The significance of an abnormal breast thermogram

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SUMMARY. While thermography will not indicate all cancers and should not be used as an isolated method of screening, it has a very definite place as one of the modalities in a screening programme and when used with a clinical examination, the false positive rates and false negative rates are considerably reduced.

Key words: thermography; abnormal breast; screening program.

One of the condemnations of breast thermography has been the high incidence of abnormal thermograms or « false » positives. This is fairly uniform throughout several published series (Table I), which is surprising when one considers that these series have been compiled with a variety of thermographic systems, used in varying conditions and with different standards.

'Table I. Percentage of abnormal thermograms.

Hitchcock et al. (1)	13.5%
Hoffman (2)	7.4%
Isard & Ostrum (3)	23%
Jones & Draper (4)	15%
Samuel (5)	13.8%
Stark	13.6%
Wallace & Dodd (6)	13.2%

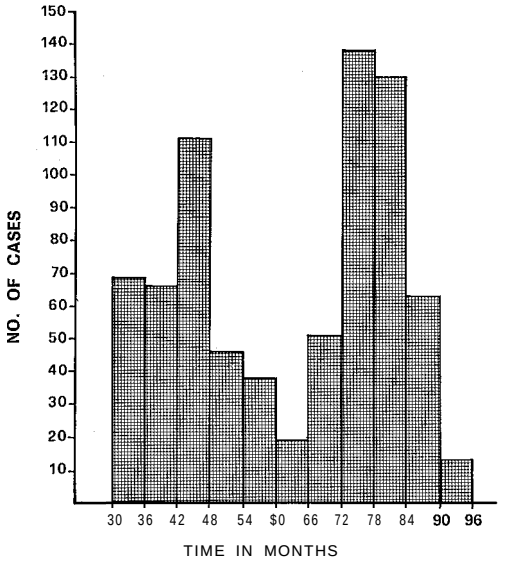
Throughout this work an Aga 665 Thermovision has been used, with in the past two years a standard temperature reference source. There is an **11"** lens used at a focal distance of 6 feet. The equipment is allowed to stabilise for fifteen minutes after switching on. The women cool for fifteen minutes and the screening is done in the same ambient temperature of 18" C plus or minus 1°C. Considerable care is taken to maintain these standards so that conditions for examination are completely reproducible.

The thermographic features considered to be abnormal are:

1) localised area of increased heat emission, a temperature differential of 1.5" C or more is significant;
2) localised increased vascularity with more numerous, tortuous, or dilated vessels;
3) unilateral increased heat of the areolar area. The fat layer, a good insulator, is absent at the areola and also there is a rich anastomosis of the superficial and deep venous systems in the Circle of Haller; and
4) generalised increase in temperature of one breast.

The essential factor is comparison of opposite parts, as well as an overall impression of the heat pattern using one breast as a control for the other.

In screening self-selected well women, 13.6% have been found to have an abnormal thermogram. A group of 744 women with abnormal thermograms have been followed for up to 96 months (Histogram 1). These were from a group of 746 consecutive abnormal thermograms. Two women in the group died of causes other than breast



Histogram 1. Duration of follow-up of women with abnormal thermograms.

cancer during the follow-up period at 36 and 52 months.

Of the 744 women, 57.7% were in the reproductive phase of life, 18.3% menopausal, 23.3 % postmenopausal and 0.6% postmenopausal but on hormone replacement therapy. A woman is considered to be menopausal when her menstrual cycle, previously regular, has become erratic and for two years following her last menstrual period.

The abnormal thermograms are more or less equally divided between right and left breasts - in fact 49 % to 5 1% . Before inclusion in the group, the thermographic screening was repeated at least once to confirm the abnormality - usually within two weeks.

Table **II. Percentage of abnormal thermograms with histologically proven cancer.**

Total abnormal thermograms	744
Carcinoma confirmed	91 (12.2%)
Carcinoma confirmed at later date *	44 (5.9%)
Total cancers	135 (18.1%)

* Three of these cases had become thermographically negative before radiological indications for biopsy.

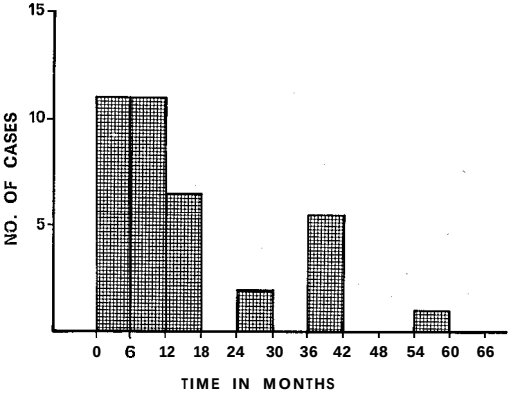
A total of 208 biopsies were performed at the time of the original abnormal thermograms, there also being an abnormal mammogram or clinical findings. The histology is as follows: 91 (12.2%) carcinoma, 56 (7.5%) severe epitheliosis, papillomatosis or very active adenosis, a picture considered by some pathologists to be pre-malignant, 57 (7.6%) benign lesions and 4 (0.5%) in which the histology was of normal tissue, even after considerable searching. This illustrates that thermography plays no part in the differential diagnosis of breast conditions.

A further 44 cancers were histologically proven in breasts with abnormal thermograms during follow-up. The time interval from first abnormal thermogram to radiological and/or clinical indication for biopsy varied from 3 to 58 months as shown in the Histogram 2. Before the biopsy was performed, the thermogram had become negative in 3 cases. These 44 cancers occurred in a group of 536 women with abnormal thermograms, i.e. the original group of 744 less the 208 women who had already had a biopsy. This is a pick-up rate for cancer of 82 per 1,000 which greatly exceeds the pick-up of 7.6 per 1,000 in my self-selected group as a whole, ([7]) and even the rate of 24.5 per 1,000 in my high risk group of well women ([8]). Of the total group of 744 women, the incidence of cancer was 181 per 1,000 (Table II). Although an abnormal thermogram is by no means specific for malignancy, any woman who has had an abnormal thermogram which can be reproduced at a second screening, must be considered to be at high risk of breast cancer.

Other causes of abnormal thermograms are as follows (Table III).

Clinical asymmetry

Clinical asymmetry in breasts such as size, previous biopsies which may result in a cold area over a scar or an area of warmth at the site of a deformity in the shape of a



Histogram 2. Time interval between first abnormal thermogram and clinical and/or radiological indication for biopsy-confirming cancer.

depression, scarring due to burns or obvious superficial veins in one breast were the cause of the abnormal thermogram in 83 women.

In the early stages of this investigation, infra red photography was used to demonstrate the superficial venous pattern. Very quickly I found that any veins shown by infra red photography were clinically visible on examination of the woman and the photography was discontinued.

This group of 83 makes nonsence of the attempt to evaluate breast thermograms in isolation from clinical facts. I firmly believe that a thermogram should be reviewed in the presence of the woman and that a clinical examination should be done immediately after the thermographic examination.

Hormonal effects

Hormonal effects were considered to be the cause of the abnormality in 142 women.

In a small group of 33 women, the thermograms were difficult to interpret if the examination was done late in the menstrual cycle - due to engorgement of veins. When repeated between the 7-10th day of the next cycle, the thermograms were negative, only to become equivocal again later in the cycle. It was noted that although their 7-10th day base line remained constant, the pre-menstrual picture could change from month to month. The contraceptive pill was not found to have any particular influence. The percentage of women taking such a hormone in this group was the same as in the total screened population.

Table III. **Other causes of abnormal thermograms.**

Total number (744 minus 252 biopsies)			492
1) Clinical asymmetry in breasts		83	
Size	8		
Obvious veins in one breast	62		
Previous biopsies	11		
Scarring due to burns	2		
2) Hormonal effect		142	
Cyclical	33		
Menopausal	109		
3) Fibrocystic disease diagnosed clinically and confirmed radiologically (no biopsy)		144	
4) Other conditions		11	
Carcinoma in contralateral breast	6		
Leukaemia	1		
Hyperthyroidism	1		
Haemangioma	2		
T.B. Sinus	1		
5) No cause found	112		

Table IV. **Influence of thermogram on final diagnosis in women submitted to biopsy in absence of clinical indications.**

	Total	*Hist. proven cancer*	*Pre-malignant lesion*	*Benign lesion*	*Negative biopsy*
Thermogram positive Mammogram positive	108	70 (64.8%)	30 (27.8%)	7 (4.9%)	1 (0.5%)
Thermogram negative Mammogram positive	40	16 (40%)	1 **(2.5%)**	21 (52.5%)	2 (5%)

The thermograms of menopausal women can also be difficult. If a base line is established during her reproductive life, it is frequently noted during the menopause that one breast has become less vascular - so causing asymmetry. The difficulty arises when such a women is first examined in the menopausal phase and asymmetry is noted. This must be classed as abnormal and the woman considered to be at risk. In 109 women in my follow-up, such a picture gradually became symmetrically avascular, or of equal vascularity to that of the less vascular breast at the time of initial examination, and so became* negative.

Fibrocystic disease

In 144 women, fibrocystic disease was diagnosed clinically and confirmed radiologically - but not by biopsy.

Other causes

Then there is a small group of miscellaneous conditions.

Six women had clinical cancers in the contra lateral breast. The remaining breast with its abnormal thermogram must be watched carefully. One woman had a very hot asymmetric axillary tail. This was the site of enlarged nodes due to leukaemia - previously undiagnosed. One hyperthyroid woman had an extremely vascular and mottled thermogram, impossible to interpret. After treatment of her thyroid condition this settled to a symmetrical thermogram of moderate vascularity. Haemangiomata were the cause in two women. One woman had a tuberculous sinus tracking upwards behind the breast. It had been discharging for six years when first seen by me. Over the next six years the sinus closed and her thermogram is now negative.

This leaves 112 women in whom no cause has been found for their abnormal thermogram - in my mind, the true false positives, i.e. 2.04% of total screened well women.

I have never recommended biopsy on the grounds of an abnormal thermogram alone - because of the multiplicity of reasons for abnormal thermograms and because there need not necessarily be spatial relationship between a lesion and the thermographic signs ([8]).

It must be accepted that all breast cancers will not give an abnormal thermogram. I have found that 21% of clinical cancers and 18.6% of pre clinical lesions have negative thermograms. For this reason, thermography must not be used in isolation as a method of screening but must be accompanied by a physical examination and preferably also a mammogram.

When used with mammography, thermography greatly increases the accuracy of screening for pre clinical cancer (Table IV). Of 40 women submitted to biopsy on the grounds of an abnormal mammogram alone, 40% were found to have cancer and 2.5% to have a possibly pre malignant lesion, but in 108 women with both an abnormal thermogram and mammogram, 64.8% had histologically proven cancer and 27.8% lesions of a pre malignant nature.

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