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Correlation of Posterior Echo Patterns and Histopathologic Features in Invasive Ductal Carcinoma of Breast

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Introduction

Sonography deserves a specific role in breast imaging as a complement to mammography and physical examination for improved diagnostic accuracy. On sonogram, the fat in normal parenchyma is hypoechoic, fibrous tissue is hyperechoic, and glandular tissue is intermediate in echogenicity. However, in the breast cancer, the architecture and consistency of the tumor are distorted, causing various echo patterns. The ultrasonographic appearance of malignant lesions is said to be a solid mass with irregular margins, inhomogeneous internal echoes, alteration in the breast architecture, and strong posterior shadowing (Haper et al., 1983; Cole et al., 1983). In the evaluation of solid breast masses by sonography, many sonographers regard posterior shadowings are evidence of a malignant lesion(Cole et al., 1982). Its frequency on demonstration of breast masses were variable range from 100% in some studies to 35% in our experience(Kobayshi et al., 1979; Fields et al., 1980; Egan et al., 1984). But some reports were described on opposed opinion that posterior shadowing is not a criterion of malignancy (Rubin et al., 1985; McSweeney et al., 1985; Bassett et al., 1987; Bassett et al., 1991; Venta et al., 1994).

To interpret the significance of posterior shadowing in the demonstration of solid breast masses, we retrospectively evaluate the sonographic appearance of breast carcinoma confirmed as invasive ductal carcinoma by pathologic examination, to determine the relation between the posterior echo pattern and histopathologic tissue composition.

Materials and Methods

From January 1996 to May 1997, we retrospectively reviewed the sonographic findings

of 26 breast masses which had histologically proven invasive ductal carcinoma. The sonograms were obtained with the Ultramark 9 HDI (ATL, Bothell, Washington, USA), using a 5.0MHz linear transducer.

We classified the sonographic findings into two groups, enhancing or shadowing by the pattern of posterior echoes. We excluded other sonographic findings such as mass margin, alteration of parenchymal architecture, internal echo patterns, and peritumor echo patterns.

We evaluated these two groups of masses on the basis of histologic character that included the volume of connective tissue, the degree of elastosis, grossly defined margin, internal necrosis and its amounts, peritumor inflammation, histologic differentiation, and mitotic index. Depending on the ratio of connective tissue volume to tumor cell volume, we divided the lesion into small, similar, large, and gave a grade of one, two, or three. The degree of elastosis was divided into four grades none, mild, moderate, and severe. The gross margin was divided into well and poor circumscribed. The amount of necrotic tissue was scored from negative to three plus. The inflammatory reaction of the lesion was graded into one to three plus. The histologic differentiation was according to normal cell arrangement ratio, such as more than 75%, 10% - 75%, less than 10%, and scored from one to three respectively. The count of mitotic index was determined as less than 10, 10 - 20, and more than 20 mitoses per ten high power fields. The data of the two groups were analyzed statistically by the Chi square test.

Table 1. Attenuation characteristics of invasive ductal carcinoma: correlation with histology

Histologic Characteristics	Enhancement group n=17	Shadowing group n=9	Total n=26
Connective tissue:[a]			
Grade 1	7	0	7
Grade 2	6	2	8
Grade 3	4	7	11
Elastosis:[b]			
None	12	0	12
Mild	4	2	6
Moderate	0	2	2
Severe	1	5	6
Circumscription:			
Well	12	1	13
Poor	5	8	13
Necrosis:			
Negative	9	5	14
(+)	3	4	7
(++) to (+++)	5	0	5
Inflammation:			
(+)	10	8	18
(++)	6	1	7
(+++)	1	0	1
Histologic differentiation:			
Score 1	0	1	1
Score 2	4	1	5
Score 3	13	7	20
Mitotic index:			
Score 1	9	8	17
Score 2	1	0	1
Score 3	7	1	8

[a] $p < 0.05$
[b] $p < 0.01$

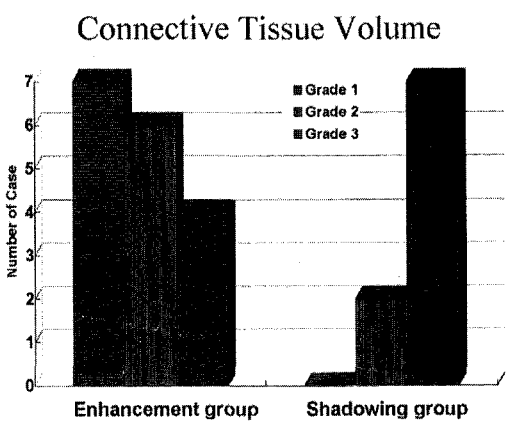


Fig. 1. In the connective tissue volume, shadowing group showed higher graded graph than enhancement group, which implied the lesion with shadowing contained more abundant connective tissue.

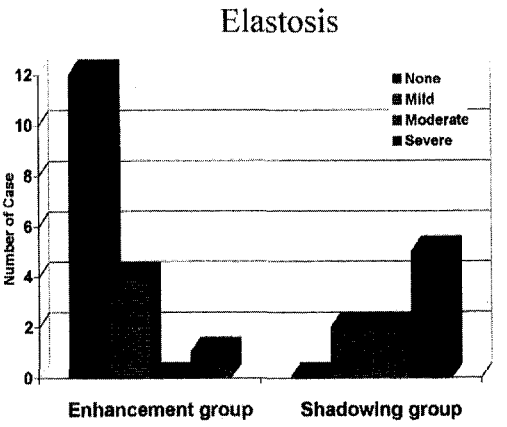
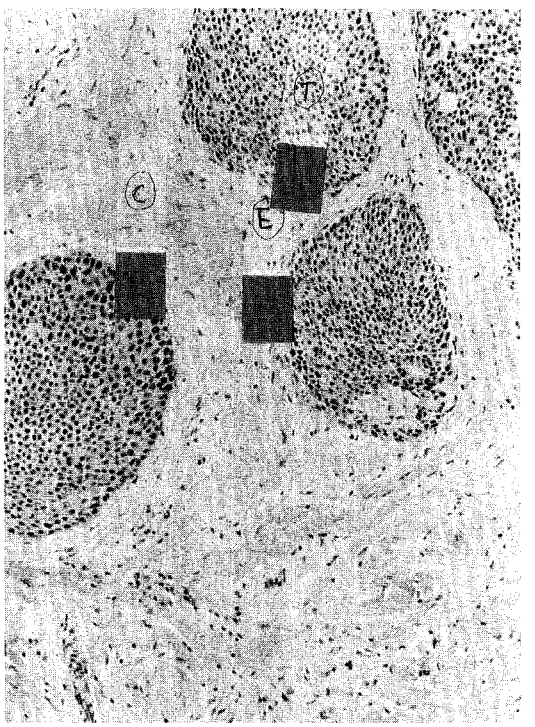


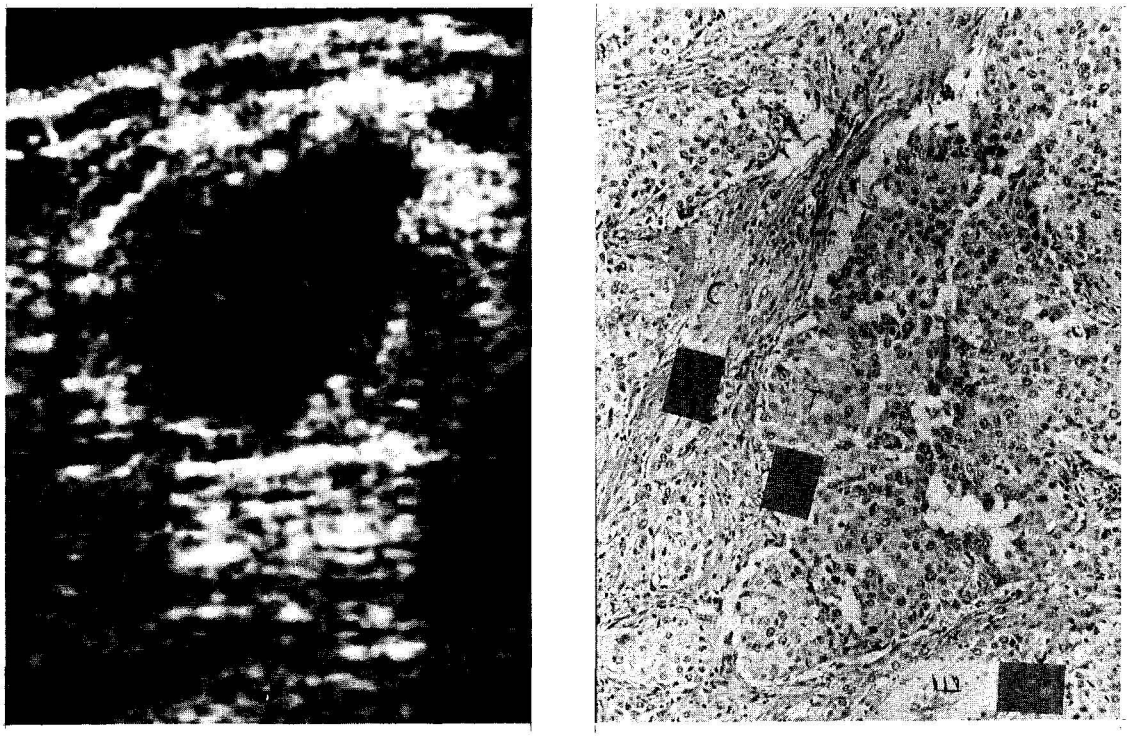
Fig. 2. In the elastosis, shadowing group is represented mostly moderated or severe grade of elastosis, whereas enhancement group is none or mild degree.

(A)



(B)

Fig. 3. 51-year-old woman with invasive ductal carcinoma in left breast.
A: Ultrasonogram shows 1.2 cm ill defined hypoechoic mass with posterior sonic shadowing.
B: On microphotography (H and E stain, X 100), tumor cell nests (T) are separated by abundant collagen fibrous tissue (C). Extensive elastosis (E) is also found.



(A) (B)

Fig. 4. 47-year-old woman with invasive ductal carcinoma in left breast.
A: Ultrasonogram shows an irregularly marginated hypoechoic lobulating mass with partial echogenic rim and posterior sonic enhancement.
B: On microphotography (H and E stain, X 100), most of the area is occupied by tumor cell nests (T) with scanty amount of fibrous strands (C). Focal elastosis (E) is found.

Results

Nine cases(35%) showed a shadowing pattern, and 17 cases(65%) showed an enhancing pattern. Histopathologic findings of these two groups are illustrated in Table 1. In the volume of connective tissue (Fig. 1), the shadowing group represented mostly grade two or three, whereas the enhancing group represented mostly grade one or two, which implied that lesions with shadowing contained more abundant connective tissue volume than the enhancing group(p=0.0017). The degree of elastosis (Fig. 2), the shadowing group (Fig. 3) represented moderated or severe degree, whereas the enhancing group represented mostly grade none or a mild (Fig. 4). Other histologic findings, including intratumor necrosis, histologic differentiation, and mitotic index were not notably different in the two groups.

Discussion

Many studies have been carried out to differentiate malignant from benign breast masses by sonography. The collective results including irregular margin, inhomogeneous internal echoes, posterior shadowing and peritumor changes were suggested malignancy (Cole et al., 1983).

Harper et al.(1983) reported that posterior shadowing was observed in 97% of 43 cases of confirmed carcinoma of the breast. Cole et al. (1982) also report similar result that posterior shadowing was observed with high frequency (94%) in an analysis of 71 confirmed breast carcinomas.

The collective results of these reports, the frequency of posterior shadowing by breast sonogram was over 90%, and later many sonographer think so posterior shadowing is as a criterion of breast malignancy.

On the other hand, Bassett et al. (1987) observed posterior shadowing in only four cases of in evaluation of 30 invasive ductal carcinoma. These authors later mentioned in another article that diagnosis of breast carcinoma by sonography is further complicated by the fact that some carcinomas, probably fewer than 10% to 15%, have sonographic features similar to those usually associated with benign solid masses such as fibroadenomas(1991).

Rubin et al. (1980) described that the phenomenon of attenuation behind solid masses was demonstrated in only three of the seven proven cancers and was also seen in one proven fibroadenoma and in one fibrocystic disease. The authors describe that one could not differentiate benign from malignant solid mass on the basis of posterior shadowing. Venta et al.(1991) also emphasized that posterior shadowing is not a valuable criterion for differentiation benign from malignant solid masses. Indeed many studies has been reported that benign solid breast masses show posterior shadowing by sonography, such as fibroadenoma(Rubin et al., 1985; Bassett et al., 1991; Fornage et al., 1989; Kelly et al., 1979). Summarizing the above mentioned reports, posterior shadowing reveled variable frequency in demonstration of breast masses, and it is difficult to accept the phenomenon of posterior shadowing on sonogram as a specific criterion for malignancy.

Our study also show low frequency as 35% in evaluation of posterior shadowing in invasive ductal carcinoma by sonogram. Our goal is to know what character of pathologic breast tissue influence the posterior shadowing in breast sonogram. We evaluate 26 confirmed as invasive ductal carcinoma and compare pathologic tissue character and the degree of sonographic beam attenuation. The result was that posterior beam attenuation was influenced by the amount of connective tissue volume and the degree elastosis of the breast carcinoma. Our results agreed with McSweeney et al.(1985) those mentioned that posterior shadowing is also related to desmoplasia, and also with Calderon et al.(1976) who described the relation between connective tissue volume and beam attenuation in extracorporeal breast tissue.

Conclusion by the basis of our study, the posterior shadowing is largely influenced by the two pathologic tissue character, one is the volume of connective tissue volume and the other is the degree of elastosis. And we could not considered posterior shadowing as a specific criterion for malignancy.

Our study has several limitations in evaluating the sonographic findings of breast masses(McSweeney et al., 1985). Posterior shadowing is influenced by the histologic cell type, the method of examination, and kind of transducer. Also histologic change is influenced by the patient's age, and the location of tumor. In addition, there is some subjectivity in interpretation of sonographic finding.

Summary

Traditionally posterior shadowing is regarded as a malignant criterion in the evaluation of breast mass by sonogram. But on the basis of our clinical experiences of breast sonogram, we often met a breast mass without posterior shadowing later confirmed breast carcinoma through pathologic examination. For the focus of what character of pathologic breast tissue influence the posterior shadowing in breast sonogram, we analyzed retrospectively the sonographic findings of 26 histologically proven invasive ductal carcinomas. Even though invasive ductal carcinoma is the only one of the many breast cancers, it represents the greater part of breast malignancy. The posterior echo pattern was compared with various histologic characteristics, such as the amount of connective tissue, degree of elastosis, necrosis, gross circumscription, accompanying inflammation, histologic differentiation, and mitotic index. Nine breast masses (35%) demonstrated posterior echo shadowing, while 17 masses (65%) showed enhancement. The tumors with posterior echo shadowing had more abundant connective tissue, increased elastosis, and poorly demarcated margin ($p<0.05$). Other histologic characteristics are not influence in posterior shadowing with significant in stastically. On the basis of our study, the phenomenon of posterior shadowing by sonogram is difficult to accept as a specific criterion for malignancy. It is only a phenomenon influenced by the amount of connective tissue volume and elastosis.

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- 초 록 -

유방 침윤성 관상피암의 초음파 소견 중 후방 에코 양상과 조직소견의 상호 비교

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통상 유방 초음파 검사에서 후방 에코 감소는 악성종괴를 나타내는 기준으로 여겨져왔다. 그러나 저자들의 임상경험에서 후방 에코 감소를 보이지 않던 종괴가 술후 조직검사에서 악성 종양으로 판명되는 경우가 적지 않았다.

하여 저자들은 유방의 조직학적 구성 요소중 어떤 것이 후방 에코 감소에 영향을 미치는가에 대해 침윤성 관상피암 (유방암중의 한 종류에 국한되지만 유방암의 대부분을 차지한다.) 으로 판정된 26례를 대상으로 후향적으로 분석해보았다.

후방 에코 양상을 다양한 조직학적 소견, 예를 들면, 결체조직의 양, 탄력섬유증 (elastosis)의 정도, 조직괴사의 정도, 육안적 경계, 종괴내 염증반응, 조직학적 분화도, 유분열지수 (mitotic index)등과 비교 분석하였다.

아홉예 (35%)가 후방 에코 감소를 보였고, 17례 (65%)가 후방 에코 증가를 보였다. 후방 에코 감소를 보인 종괴들은 많은 결체조직과 고탄력섬유증, 그리고 불분명한 경계를 보였다($p<0.05$). 하지만 나머지 조직학적 요소들은 후방 에코 감소에 영향을 미치지 않았다.

저자들의 연구에 의하면 유방 초음파 검사에서 종괴내 결체조직의 양과 탄력섬유증의 정도에 의해 후방 에코 증감을 보여 단순히 후방 에코 감소 그 자체가 악성을 시사하는 소견으로 받아들이기 어려울 것으로 생각한다.

핵심용어: 초음파, 후방 에코