

Preliminary results using computerized telediaphanography for investigating breast disease

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An instrument (telediaphanograph) for examination of the female breast has been developed which is optically based and carries no risk to the patient. Malignant lesions, which are strongly light absorbing, can be visualized by dark shadows cast on the superior aspect of the breast. The discriminating ability of telediaphanography for carcinoma has been investigated in relation to 129 patients with suspected breast disease. The sensitivity was found to be 0.94 and the specificity 0.89.

In 1929 Cutler first described transillumination of breast tissues as an aid to diagnosis. However, the advent of X-ray mammography limited interest in this optical method until recently. The small but cumulative radiation dose from repeated exposure to ionizing radiation in long-term screening programmes using mammography has led to concern (Bailar, 1976). Two studies (Breslow et al, 1977; Tabar et al, 1985) have shown a significant reduction in mortality in groups of women screened for breast cancer when compared with controls. This benefit is limited to women aged 50 and over. Strax (1980) has pointed out that an ideal imaging procedure (for screening) would be non-invasive and would avoid the use of X-rays.

A television camera with a near infrared sensitive detector has been adapted to image breast lesions. The major advantages of this method is that instant photographs or digitized printouts can be obtained and X-radiation is not required. With digitization of video signals image processing is feasible. This report documents our initial results with this instrument*.

Patients, methods and materials

A total of 129 patients with known or suspected breast disease were examined by telediaphanography in addition to clinical examination, X-ray mammography and fine-needle aspiration biopsy. An initial group of 49 patients were examined at the Surgical Consultation Clinic, Edinburgh Royal Infirmary (by NB). Subsequently a further group of 80 patients attending the Breast Unit, Longmore Hospital, Edinburgh, were similarly investigated (by PL). The objective of this preliminary study was to ascertain whether palpable carcinoma could be reliably

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Fig.1. An image demonstrating the presence of a 15 mm invasive ductal carcinoma. Picture obtained from the video monitor using Polaroid 667 film. The lesion was clinically impalpable.

distinguished from benign breast lesions by telediaphanography.

Breast tissues transmit a small fraction of the incident light. The intensity that emerges depends on thickness and composition. Maximum transmission is in the near infrared region at 1100 nm. The additional absorption caused by neoplastic lesions is believed to arise mainly from neovascularization at the advancing front of the tumour.

In this study a video camera, sensitive out to about 1000 nm (National Panasonic, extended red newvicon), was used. A torch was used to transilluminate the breast. The investigation was

Table 1. Results of 49 patients with palpable lesions scanned by telediaphanography

Final diagnosis	Number	Diagnosis by telediaphanography			
		Cancer	Suspicious of cancer	Benign	Failed
Carcinoma	18	13	4	1	—
Cysts	7	1	—	6	—
Other benign disease	24	2	—	21	1

carried out in a blacked-out room with the patient seated on a chair capable of rotation and height adjustment. The camera was focused on the breast while illuminated from below. The output from the camera was fed via a frame store and micro-computer to video monitors. The frame freeze facility permits a stable image to be photographed and/or digitized, then printed out.

Abnormal findings may be indicated by a well-defined shadow (Fig. 1) or by large dilated superficial vessels. Sometimes the entire breast may demonstrate increased light absorption (compared with the contralateral control). Dark areas with very sharp outlines can also arise from blood-filled cysts or sites of aspiration and in such cases care should be exercised in interpretation, and telediaphanography should preferably be performed before fine-needle aspiration biopsy. Disc drives connected to the computer permit input of the system software and output of image to disc. A digitizer board in the computer digitizes an image in 8 seconds. The computer allows captioning of images, retrieval of stored images for serial comparison and inexpensive printouts.

Results

The results of the initial study of 49 patients are shown in Table 1. The sensitivity 0.94 (17/18) for carcinoma was sufficiently good for us to examine another group of 80 patients, 56 of whom had breast cancer and 24 had benign disease. Table 2 shows that for demonstrating clinically palpable carcinoma the sensitivity is again 0.94 (53/56). Generally, benign disease does not give rise to specific features in the image and only in 2 out of 24 cases did false-positive indications arise. One patient had an abscess and the other a blood-filled cyst. In Table 3 the same data are divided into two groups: women below age 50 and women aged 50 and over. The size of lesions was estimated at clinical examination using calipers. For women over age 50 all carcinomas larger than 2 cm were correctly reported and 7 out of 8 for those less than 2 cm. In the group below age 50, 14 out of 14 carcinomas of diameter greater than 2 cm were correctly reported. In the same age group for tumours less than 2 cm, 8 out of 10 were correctly reported.

Discussion

The value of screening for breast cancer in women over 50 years of age appears to be established and the important role of mammography in such a process is clear. The benefit from screening women less than 50 years of age is not clearly established. This may possibly be due to the poor definition achieved in young women with dense dysplastic breasts.

From this early pilot study telediaphanography appears to have an equally good discriminating ability in both age groups, although currently it appears less efficient for smaller lesions.

The figure of 89%, the positive rate for breast carcinoma, is encouragingly high for a new technique, where it will be appreciated there is a lengthy learning curve, both for the method of examination and for the interpretation of images. Neither of the two operators (NJB and PL) had any previous

Table 2. Discriminating value of telediaphanography

Histology	Telediaphanography		Total
	Positive	Negative	
Cancer	53	3	56
Benign	2	22	24

Table 3. Discriminating value of telediaphanography in relation to size and age

	< 50 years		> 50 years	
	< 2 cm	> 2 cm	< 2 cm	> 2 cm
Positive	8	14	7	24
Negative	2	0	1	0
Total	10	14	8	24

radiological training and were able to learn the method quickly although interpretation of images has taken somewhat longer to learn.

Telediaphanography avoids the worry of cumulative radiation dosage to women under 50 and is a far cheaper method of imaging the breast than mammography.

While telediaphanography is an experimental technique, we believe these results show that it may prove of value in breast screening and are setting up a study to look at its use in the diagnosis of impalpable breast lesions in comparison with mammography.

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