Thermographic variations in the breast during the menstrual cycle

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SUMMARY. **The tbermographic vascular breast modification during the menstrual cycle were examined in 48 women of ages from 18 to 48 years, chosen from a population sample presenting negative clinical and mammographic examinations.**

Six grades of vascularisation were found; two points of maximum vascularisation were observed corresponding to the ovulatory and the premenstrual phase with minimal or absent vascular pattern in the post-menstrual and luteal phases. The aim of the research was to choose the best period of the menstrual cycle for performing thermographic examinations of the breast, and to have an indirect index of steroidal hormone activity.

Key words: menstrual cycle, breast vascularisation, oestrogens, progesterone.

The modification undergone by the mammary gland during the various periods of life forbid us to consider it as a static anatomo-functional entity influenced solely by pre-information of a genetic character. We may distinguish between three orders of modification:

1) modifications connected with development, maturity and senescence of the organ;

2) modifications related to pregnancy and nursing;

3) modifications related to the menstrual cycle which themselves take on a cyclic character.

These last are the easiest to study because of the short lapse of time in which they occur, and they take on a special importance, moreover, in as much as not infrequently they become a source of trouble to the female and assume a pathological significance.

A typical example of this limit-situation is provided by the pre-menstrual syndrome characterised by a sense of tension, sensitivity and increase in the nodularity of the organ.

The hypotheses on the origin of this phenomenon are principally two.

The former regards the proliferation of the mammary tissue and the latter regards only vascular engorgement.

A histological control of the first hypothesis not being possible, the second becomes more reliable.

On the basis of the above considerations dynamic telethermography seems particularly suitable for the prolonged study of breast modifications inherent in the menstrual cycle: D.T.T., indeed, supplies quantitative and morphological data on the surface vascularisation of the breast [1, 2, 15, 19, 20, 21, 22, 24, 25].

Furthermore, since this sort of investigation is extended in time, one should bear in mind that D.T.T., apart from satisfying the requirements of repeatability, safety, speed and facility of performance, is also agreable to the subject.

In our Institute, therefore, a study of the vascular modifications of the breast inherent in the menstrual cycle was undertaken by means of D.T.T.

Before going on to set out the methods and results of this study, we think it fit to review the hormonal cibernetics of the breast.

OUTLINE OF THE HORMONAL CIBERNETICS OF THE BREAST

The trophic and functional state of the mammary gland is influenced by the whole endocrine make-up but the study of these influences is very difficult because the hu-

man mammary gland is not comparable to the animal one and also the study of mammary tissue cultivated in vitro is not possible for a sufficient time [11, 12, 18].

The most reliable data come from the techniques of radioimmunological dosage of the hormones [26, 27].

From this data we may deduce that the most important hormones in the physiology of not pregnant mammary gland are oestrogens and progesterone [9, 12, 13, 14, 17].

A) Oestrogens

These are the hormones of greatest importance in mammary physiology and in particular in sexual dimorphism.

Their action is comparable as regards both uterus and breast, and also on the connective and epithelial component [3, 4, 6].

At cell level they perform an activity favouring epithelial mitosis.

In small doses, comparable to those occuring naturally, in the folliche phase of the menstrual cycle, they carry out their function mainly at the level of the tubules of the mammary gland, favouring lengthening and multiplication.

At higher doses they may induce a differentiation in the direction of acinus formation, which is also enhanced by progesterone.

They also have a local action inhibiting the lactogenic effect of prolactin.

The effects of oestrogens on the vascularisation of the breast are of special interest for our study: they increase vascular deficiency, hydration and capillary permeability, perhaps by liberating histamine or prostaglandin E1 [10, 23].

Autoradiographic methods show that Estradiol attaches itself to the vascular walls of the target organs, and it is likely that from here, and by means of the above mentioned effects, it causes the blood engorgement and connective oedema which are chemically manifested in the engorgement syndrome.

B) Progesterone

At mammary level progesterone also fulfills a double function at cell and vascular level.

On the epithelia of the mammary gland progesterone has an action inhibiting mitoses in the proximal part of the tubuli, while it favours mitoses in the direction of acinus formation in the distal part; its action complements the action peculiar to the oestrogens.

An additional feature of progesterone is that of intervening as a mitotic inhibitor only at a very precise moment of the cell reproductive cycle, i.e. immediately after mitosis and before D.W.A. synthesis begins.

That explains the importance of the fact that the duration of increase of pregesterone is an essential element for the intensity of its action: indeed a minimum duration of the luteal phase of 12 days is necessary in order that all the sexual epitheiial cells may undergo the influence of progesterone [5, 7].

At vascular level the progestinic action is sharply opposed to that of oestrogen, diminishing the vascular permeability and the connective oedema, but hardly influencing the state of vascular dilation.

In conclusion, the eutrophia of the mammary gland and its cyclic modifications are related mainly to a delicate equilibrium between oestrogen and progestinic influences which express themselves in modifications in the location and number of epithelial mitoses and, at the expense of the vasal network, in modifications of calibre and permeability.

MATERIALS AND METHODS

For our research we used an AGA Thermovision Mod. 680 Thermograph provided by the Institute of Radiology of the University of Modena.

This thermovisual type apparatus is provided with normal, inverted and isothermic function representation.

In our research we always used inverted representation performing thermograms in the frontal position, oblique anterior right and oblique anterior left positions, regulating the apparatus to different sensibility ranges (At 2°C At l°C, At *0,5°C).*

Subsequent controls were always carried out with the same range adjustments.

Research was performed on 48 women of ages from 18 to 48 years, chosen from a population sample presenting negative clinical and mammographic examinations; a preliminary thermographic examination had been performed with the aim of showing possible thermic or vascular abnormalities.

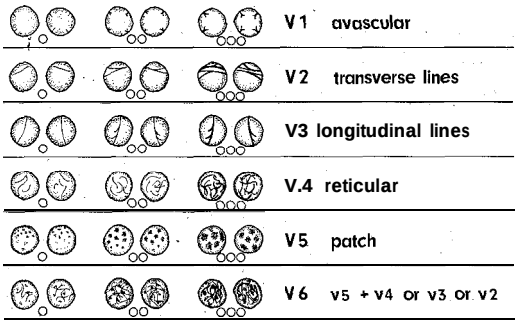
The selected women were informed before-

hand of the aims, methods and harmlessness of the research in which they were invited to take part; this was in order to avoid any influence from emotional factors and to obtain their fully conscious consent.

The subjects underwent repeated thermographic examinations throughout two menstrual cycles, in the same basic conditions of temperature, humidity, ventilation and skin cooling, and care was taken to carry out the examination at the same time of day for each subject in order to reduce to a minimum the possible influence of factors connected with the passing of time.

From 5 to 8 thermographic outlines per cycle were performed on each subject.

In order better to study the variations in superficial venous vascularisation, we worked out a system of classification divided into six grades of vascularisation, characterised also by morphological differences (Graph 1).

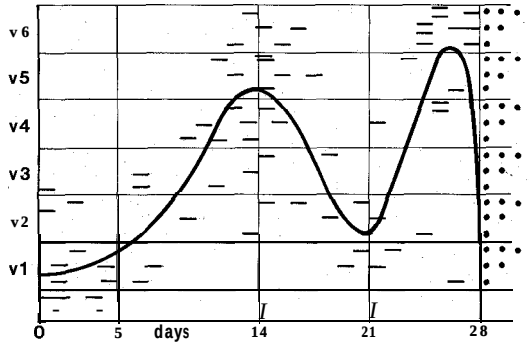


Graph 1. Grading of breast vascularisation.

RESULTS

In 77% of the cases we found a morphological and quantitative variation of the superficial venous pattern, presenting a cycle rate in relation to the various phases of menstruation.

In particular two points of maximum vascularisation were observed corresponding to the ovulatory and the premenstrual phases. These were divided by periods of minimal or absent vascular pattern in the post-menstrual and luteal phases.



Graph 2. Vascular variations.

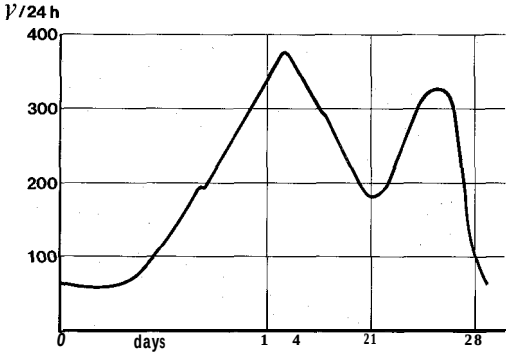
For purposes of control repeated thermographic examinations were carried out on a further group of 12 women who had advanced at least 5 years beyond the menopause age, and no variation of vascularisation was observed in these controls.

Graph 2 gives a graphic representation of the vascular variations found in relation to the menstrual cycle, based on the quantization proposed by us. The continous line represents the median progress of the phenomenon, while the horizontal lines represent the levels of individual observations on 10 subjects.

It is interesting to note the parallelism between the curve of the superficial vascular variation rate and the curve of the amounts of Estradiol in the urine shown in Graph 3.

The similarity of rate of the two phenomena would lead one to identify the blood quantity of Estradiol as the major factor in vascular changes in the breast.

Nevertheless a difference of qualitative type



Graph 3. Estradiol in the urine.

between the images of the vascular pattern in the ovulatory phase and the premenstrual phase is present in the majority of the cases observed. Jn fact, in the premenstrual phase the vascular pattern appears more fractionated and twisted than in the ovulatory phase; this image being perhaps due to the proliferation of acini induced by progesterone, which is absent in the ovulatory phase.

Variations in mammary vascularisation showed themselves to be more intense especially in the premenstrual phase, in subjects with a more serious mammary engorgement syndrome.

ce of endogenous hormones which are likely to be inhibited by the treatment itself.

This point, therefore, also tells in favour of the hormone responsability in vascular modifications of the breast.

The percentages of variations of vascularisation, among our cases, are given in Tab. I, where the subjects have been divided into 3 groups according to age and where the absolute values and percentages of the variations encountered in each individual group have been indicated.

In Fig. 1 and 2 the thermographic sequences of two cases are reported, showing the

Tab. **I. Variations of vascularisation for age.**

Age	Number of patients	%	% vascular variations observed	
			absolute	percentage
1st group 18-27	21	43.7%	16	76.1 %
2nd group 28-37	14	29.2%	12	85.7 %
3rd group 38-48	13	27.1%	9	69.2%
18-48	total 48		total 37	77.08%

On the other hand, subjects presenting small variations or none at all gave a thermographic picture of « cold breast », with little or no vascularisation and in 4 cases yielded laboratory findings of hypoestrinism.

Our cases included two women who underwent oestro-progestinic contraceptive therapy. During the menstrual cycle they showed no variations worthy of note, but rather a high degree of basal vascularisation.

Also included were 5 women undergoing oestro-progestinic therapy according to the sequential technique, taking increasing doses of oestrogen during the cycle and superimposing progesterone during the last two weeks: all these subjects showed a constant increase of vascularisation throughout the cycle up to the menstrual phase, when a sudden decrease took place.

Both these ways of administering oestrogen-progesterone gave a vascularisation graph which varied in accordance with the oestrogen dosage but without reflecting the influen-

variation in superficial vascularisation in conjunction with the variation of the menstrual phases.

CONCLUSIONS

On the basis of the results obtained it seems possible to draw two main conclusions: the first, of special thermographic interest, concerns the method of performing the examination with a clinical aim: in fact, given the variable nature of the vascular pattern, it seems appropriate that the telethermographic observation, directed towards diagnosis, be effected around the twenty-first day or the seventh day of the menstrual cycle, i.e. when vascularisation is minimal, in order the better to get a thermic image of neoplasm or a pathological picture in general.

It would also be appropriate to perform more than one thermographic picture at intervals of a few days in order to appreciate the con-

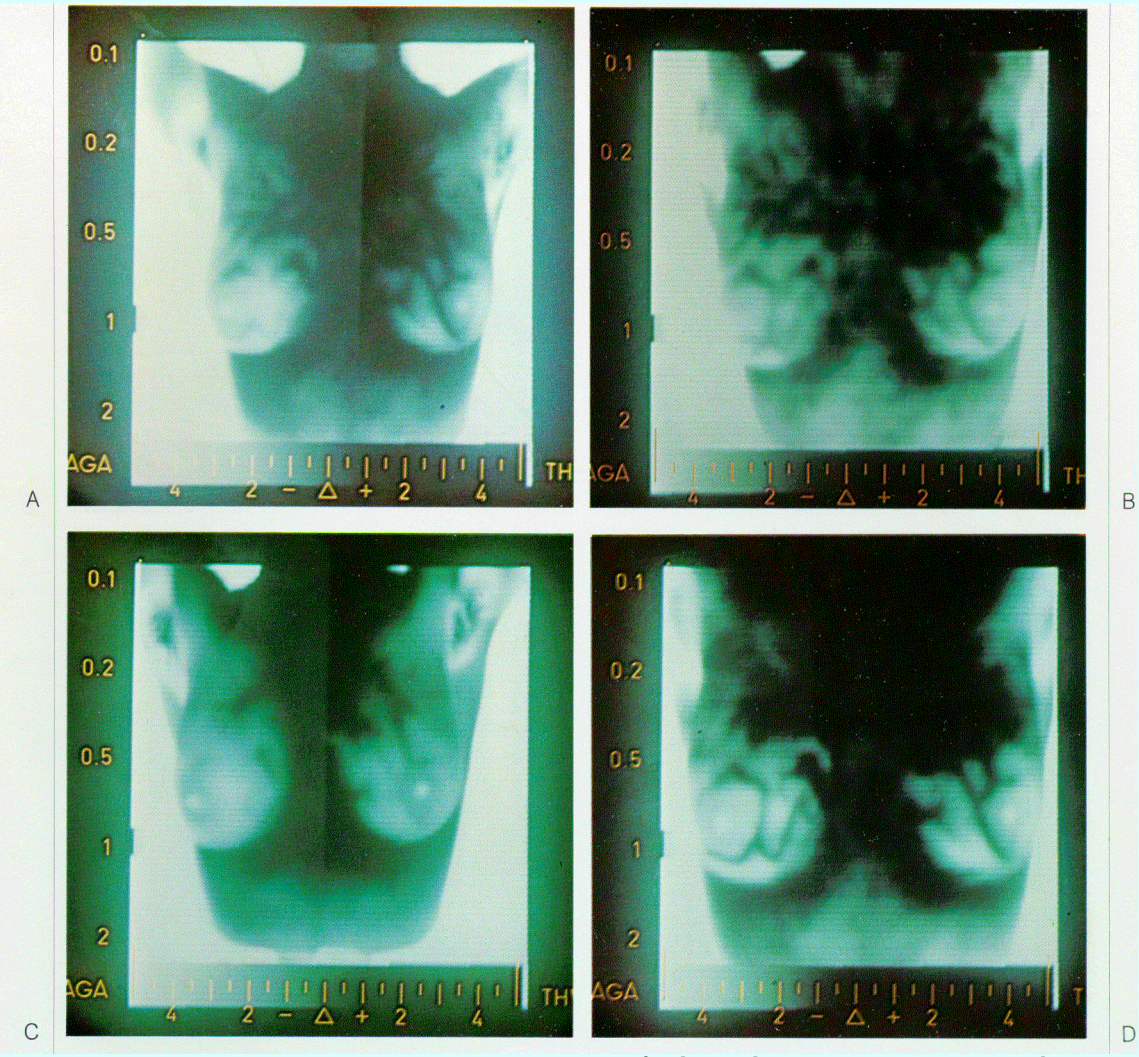


Fig. 1. Case 11, G. I'., age 24. Variations in superficial vascularisation, in conjunction with the menstrual phase. (A: 7th day; B: 14th day; C: 21st day; D: 28th day).

trast between vascular variability and staticness of the eventual pathological image.

The second conclusion concerns the vexed field of mammary endocrinology.

The difficulties inherent in the endocrinological study of the mammary gland have been previously stated: telethermography may constitute a valid means of investigation in this field, since the morphological and quantitative variations of vascularisation of the breast may represent a direct index, even if not immediately capable of interpretation, of the hormone influences to which the organ is subject.

Moreover, when one considers the problems raised by the discovery of tissue receptors of the steroidal hormones, the value of a direct index to hormone activity at tissue level becomes even more evident.

The trend towards endocrinology in oncological therapy at the present time aiso suggests the possibility of telethermographic mo-

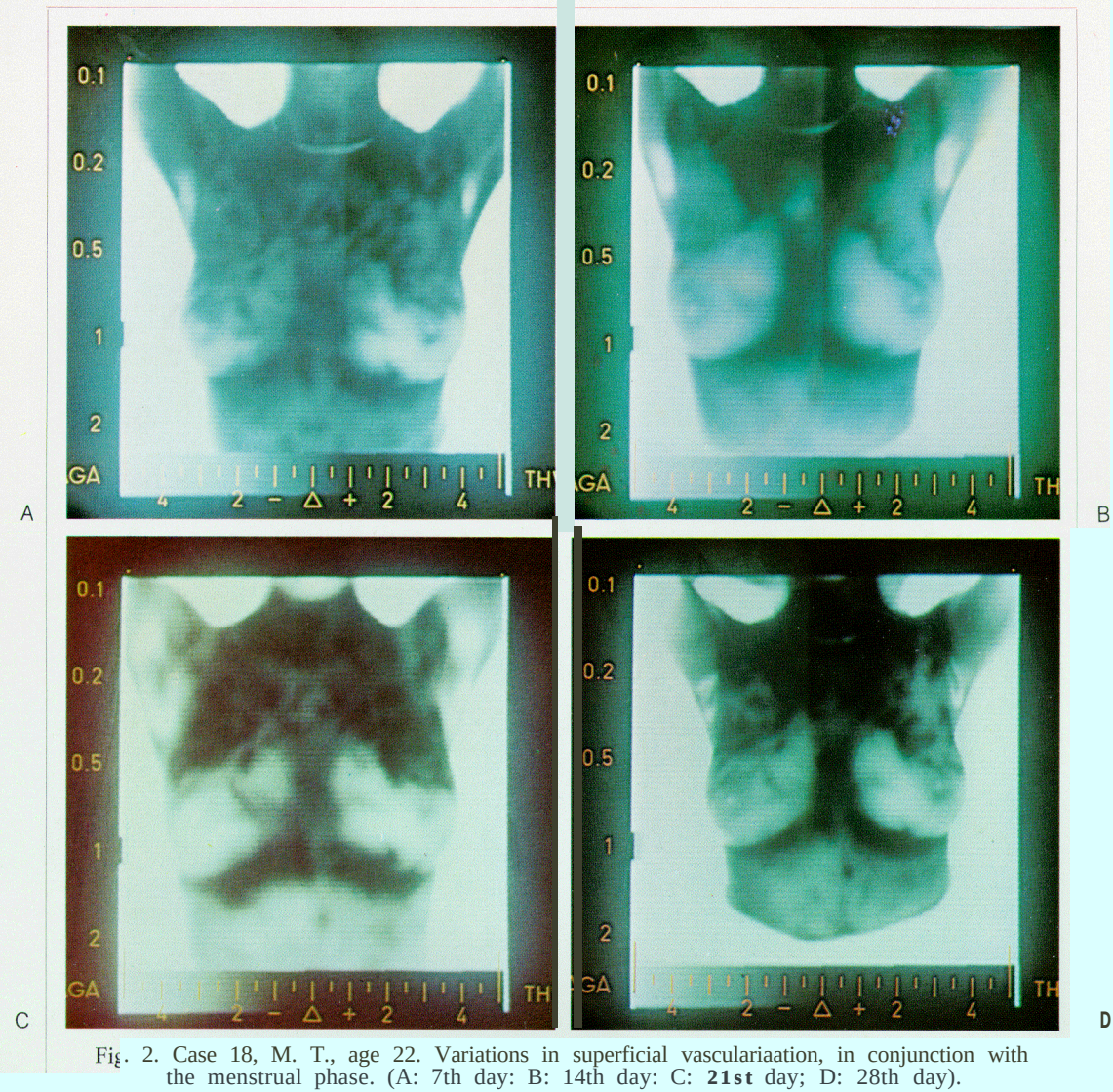


Fig. 2. Case 18, M. T., age 22. Variations in superficial vascularisation, in conjunction with the menstrual phase. (A: 7th day: B: 14th day: C: **21st** day; D: 28th day).

nitoring of local effects of this therapy, along with the possibility of immediate check-up on its effectiveness.

We hold that the above conclusions are sufficiently suggestive to lead us to continue the research by introducing the parameter of radioimmunological hormone dosage, or by researching into the cause-effect relation between the quantity of hormones in circulation and their peripheral effect.

The aim of this is to standardise the results yielded by D.T.T. in the field of endocrinology.

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