6th SESSION: THERMOGRAPHIC PROGNOSIS OF CANCERS

Thermography and future of operable breast cancers

by J. M. SPITALIER, S. CLERC, J. LEVRAUD, J. F. POLLET, M. MEDINA, R. AMALRIC, J. FONDARAI

Cancer Centre, Marseilles (France)

SUMMARY. Prior to any treatment, infrared thermography provides us with original prognostic data on operable breast cancers. Being parallel to other clinical elements of T and N prognosis, it has however an anticipated meaning at equal stage, in particular for the I.U.A.C. II stages. It is able **to foresee some unexpected failures and unhoped-for successes. In most cases mammary thermograms are really a valuable reflection of the tumour thermogenesis. Generally speaking, above a 3 °C gradient, we register a loss of 20% survival at 3 years.**

The great worth of the thermo-prognosis is in providing the clinician with an objective non-invasive test helping him in the selection of conservative treatment. The main theorical advantage is to open a way to clinical research into the study of neoplastic energy.

Key words: breast cancers, infrared thermography, prognosis, thermal difference.

INTRODUCTION

Since the initial investigations carried out by R. N. Lawson, the pioneer of medical thermography [6], we know that the *blood is heated up at the core of the breast cancer.* If the growth speed of the tumour is connected with its own thermogenesis (as in other biological samples) and if the thermal manifestations are a useful reflection of it: thermography must provide *original* data *for prognosis.* This contribution would be extremely valuable for the clinician. Indeed, breast cancers apparently similar from any other point of view may have quite different unexpected growth rates: resulting in death in a few months (in spite of the best curative treatment), or very long years of normal life for patients who have refused treatment.

The theoretical bases of thermographic prognosis for breast cancers are encouraging; but we should never overlook in practice how long and difficult is the way taken by the thermal message between cancer and medical interpretation. Numerous causes of error threaten its transmission to the skin, its cutaneous re-emission, and its translation into visible light. The loss of information produces mammary thermograms which are false-negatives. The practice thermogram of cancer has the opportunity to be pejorative. On the other hand, a serious breast cancer with bad thermal connections to the skin may have no typical thermographic manifestations (Fig. 1).

We owe to the English School the first clinical verification of breast cancer and thermographic prognosis [4,7, s] during the sixties. Since 1970, other studies in France [3, 9] and in other countries [2 5] have confirmed this orientation.

These authors have shown a significant statistical correlation between increasing temperature difference and the survival of the treated patients. The higher the difference, the shorter is the survival. They emphasize that infra-red thermography is objective, allows comparisons and does not require surgery.

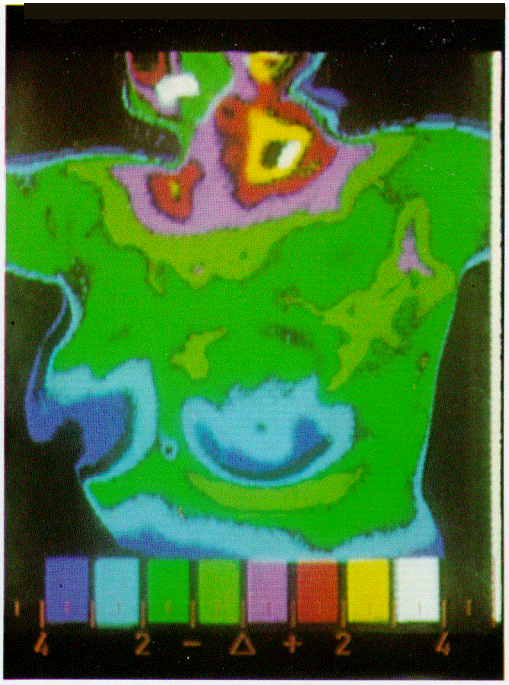


Fig. 1. Telethermography of a carcinoma on the left breast without any thermal demonstration (TH1 category). « Cold » cancer with a possible good prognosis.

MATERIAL AND METHOD

The first of our three Units of Infra-red Thermography with high-speed cameras (AGA Thermovision) was opened in June 1970. It was only at the end of 1975 that we took a first prognostic sounding from 3-years for results. From the extreme thermographic forms, a very important difference appeared ($p < 0{,}001$):

76% of failures in case of $\geqslant$ 4 °C difference
20% of failures in case of > 2 °C difference

Today, we can produce a more detailed SLUdy. Indeed, it is essential to *take into account other clinical elements* of prognosis, in particular T ad N categories of the I.U.A.C. T N M system to compare them with thermography. It is only on these terms that the individual characteristics of thermography in prognosis may be clarified.

The present study is based upon a *continuous series of 562 mammary adenocarclnomas* which underwent *a curative treatment before* 31 Dec. 1973. All records comply with the following criteria:

initial infra-red thermography, before any treatment, with at least three slides in black and white and three in colour (anterior and two three-quarter views).

Microscopical verification, complete radio-clinical assessment, absence of visible signs of distant metastases.

The thermographic data alone from the first day with written interpretation has been retained. Three elements were taken into account:

Temperature diffierence.

TH category according to our synthetic thermographic classification of increasing diagnostic weight [1] from 1 to 5.

Mammary thermogram were they belonging or not to our so-called TH-PEV + thermographic grade of fast growth [10].

It should be noted that normally, the THl, TH2 and TH3 categories have temperature differences of less than to 3 °C and those of TH4 and TH5 categories correspond and are equal or more than 3 “C. For the cancers anatomically operable in this series, the thermogram is supposed to correspond to a fast growth mammary cancer for the + 5 °C and above hot spots and for the abnormally hot surfaces

Fig. 2. Wide area covering three quadrants of the left breast associated with a thermal gradient by + 6 °C (TH5, PEV 2 category). Fast growing cancer with a very poor prognosis.

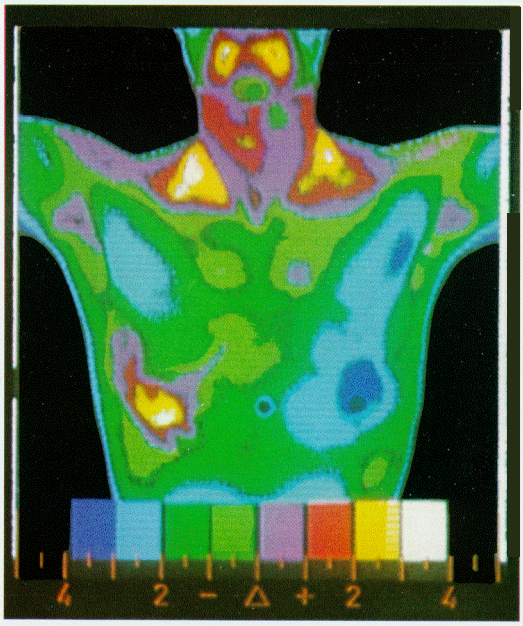


Fig. 3. Carcinoma on the right breast. Stage I, I.U.A.C. Thermography objectivates a small warm area with a thermal gradient by + 6 °C. « Warm dwarf » with a poor prognosis.

Tab. I. **Categories TH % distribution in 562 operable breast cancers.**

TH-PEV +	0,13			
TH5	0,29	Positive thermography	72%	(Δ ≥ 3 °C : 72%)
TH4	0,30			
TH3	0,17	Doubtful thermography	17%	(Δ < 3 °C : 28%)
TH1-2	0,11	Negative thermography	11%	

exceeding two quadrants with 4 °C and above gradients (Fig. 2).

The distribution of these various categories is shown in Table I. lnfrared thermography provides 72% of true-positives and 11% of false-negatives.

THERMOGRAPHY AND PRESENT OF OPERABLE BREAST CANCERS

1. Distribution of Tl category according to TH categories

These small size breast cancers when smailer or equal to 2 cm diameter comprise a fifth cl THl and TH2 categories (19%) but are absent from the TH-PEV + category (Table II). Between THl and TH-PEV +, the decrease is regular. It means that there is a

Tab. **II. 5% Tl categories / TH categories.**

	TH 1-2	TH3	TH4	TH5	TH-PEV +
% Tl	0,19	0,12	0,06	0,05	0,oo

connection between the intenaity of the surface thermographic manifestations and the volume of the tumour. There are four times less small breast cancers above 3 °C than below (Table 111). Warm microtumours are fortunately unusual (Fig. 3).

2. Distribution of Nl category according to TH categories

The mamnary thermograms are more informative when the breast cancer is accompanied by an axillary lymphadenopathy: 34% of

TH1 and TH2 cases versus 71% of TH-PEV `+ cases (Table IV) with a regular progression in the intermediate categories.

Tab. III. % Tl and N1 categories / gradients.

	% T1	% N1
Δ ⩾ 3 °C	4	61
Δ < 3 °C	15	44

There are three times more axillary lympbadenopathies from skin mammar *gradient* of 3 °C (Table 111). Thcrc is a correlation between the importance of the thermographic manifestations on the breast and the presence of an axillary lymphadenopathy (Fig. 4).

3. Gradients and Nl categories of the sole T2 category

In order to eliminate the influence of turnout size on the axillary state and the thermogram, we draw attention to the single T2 category. It consists of a good sample of operable breast cancers, of about 50%. We then work « at fixed diameter » in fact between 2 and 5 cm.

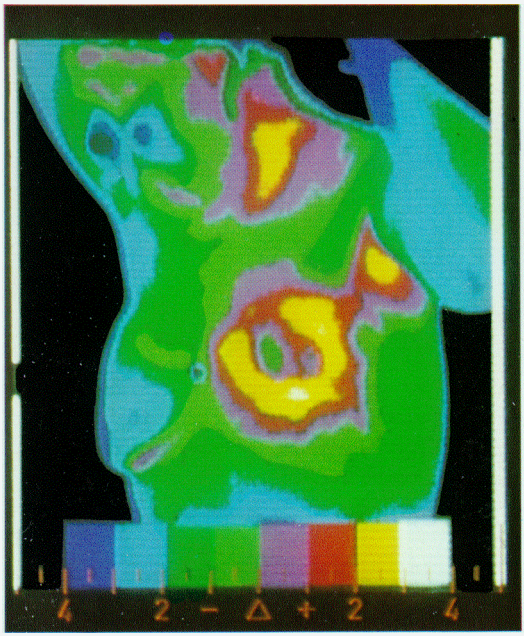


Fig. 4. T&thermography of a scirrhus on the left breast. Huge warm area by + 6°C **in** a crown form, with an homolateral hyperthermal axillary metastasis.

Tab. **IV % Nl categories / TH categories.**

	TH 1-2	TH3	TH4	TH5	TH-PEV +
% N1	0,34	0,50	0,54	0,63	0,71

The difference is very significant (l/1000) with 54% of Nl forms starting from 3 °C and 31% below (Table V). To a relatively equal size an operable breast cancer will be aasociated with an axillary lymphadenopathy, especially when the gradient of the skin temperature of the breast is higher (Table V).

Tab. V. % **N1 T2 category alone / gradients.**

a ⩾ 3°C	:	54%
Δ < 3 °C		31%
359 Cases		**p < 0,001**

THERMOGRAPHY AND FUTURE OF OPERABLE BREAST CANCERS

1. Thermographic prognosis all stages mixed

The rate of survival at 3 years is appreciably different according to our TH categories of increasing diagnostic weight, which expiess thermographic information. The more im portant the vascular and thermal manifestations of the skin increase, the more the percentage of 3-year survival after curative treatment is reduced (Table VI).

Overall, the prognosis goes from 9/10 to 8/10 between THl and TH5. The differences are modest but are consistent. On the other hand, there is a break down between TH5 and TH PEV + grade where the prognosis is lowered to 4/lO.

The rate of 3 year survival is clearly reiated

Tab. VI. % **3-year survival / TH categories.**

	TH 1-2	TH3	TH4	TH5	TH-PEV +
Alive > 3 years	0,89	0,86	0,84	0,8 1	0,38

Tab. VII. % 3-year survival / gradients.

Δ ⩾ 3 °C		67%
Δ < 3 °C		87%
		: p < 0,001

to temperature difference: it is reduced by 20% starting from + 3 °C with a very high significance of **l/l000 (Table VII).**

2. Thermographic prognosis of I.U.A.C. Nl categories

Examining those axillae with a lymphadenopathy, we find again a difference in the 3 year-survival of 20% with a significant meaning of l/100. Here, thermography provides original information (Table VIII).

Tab. VIII. **% category Nl 3-year survival / gradients.**

△ ⩾ 3 °C	**60 %**	
△ < 3 °C	**82%**	
	: p < 0,001	

3. Thermographic prognosis of I.U.A.C. II stage alone

The II stages gather Tl and T2 categories with the Nl category according to I.U.A.C. Once more a difference of 20%, significant at 5/100, appears. Here, thermography enables, before any other diagnostic or operative handling, selection of patients having an I.U.A.C. II stage breast cancers with equivocal chance of survival at the third year. This is important as the I.U.A.C. II stages represent a major fracrion of the recruitment (Table IX).

Tab. **IX % gradients 3-year survival / II stages alone.**

△ ⩾ 3 °C	**72%**	
a < **3°C**	**9070**	
228 cases		**: p < 0,05**

4. Clinical axilla versus gradient confrontations

We were curious to compare the prognosis of I.U.A.C. NO categories with gradients of 3 °C and over with that of the I.U.A.C. Nl category with an inferior to 3 °C temperature difference and found they were alike (Table X).

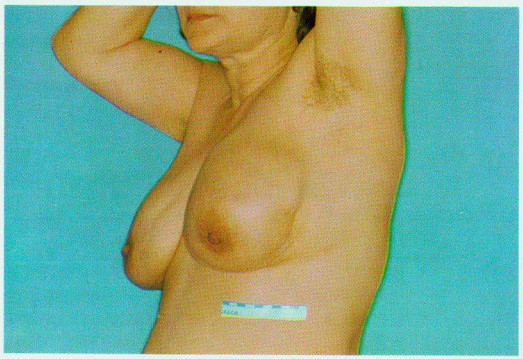
It may otherwise be said: *that the pejorative prognostic weight of the Nl category and that of 3 °C or more temperature difference* are *very* close. Also, we may think that favourable extension of the prognosis provided by rhe NO category and that of the 3 °C temperature difference are similar (Table X).

Tab. **X. N categories 3-year survival / gradients.**

NO a > 3°C	**54177**	**7OY0**
N1 △ < **3 ° C**	**44162**	**71%**

5. Value of the fast growth thermographic theory

It often happens that clinics surmise the fast growth of a breast cancer during the



A

B

Fig. 5 A-R. **Left mammary carcinoma.** Stage **111, I.U.A.C. in a** clinically **obvious evolulive** phase **(PEV 2 clinics).**

verbal examination (fast increase in the volume of the tumor) or due to local signs (pink colour of the skin, peritumoral oedema). Thermography reveals excessive tumoral thermogenesis, clearly above average, when abnormally warm surfaces exceed the cancer and/or when the gradients are very high. There is often a convergence between the two methods but divergences can exist both ways (Fig. 5 A-B).

The comparison is profitable: the prognosis at 3 years is different with a very high meaning for the convergences (l/1000) and acceptable for the divergences (5/100). The prognosis is best when the two methods agree in eliminating any suspicion of fast growth and four times worse if they agree in confirming a fast growth (Table XI).

Tab. XT. Cure **at 3years / notion of fast growth according** to **clinics and/or thermography.**

		Clinics	
		PEV 0	**PEV +**
Thermography	PEV 0	**84%**	**49%**
	PEV +	29%	**20%**
			508 cases

It is more serious for a breast cancer to be classified into a clinical PEV 0 - thermographic PEV + (3 successes out of 10 at three years) than to be classified into PEV+clinics - PEV 0 thermography (1 success out of 2 at three years).

In estimation **of** *a fast growing breast cancer, thermography is superior to clinical examination.*

6. Past growth type thermography versus N category

Referring to the comparison mentioned in paragraph 4, we see, once more, how much better the thermographic indication of fast growth is than clinical examination. The prognosis of a breast cancer with an axillary iymphadenopathy and without thermographic suspicions of fast growth is near 30% better at 3 years than another one without axillary lymphadenopathy, but having fast growth type thermography findings (Table XII) with a 5/100 meaning.

Having compared the thermographic prognosis to the clinical data, we will later show a comparison with those of local microscopical grading, axillary staging, isotopic research into hormonal receptors and immunological exploration.

Tab. XII. Cure at 3years - N versus pev 0 thermography.

NO	**-PEV + THERMOGRAPHY**	**37%**
Nl	**PEVOTHERMOGRAPHY**	**65%**
264 cases		: p < 0,05

DISCUSSION

Thermography of breast cancer has certainly provided an early prognosis. Prior to other para-clinical and operative explorations, its indication is a bad omen at equivocal palpation. On the other hand, the absence of visible surface symptoms, a false-negative that some people highly criticize in diagnosis, is a favourable prognosis.

Generally speaking, depending on whether it is exceeded or not reached, the + 3 °C temperature difference provides an average 20% success at 3 years. << Negative >> infrared thermography is valuable for any woman having a breast cancer, whatever the stage may be.

It is in prognosis that thermography (real functional test of cine thermography and not a radio-anatomical photograph as mammography) assumes probably its real dimension in mammary cancerology. Here it appears to dominate the clinical data. It shows us how malignant are the << warm microtumours >> and how benign are the << cold macrotumours >>.

Even now, it is right to classify « the thermal stage >> of breast cancers for their prognosis and their therapeutic indications. Thermography contributes objectively to the choice of conservative surgery by selecting the small size breast cancers, for which the thermograms do not indicate a suspicion of fast growth.

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