

Current Perspectives on Indications and Limitations of Mammography

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Women have a 7 percent natural lifetime risk of developing breast cancer, which is the leading cause of death in women aged 40 to 50 years. Most data suggest that the earlier the disease is diagnosed, the better the chance for cure. Women with "minimal breast cancer" have an actuarial 20-year survival rate of 93.2 percent. The majority of these breast cancers are diagnosed by mammography. The radiation doses from this technique have been dramatically decreased over the last ten years to about 0.1 to 0.6 rads per study. The two largest breast cancer screening studies, the Health Insurance Plan of Greater New York and the Breast Cancer Detection Demonstration Project, have shown conclusively that women over 50 years old can benefit from annual mammography and that certain groups can benefit from mammography at close intervals before the age of 50 years. This article describes the development of mammography and outlines current perspectives on its indications and limitations.

Virgil in the *Aeneid* wrote, "Deep in the breast lives the silent wound." Written 2,000 years ago, these words are still cogent for many women concerned about breast cancer. In 1863 Sir James Paget, a prominent British physician, commented on this disease: "I'm not aware of a single clear instance of recovery."¹ Fortunately, his assertion concerning this rather unpredictable neoplasm,

which affects 7 percent of the female population, is no longer applicable.

Undoubtedly, part of the advances in this area result from heightened awareness of the patient about the disease and of the importance of monthly breast self-examination, although there have been no clinical trials specifically testing only this one modality. Physical examination has proven helpful in the diagnosis of breast cancer, especially in the young woman with dense glandular breasts; but again there have been no adequate clinical trials concerning this modality alone. Mammography, however, has been shown to contribute significantly to the diagnosis of breast cancer at an earlier stage, and this article will discuss the technique of film-screen mammography as well as

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present suggestions for how this technique can be used rationally. The limitations of the present state of the art for this technique will also be described.

Historical Development of the Mammographic Technique

Diagnosis of breast disease with x-rays was probably first reported in 1913 by Salomon, a German physician, who described the roentgenographic signs of carcinoma in postsurgical specimens.² The first mammogram of a living breast was published in a book on malignant tumors by Zweifel-Payr in 1927.³ Over the next few years, many publications on mammography appeared, primarily from South America and the United States.

Leborgne,⁴ a South American physician, was the first to classify various calcifications in the breast, and his book *The Breast in Roentgen-diagnosis*, published in 1953, is a classic work. Egan,^{5,6} an American physician still actively practicing mammography at Emory University in Atlanta, was one of the first researchers to modify the roentgen technique to achieve better diagnostic quality, and the early publications of his method are very impressive. In 1965, Ruzicka⁷ published an article on a new technique of mammography called xeroradiography, which displayed a wider range of recording diagnostic information at a lower dose. Consequently, many radiologists began to use this technique. There was still concern, however, about the amount of ionizing radiation.⁸

In 1972 the Dupont film-screen system of mammography was introduced,⁹ which significantly decreased the radiation dose to the breast. More recent modifications of this basic system have reduced x-ray exposures even further.¹⁰ Today the typical exposure to the mid breast of xeromammography is 0.37 rad, and of film-screen is 0.04 rad.¹¹

To put these exposures into perspective (using the best figures available), it is estimated that at a dose of 1 rad to the mid breast, a woman 35 years of age or older may have 13 annual examinations before her natural breast cancer risk of 7 percent is increased to 8 percent.¹² Therefore, with the

xeromammogram at 0.3 rad, a woman may have 39 annual examinations before her risk is increased by 1 percent. Likewise, with the film-screen technique giving 0.04 rad, a woman may have approximately 300 annual mammograms before her risk of developing breast cancer is increased by 1 percent. Although the overall risk of either technique is small, every effort should be made to keep the radiation dose as low as possible.

"Minimal Breast Cancer" and Screening

In 1971 Gallager and Martin¹³ defined "minimal breast cancer" to include lobular carcinoma in situ, intraductal carcinoma in situ, and minimally invasive carcinoma, either lobular or ductal, less than 5 mm in diameter. They estimated that patients with such "minimal" disease would have a ten-year survival rate of over 90 percent. The assumption in this prediction was that the smaller the lesion when detected, the better the outlook for survival.

This concept was tested by Wanebo and others,¹⁴ who found a crude survival rate at five years of 98 percent in 95 minimal breast cancer patients and a survival rate of ten years of 95 percent in 42 patients. The hypothesis was further investigated by Frazier and his colleagues,¹⁵ who found an actuarial 20-year survival rate of 93.2 percent in 176 patients with breast carcinoma that fit into this category of "minimal breast cancer."

Data such as these prompted much discussion about the efficacy of screening asymptomatic women for breast cancer. At that time, the only study attempting to test the efficacy of breast cancer screening had been the Health Insurance Plan of Greater New York Screening Program undertaken in the 1930s. When the results were classified according to age at the time of detection, a 40-percent mortality reduction was seen in women over 50 years old, but there was no reduction for women aged 40 to 50 years of age. There was, however, conclusive evidence that women aged over 50 years benefited from mammography and physical examination.¹⁶ Based on these conclusions, in the mid-1970s the American Cancer Society and the National Cancer Institute organized the Breast Cancer Demonstration Project, which

screened 280,000 women to test the usefulness of mammography and physical examination in the diagnosis of breast cancer. The data are quite remarkable.

First, of 1,597 breast cancers, 711 (or 45 percent) were found by mammography alone. Furthermore, mammography was very effective in finding cancers of the breast in women under 50 years of age. Most important, the cancers diagnosed by this technique alone were significantly smaller (and presumably earlier) than those cancers found by both mammography and physical examination. Of all breast cancers, 38 percent were defined as minimal, of which one half were found by mammography alone. In 55 percent of the minimal cancers, physical examination was negative.¹⁷ With this study, the benefit of mammography in screening for breast cancer had been demonstrated conclusively. Nevertheless, the controversy concerning whether to screen or not to screen and the methods to be employed continues. Some authorities believe more evidence is required before widespread mass screening can be justified on a cost-benefit basis.^{18,19}

In spite of this concern, however, there are certain suggested guidelines for the use of mammography that should be familiar to most family physicians (Table 1).

Indications for Mammography

Today the American Cancer Society recommends that every woman between the ages of 35 and 40 years have a baseline mammogram regardless of the clinical findings or symptoms. This practice is suggested because of the importance of comparison studies, as subtle changes in density on later mammograms may be the only indication of a developing neoplasm.

Mammography is a technique to supplement clinical judgement. It should never be used as a substitute for examination of the breast. Each patient referred for mammography should have a thorough breast examination and history, and these findings should be furnished in detail on the mammogram request. These data, coupled with the patient's age, parity, family history, and previ-

Table 1. Indications for Mammography

History
Significant breast pain
Anxiety about breast cancer
Nipple discharge
Physical examination
Palpable lesion
Secondary signs of malignancy
Fatty or nodular breasts difficult to examine
Prior to mastectomy for known breast cancer
Prior to radiation or chemotherapy
Search for primary lesion in adenocarcinoma nodal metastases
High-risk patient

ous breast surgery, aid the radiologist in interpreting the films.

Pain in the breast, or mastalgia, is the most common mammary complaint.²⁰ Historically this has been thought to be primarily a feature of benign disease,²¹ but recent evidence suggests that mastalgia should warrant serious consideration of cancer as the cause. In a study of the case histories of 240 patients with operable breast cancer over a four-year period, Preece and colleagues²² found that 15 percent of their operable cases had pain as the presenting complaint and that patients with pain only should be carefully scrutinized for malignancy. Consequently, many women presenting with pain will require mammography.

Any woman with a palpable lesion can potentially benefit from mammography. Even if the mass is clinically benign, mammography may show other areas not clinically apparent that may require further surgical investigation. Mammography can also help to localize the lesion for biopsy. Any woman with secondary physical signs of cancer, such as skin thickening or dimpling, nipple retraction, dilated superficial veins, or bloody nipple discharge, may also require a mammogram. The woman with large fatty breasts, which are difficult to examine, or with nodular lumpy breasts often will require mammography to supplement physical examination.

For the woman with known breast cancer,

Table 2. High-Risk Patient

Prior history of breast cancer Family history of breast cancer (especially mother or sister) Nulliparous First pregnancy at older age Prior history of breast disease (eg, fibrocystic disease) Certain medications Prominent ductal pattern on mammography

mammography should be performed preoperatively to detect bilateral breast cancers (which occur in 2 percent of all patients) and to obtain a baseline study of the contralateral breast. The remaining breast should have at least yearly follow-up studies because of the high risk of developing a second primary tumor. In addition, mammography can be used to evaluate an inoperable cancer before radiation or chemotherapy to help assess response to therapy as well as to be used as part of the survey for the primary malignancy in a patient with nodal adenocarcinoma metastases, although the cost-benefit of this situation is questionable.

Two special indications for mammography are the woman who is anxious about breast cancer and the woman who feels a mass that is not clinically apparent. Most authorities would agree that intense anxiety can be allayed by a normal mammogram. The patient who feels a mass not clinically palpable should have a mammogram, for if she performs monthly breast self-evaluation, she knows her breasts and may well perceive subtle changes in density probably with more accuracy than the examining health professional.

Finally, mammography should be used to periodically evaluate any patient in a group at high risk for breast cancer (Table 2). Patients with a prior history of breast disease, especially fibrocystic disease, are statistically at a slightly higher risk of developing breast cancer. Those with a family history of breast cancer in a mother or sister are about three times more likely to develop the disease. For some unknown reason, nulliparous women or women who are older at first pregnancy

are at higher risk of developing the disease.

As noted previously, women with one breast cancer are five to seven times more likely to develop a second cancer in the other breast and women receiving certain medications (especially reserpine and L-dopa) have a higher incidence of breast malignancies. Finally, the women with dense breasts and a prominent ductal pattern by mammography are at higher risk. For more extensive discussion about these high-risk patients, see the articles by Leis²³ and Peck and Lowman.²⁴

Other less conclusive, yet statistically significant, predisposing factors are race (Caucasian), obesity, hypertension, diabetes, hypothyroidism, and cancer of another endocrine organ.

Limitations of Mammography

Mammography is a technique to supplement clinical examination and judgment, and as does any other modality, it has certain limitations (Table 3). The breast tissue of the adolescent or younger woman is often homogeneously dense, with developing ducts and lobules and little intramammary fat, and the small density differential on mammography makes them more difficult to interpret. Physical examination or ultrasound may be more sensitive in the younger breast, especially in the patient less than 35 years of age.

The severely dysplastic breast in any age group may be difficult to evaluate mammographically. Dysplasia or ductal hyperplasia, ectasia, papillomatosis, and cystic formation, in which the differential densities of the breast are obscured by large amounts of collagenous tissue, may hide subtle malignancies. The mass at the extreme periphery of the breast near the chest wall or infraclavicular area is also technically difficult to detect because the mammogram may not include this area on the film. The dyspneic patient who cannot hold her breath or the handicapped or crippled patient who cannot position herself properly will often not receive full benefit from mammography.

Finally, a volatile political and social issue alluded to earlier concerns the potential ionizing effects of radiation from mammography. In 1976 one author reported that there were probably as many cancers induced by diagnostic mammogra-

Table 3. Limitations of Mammography

Severely dysplastic breasts*
Young or adolescent breasts*
Deep mass near chest wall
Mass in infraclavicular region
Dyspneic or crippled patient
*Ultrasound of the breast may be helpful

phy as were cured by early detection, which, unfortunately, became the topic of a rash of newspaper articles and lay publications.⁸ The calculations, however, were based on high-dose techniques, and tenuous relationships were used in the conclusions. As mentioned earlier, with current improved technology, both xerography and plain film-screen mammography have significantly lowered radiation doses. The University of Virginia Medical Center uses a film-screen combination, and the full series of mammography including magnification views delivers a total skin dose comparable to that received by three chest roentgenograms. In essence, this means that there is no demonstrable increased risk in having a mammogram. Furthermore, lead is used beneath the radiographic film-screen, so no radiation is delivered to the gonads. It is reasonable to be concerned about radiation, but with modern technology, the potential benefit of mammography for the patient certainly outweighs the relative risk of the procedure.

Summary

The mammogram is a relatively safe and effective diagnostic tool used for supplementing monthly breast self-examination and physical examination. As does any technique, it has certain pitfalls; yet in most cases the yields far outweigh the risks. The best chance to cure breast cancer is to find the tumor as early as possible. The rational use of

mammography offers the best known opportunity for early detection of breast cancer that is currently available.

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