procedure with iodine alcohol, and field placement, limits of the expander and valve to be applied on the thigh were marked with shiny green color (FIGURE 1). An empty 50 ml, silicone, semispherical, with 6 cm diameter expander was used.



FIGURE 1 – Marking expander and valve limits to be applied on the thigh with shiny green color.

A 3-cm straight line was marked between the expander and the valve, cranially positioned, over which the skin incision was performed (FIGURE 2).

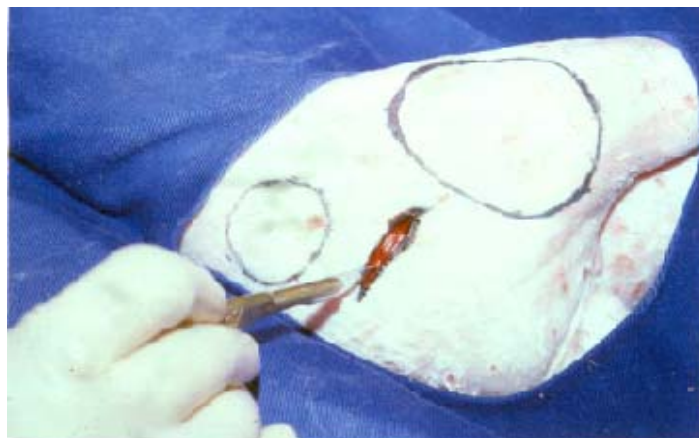


FIGURE 2 – Incision of skin over the mark.

Air was infiltrated under pressure with syringe, between muscle fascia and skin with fleshy panculus, where an easy clivage plane of areolar tissue is present. These planes were separated by rhombic dissection, one centimeter surpassing the marked area, so that a wide room was opened to receive the expander. Similarly, the displacement of the suitable area for the valve was proceeded.

Both expander and valve were placed into their respective rooms (FIGURE 3), and this was fixed with a monofilament nylon thread 5-0 (FIGURE 4). 10 ml of physiologic solution are injected through the remote valve (FIGURE 5).



FIGURE 3 – Insertion of expander and valve in their respective rooms.

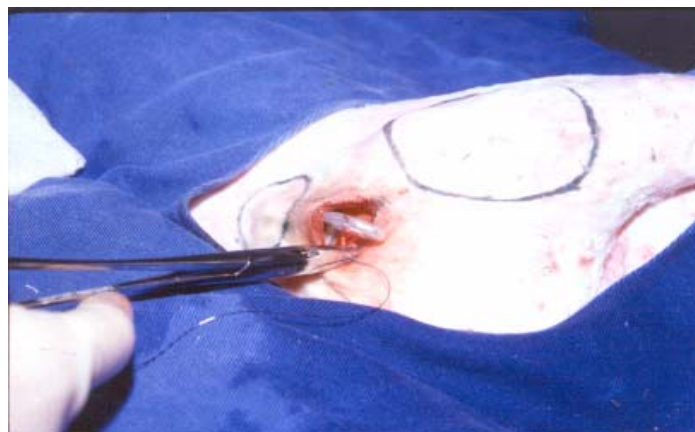


FIGURE 4 – Fixing the expander with monofilament nylon thread 4-0.

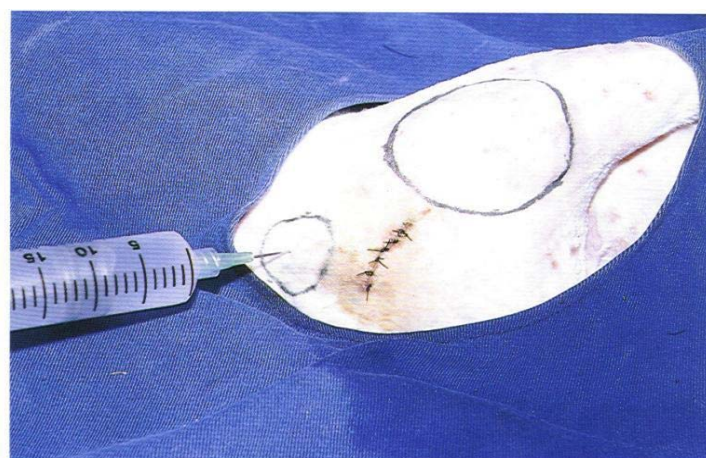


FIGURE 5 – Infiltration of 10 ml of physiologic solution through the remote valve, to inflate the expander.

The incision was sutured with the same thread and a gauze and micropore sticking plaster is applied.

Then, progressively five expansions were performed and 10 ml of physiologic solution were injected in each expansion, starting from the surgery, when the first expansion was performed, followed by the third, seventh, fourteenth, and twenty-first days, when the maximal capacity of the expander was reached – 50 ml (FIGURE 6).



FIGURE 6– Final aspect of the expanded skin with the maximal capacity of the expander – 50 ml.

In the F-2 group animals, as expanders were placed on their R and L thighs in order to have symmetric marking, a plastic mould was used with three fixed anatomical points (coccyx, side epicondile and medial epicondile) on which the right side mark was projected, and transferred to the opposite side (FIGURE 7).



FIGURE 7– Plastic mould on which the right side mark was projected being transferred to the opposite side.

Surgical technique was identical for both sides.

The immediate expansion with 10 ml of physiologic solution only in the R side was performed, as well as subsequent expansions.

Post-surgical care

As antibiotic, a 50 mg/day intra-muscle via dose, tetracycline was used as a single dose, starting in the intra-surgical period, and it was maintained up to the 5th post-operative day.

The suture was removed from the skin in the 7th post-surgical day.

Study of Radioisotopic Perfusional Assessment

The first radioisotopic perfusional evaluation was performed just after the surgery, thereafter known as time zero, and the following evaluation were performed at the second, sixth, thirteenth, twentieth, and twenty-seventh post-surgical days, i.e., at the eve of the next expansion.

As radiotracer, technetium 99m (^{99m}Tc) was used in the chemical form of sodium pertechnetate, obtained by a molybdenum-99 (^{99}Mo) generator, provided by Institute of Research Energetic and Nuclear (IPEN).

Scintillographic images were obtained by a CGR scintillation camera with wide action field and equipped with parallel holes collimator, with low energy and high resolution (HRBE – 7 – 160 – GC) (FIGURE 8).

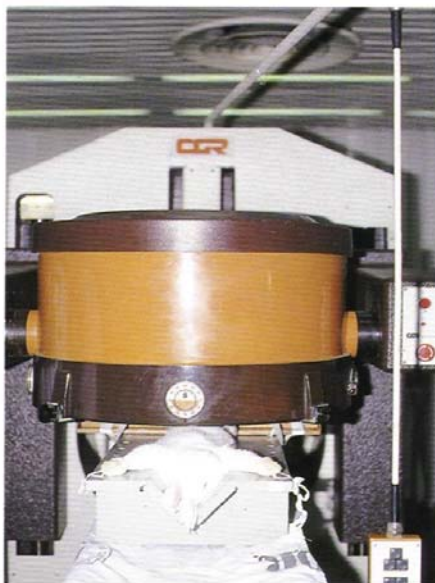


FIGURE 8 – CGR scintillation camera, used for obtaining scintillographic images.

Scintillographic studies processing was performed in a SOPHA S-500 computer system with 128 Kbytes of memory and endowed with a specially developed computer program for this model (FIGURE 9).



FIGURE 9 – SOPHA S-500 computer system.

The sequence for obtaining scintillographic images follows the previously described plan.

Firstly, animals were immobilized on fixative ditches (FIGURE 10), specially created for this model. Images were taken 60 seconds after a venous injection of 18.5 MBq (0.5 mCi) of ^{99m}Tc -pertechnetate in the marginal ear vein, the needed time in order that the radio drug was homogeneously spread within the vascular room. 300.000 images counting were accumulated, in the anterior projection of hips and thighs, involving the expanded region and the opposite side.

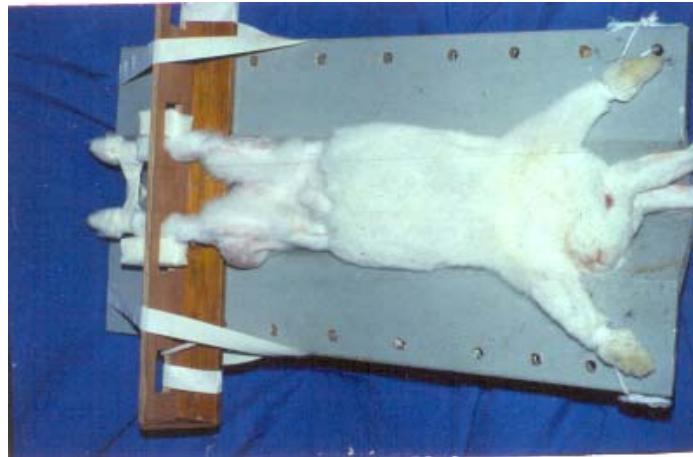


FIGURE 10 – Fixative ditches used for immobilizing the rabbit.

Images were stored in a computer and previously selected software was used.
Quantitative analysis – Calculation of the Reperfusion Rate

Through a manual focuser, interest areas around the expanded cutaneous region, the ‘expanded area’, was highlighted and this same measure was transferred to the opposite side, the ‘control area’. The blood volume of the region to be investigated was projected on the bounded area of the image (FIGURE 11).

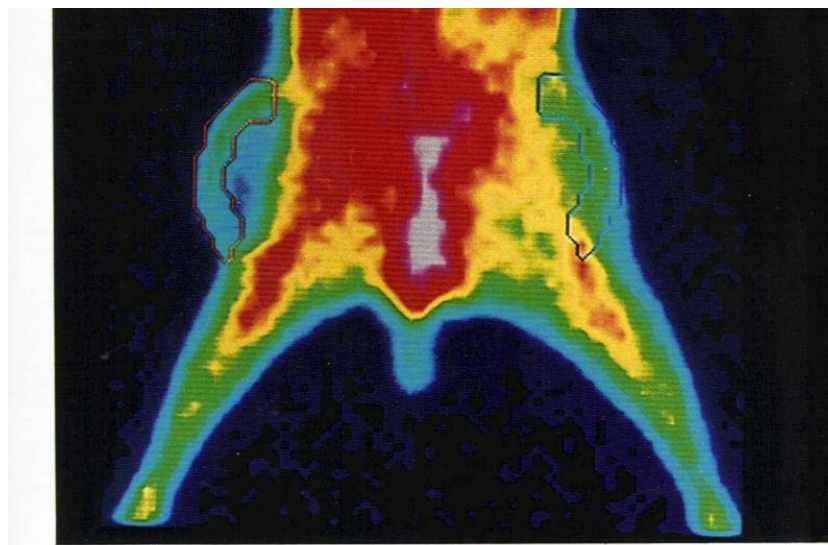


FIGURE 11 – Interest areas highlighted on the ‘expanded area’ (side R) and on the ‘control area’ (side L), for the calculation of the Perfusion Rate.

These interest areas provided the total number of counting, as well as the quantity of video matrix units.

The perfusion rate was defined (i) by the ratio:

$i = C/A$, where

i = reperfusion rate

C = total number of counting and

A = area or video matrix units

The Relative Perfusion Rate (I) calculation through the ratio between expanded area perfusion rate and control area rate. The computer was programmed to give directly the relative perfusion rate.

Perspectives

This experimental model may be used for future researches related to the skin blood circulation, by using a number of procedures that may be applied by the Medicine, especially by the Plastic Surgery.

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RESUMO - Este modelo experimental em coelhos tem como proposição investigar a variação do fluxo sanguíneo na pele expandida em relação ao tempo de expansão. Utilizam-se coelhos da raça Nova Zelândia. Estudam-se dois grupos : F-1 que recebe expansor na coxa direita e F-2 que recebe expansores bilateralmente. São feitas progressivamente cinco expansões. Realiza-se a primeira avaliação perfusional radioisotópica logo após o ato operatório e as seguintes no segundo, sexto, décimo-terceiro, vigésimo e vigésimo-sétimo dia pós-operatórios. Utiliza-se como radiotraçador o tecnécio 99m na forma química de pertecnetato de sódio. Obtêm-se as imagens cintilográficas em câmara de cintilação CGR. Faz-se a análise quantitativa pelo cálculo do Índice de reperfusão.

DESCRITORES – Perfusão. Radioisótopos. Expansão de Tecido. Pele. Modelo Animal. Coelho.

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