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Andrew K. Poznanski

Lee Stevenson

D. N. Dickson

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THE RATIONALE OF BREAST RADIOGRAPHY

ANDREW K. POZNANSKI, M. D.*, LEE STEVENSON, M. D.**

AND D. N. DICKSON, M. D.*

RADIOGRAPHY of the breast has developed in recent years into a useful and highly accurate method for the evaluation of breast pathology. Although the method was attempted early in the history of Radiology, it has been only since the work of Leborgne¹ in South America, Gross and Sigris² in Europe, and Gershon-Cohen³ in this country that progress in diagnostic accuracy has occurred. Egan⁴ introduced the use of industrial film and did much to popularize the examination.

The basic usefulness of breast radiography is as an adjunct to the clinical examination of the breasts. A palpable lump has to be removed for pathological section in most cases, as even a small percentage of error in diagnostic accuracy can be significant to the individual patient. There are, however, malignancies of the breasts that are not palpable, but which are visible on the x-ray study. We have had several such experiences in this institution and several reports have appeared in the literature.^{5,6}

Radiographic examination of the breasts is a simple atraumatic procedure. Our method has been recently described by Holohan.⁷ The basic factors are the employment of a low kilovoltage and the use of an industrial film so as to give high detail for identification of minute calcifications and at the same time to maintain a high degree of contrast and latitude. The films obtained are relatively dark-densities up to 5 (on the standard density scale) are not uncommon. This enables us to take advantage of the great latitude of the film, but necessitates viewing with a high intensity illuminator.

The dose to the skin of the breast is of the order of 6 to 8 roentgens. The gonadal dose is negligible because of the low penetration of the radiation used, the good collimation and the use of lead protection under the breast in the superior inferior view.

*Department of Radiology.

**Department of Obstetrics and Gynecology.

Prior to obtaining films the patient is examined by the Radiologist, as well as the clinician requesting the study. This correlation of the physical and radiological findings is useful in evaluation of the films.

In the plain radiograph of the breasts there are basically three types of densities seen: (1) fat density, (2) water density, and (3) calcium. Tumors, cysts, fibrous and glandular tissue all have a density equivalent to that of water and can be differentiated from each other only if surrounded by fat. The presence of calcification is another important factor in the evaluation of breast radiographs.

In the young woman the glandular tissue of the breasts is abundant and there is relatively little fat. As the result very little detail can be perceived and masses, therefore, are very difficult to identify. In fact, tumors without evidence of calcification can easily be missed in this group of patients. As the breasts become more mature, particularly, when the patient passes the menopause, more and more fatty infiltration occurs. The presence of this fat acts to outline neoplasms and at this stage relatively small tumors can be detected on the films.

Benign nodules in the breasts are sharply outlined and well demarcated. Fibroadenomas are sometimes lobulated and have a thin line of fat about them. Discrete cysts are also sharply outlined. The roentgen appearance of the various benign conditions of the breasts is well described by Ingleby and Gershon-Cohen.³ Benign calcifications are also seen within the breasts. These as a rule are dense and discrete and may outline milk ducts or be present within the intima of arteries. Other dense collections of calcifications can be seen in old fibroadenomas or scattered throughout the substance of the breasts.

The main criteria of malignancy of the breasts are: (1) The presence of a mass with spicules radiating from it. This soft tissue is outlined by fat. Sometimes a lobulated mass with a notch is present. (2) Fine punctate calcifications. These are particularly important since they are frequently associated with non-palpable tumors. (3) Malignant lesions usually feel larger than they appear on the radiograph. (4) The presence of skin thickening. This can also be seen in inflammatory lesions.

The radiologic demonstration of small breast cancers which are nonpalpable has been previously described.^{5,6} The following two cases are illustrative examples.

(Mrs. P) A 38 year old female had multiple small nodules in both breasts without evidence of a dominant lump. Radiography of the breast was obtained in a search for suspicious lesions and showed a small area of calcification in the outer portion of one breast which was very suggestive of malignancy. Localization of this nodule was made radiographically and at surgery a very small carcinoma measuring a few millimeters was found which corresponded to the area of calcification.

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(Mrs. R) A 66 year old patient had a whitish discharge from the nipple, but without evidence of palpable lump. Because of the presence of the discharge, an x-ray examination of the breasts was ordered. The films showed a rather extensive area of calcification in the outer portion of the breast. At the time of biopsy the tissue removed felt relatively soft and did not have the appearance of a malignant neoplasm. Microscopic sections, however, showed an intraductal carcinoma.

In both patients the diagnosis was made by the presence of fine calcific flecks. Sometimes similar flecks of calcification are due not to tumor but to ductal hyperplasia. The presence of such calcific flecks, if they can be accurately localized radiographically, should be an indication for biopsy of the area, as differentiation from carcinoma can only be made by the pathologist.

Biopsy of such non-palpable lesions poses some problem to the surgeon in locating the suspicious area. Careful diagrams for localization can be of help. Also of value are radiographs of the specimen to determine whether the suspicious area was removed.

The accuracy of radiographic examination of the breasts is quite high. Between 1959 and March, 1963, 1,529 breasts in 814 patients were examined radiographically at Henry Ford Hospital. Three hundred and eighty-three breasts were operated. The films were interpreted as either benign, malignant, possible malignant, and probably benign. Some examinations were also classified unsatisfactory. Of the total, 123 or approximately 10 percent were included in a doubtful group and called either probably benign or possibly malignant. There was a tendency to err on the side of malignancy as it was considered that a false positive would be of more benefit to the patient than a false negative.

In the operated group 269 were considered radiologically benign. In this group 13 malignancies were found. It was noted that the average age of the patients in this group was less than the average age of the patients with malignancy. The cases missed included several in younger women with relatively dense breasts and little fat to outline the mass lesion and with tumors which did not contain calcification. Several were also confused with an inflammatory process.

Forty-six of the operated cases were called malignant. In this group 39 were actually malignant and 7 were benign.

In the third group called possibly malignant or probably benign, 10 proved to be malignant. Most of these suspicious cases were considered because of the presence of fine flecks of calcifications which were not entirely typical of malignancy.

Of the 315 cases that were called either definitely benign or malignant, the correct diagnosis was made in 295. This represents an accuracy of over 93 percent. The accuracy was somewhat better in the group called benign than the ones called malignant. Other and larger series have had similar results. In some series where the average age of the patient was greater the accuracy was better.

In general the rapidly growing malignant neoplasms particularly those with an inflammatory character are palpable clinically before they are seen on the radiographs. On the other hand some of the very slowly growing malignant tumors can be detected radiologically before they are clinically palpable. Gershon-Cohen⁸ has reported several cases of such non-palpable neoplasms which he followed by x-ray study for several years, since surgeons were reluctant to remove a lesion they could not feel. Only after several years the lesions became palpable. Many of these had fine flecks of calcification characteristics of malignancy.

The use of radiography as a screening procedure is being investigated in many centers. One of the first studies was done by Gershon-Cohen⁵ of Philadelphia who examined 1,312 women at 6 month intervals for 5 years and discovered 23 cancers. In 6 of these the tumor was not palpable even in retrospect. A recent study reported by Witten⁹ studied 5,000 women that did not have palpable lumps within the breast and were 40 years or more of age. In this rather large group of patients only 8 malignant neoplasms were seen. All were in patients over 57 years of age. He concluded that it is doubtful that radiography of the breast can be of much value as a screening procedure in the premenopausal woman, and that even in the postmenopausal group the yield was rather small. In our relatively smaller experiences some of our non-palpable lesions were discovered in relatively younger patients, the youngest being 38 years. In these young patients the only tumors which can be thus found are those with fine flecks of calcification.

In our group of patients 4 cancers were in women under 40. In 3 of these, calcification was present and the correct diagnosis was made. In the fourth there was no evidence of calcification and the mass of the carcinoma could not be separated from the surrounding tissue.

The basic difficulty of using radiography of the breast as a screening procedure is that unlike the Papanicolau smear of the cervix, it can only detect tumors that are already grossly visible, while the pep smear can detect neoplasms before they are invasive. The relatively low yield, particularly in the premenopausal group makes its value as a general screening procedure somewhat doubtful.

The indications for Breast Radiography are:

1. The patient with bilateral cystic disease who has had repeated breast biopsies and who is considered a candidate for another biopsy. In this type of patient radiography can be of value in following the patient or in the case where biopsy is contemplated and in pointing to a suspicious area for biopsy which may not be palpable.
2. The patient with a very fatty breast that is difficult to examine. This type of patient is an ideal candidate for radiography since a lesion in the breast is well seen, as it is well outlined by fat. The lesion seen in the breast which may be difficult to palpate may be clearly seen on the radiographs.

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3. The patient with a vague firmness of the breast in which a definite lump cannot be palpated. In this situation breast radiography can be useful as an adjunct to the clinical examination in evaluating whether or not the lesions should be biopsied.
4. The patient with a breast lump: Prior to biopsy of the lump radiography of the breast can be useful in ruling out non-palpable carcinoma in the opposite breast or in another portion of the breast to be biopsied. It is also useful in this patient to advise the patient as to the probability of the type of operation. When a lump is carcinoma, knowledge of the presence of another tumor in the opposite breast may be important in choosing the surgical approach.
5. A patient with cancerphobia: In this group radiography of the breast can be useful to reassure the patient.
6. In the patient with a familial history of breast cancer: The study may be useful as a screening examination since this group has a high risk.
7. A patient with mastectomy for carcinoma: This patient has a greater chance of developing carcinoma in the opposite breast than the average woman. We are in the process of evaluating the possibility of using radiography as a screening procedure in this group.

SUMMARY

The basic value of breast radiography is that some malignancies of the breasts can be detected radiographically before they are palpable. Most neoplasms that can be identified radiographically that are not clinically palpable are the intraductal type identified on x-rays by fine punctate calcifications. Another group of non-palpable tumors are the small carcinomas very deep in the substance of the breast. Breast radiography is a simple, accurate, non-traumatic procedure which can be useful as an adjunct to the clinical examination, in diagnosis and evaluation of the proper mode of therapy.

X-RAY REPORT	TOTALS	OPERATED	BENIGN	MALIGNANT
Benign	1330	269	256	13
Malignant	56	46	7	39
Probably Benign	58	25	21	4
Possibly Malignant	65	37	31	6
Unsatisfactory	20	6		
	<u>1529</u>	<u>383</u>		

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