

Relationship of Preoperative Breast Magnetic Resonance Imaging to Early Outcome after Breast-Conserving Surgery with Radiation for Women with Early-Stage Invasive Breast Carcinoma or Ductal Carcinoma in Situ

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Purpose: The purpose of the present study was to analyze the influence of preoperative MRI in newly diagnosed breast cancer on early outcome after BCS with radiation therapy (RT).

Materials and Methods: A total of 319 women with early breast cancer underwent BCS including RT at our institution between January 2007 and August 2008. Of 319 women, 192 (60.2%) women underwent breast MRI, while 127 (39.8%) women did not. We compared histopathologic characteristics and outcomes according to MRI use between the two groups. The mean follow-up time for all patients was 35.0 months.

Results: Seven of 192 (3.6%) patients who underwent breast MRI showed recurrence at any site, while 12 of 127 (9.4%) patients who did not undergo breast MRI showed recurrence. The IBTR rate was higher, with statistical significance, in the no-MRI group ($p = 0.039$). However, difference in total recurrence rates failed to reach statistical significance ($p = 0.051$). Multivariate study after adjustment showed no difference in recurrence rates between the two groups (Hazard ratio 2.6, $p = 0.16$).

Conclusion: Although use of MRI for preoperative staging in patients with BCS and RT did not result in improvement of a patient's general early outcome, IBTR showed a statistically significant decrease.

Index words: MRI; Breast; Breast cancer; Staging; Recurrence

Introduction

Since randomized trials comparing breast-conserving

surgery (BCS) with mastectomy have demonstrated equivalent long-term survival, BCS including radiation therapy (RT) is well established as an alternative to mastectomy for treatment of early-stage breast carcinoma (1, 2). For the patient undergoing evaluation for BCS, the standard primary imaging modality for evaluation of the breast is mammography, with correlation of ultrasound, as indicated. However, use of magnetic reso-

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nance imaging (MRI) of the breast for evaluation of potential candidates for BCS has increased (3, 4).

The benefits of breast MRI evaluation for invasive carcinoma in the preoperative setting have been well described. As well as its high sensitivity, approaching 100% for visualization of primary invasive cancers (5), for the purpose of preoperative evaluation, MRI also detects anywhere between 16% and 37% of mammographically and clinically occult multifocal or multicentric breast cancers (6). For the patient undergoing BCS, it remains uncertain whether MRI identification of these small multifocal, occult, and/or additional foci of disease leads to improved local control, and, consequently, general outcome. Robust evidence from randomized controlled trials and case series has demonstrate relatively low rates of ipsilateral breast tumor recurrence (IBTR) following BCS and RT (1, 7); therefore, it is possible to speculate that the majority of these microscopic foci on MRI that were not excised at the time of BCS may be successfully treated with RT. Thus, it is reasonable to ask whether preoperative MRI studies contribute to improvement of local control outcomes and whether the benefits of MRI outweigh the associated costs and fear of overtreatment.

Currently, data demonstrating the relationship between use of preoperative MRI and local recurrence outcomes after BCS come from three retrospective studies (8–10). However, failure to make appropriate adjustments for important clinical factors, such as adjuvant therapies and tumor characteristics, or a relatively long MRI-performed period limits interpretation of their observed benefits and reported local recurrence outcomes according to MRI use.

The purpose of the present study was to analyze the influence of preoperative MRI in newly diagnosed breast cancer on early outcome after BCS with RT.

Materials and Methods

Patients

The study protocol was approved by our institutional review board. Patient informed consent was waived.

The study population consisted of a total of 319 women who underwent BCS including breast irradiation at our institution between January 2007 and

August 2008. The study population was limited to patients who met the following criteria: American Joint Commission on Cancer (AJCC) clinical and pathologic stage 0, I, or II disease (TisN0M0, T1N0M0, T2N0M0, T1N1M0, or T2N1M0) using the fifth edition of the AJCC staging manual (11); unilateral disease at presentation, invasive breast carcinoma or ductal carcinoma in situ (DCIS) of the breast; definitive locoregional management using BCS followed by RT; if performed, breast MRI study performed before RT; and no prior or concurred malignancy (breast or other sites).

Preoperative Breast MR imaging

Of the 319 women enrolled, 192 women (60.2%) had undergone a preoperative breast MRI, and 127 women (39.8%) had not undergone a breast MRI. All MRI examinations were performed for preoperative staging before surgery. Breast MR was performed using a 3.0-T MR system (Achieva, Philips Medical Systems, Best, The Netherlands). All patients gave signed informed consent before imaging. Patients were placed in the prone position on a dedicated bilateral breast coil. The MR protocol included bilateral unenhanced and contrast-enhanced, transverse T1-weighted, 3D, fast spoiled gradient-recalled (FSPGR) sequences: TR/TE, 4.4/1.7; flip angle, 10°; and matrix, 500 × 500. The field of view was 32 × 32 cm over the study, and slices were ≤3 mm in thickness. T1 3D FSPGR images were acquired before and immediately after bolus injection of 0.1 mmol/kg body weight of gadolinium contrast agent (Omniscan, GE Healthcare) using an automatic injector. The injection was followed by a saline flush. Immediate contrast-enhanced images were acquired at 1.5 min, and delayed contrast-enhanced images were acquired at 3, 4.5, and 7 min after contrast injection. After the dynamic series, image subtraction was performed, and enhancing lesions were identified on the subtracted images. To verify the presence of a contrast-enhancing lesion and to exclude subtraction artifacts, we re-identified the lesions on the non-subtracted images. Maximum-intensity projection images were created from early and late subtraction images, which resulted in creation of projection images that were analogous to mammograms.

Clinical and radiologic findings were available to the

radiologist at the time of breast MRI interpretation. All MRI examinations were interpreted by one of four experienced breast radiologists with more than 7 years of experience. Whenever breast MRI depicted suspicious lesions that were not visible or could not be reliably reproduced using other imaging modalities (mammography, ultrasound), open biopsies were performed after US-guided skin marking on suspected areas corresponding with abnormal MRI findings at the same time with BCS.

Surgical treatment

All patients enrolled in this study underwent BCS. Definitive locoregional treatment for all women consisted of BCS followed by RT. Surgical treatment included complete gross excision of the primary tumor. If surgical margins were positive or close (less than 2 mm), re-excision was performed, unless the patient was very old or in poor general condition.

Sentinel lymph node biopsy was performed in most cases of invasive malignant tumors. After that, depending on the histopathological result, axillary lymphadenectomy (level 1 and 2) was then performed simultaneously or as a second intervention. Histopathologic findings in BCS specimens were used as the gold standard. We analyzed the following parameters according to MRI use: tumor size, nodal status, histologic grade, histologic type, presence of extensive intraductal component (EIC), hormone receptors, human epidermal growth factor receptor 2 (HER2) onco-gene expression, and surgeon who performed BCS.

Radiotherapy

Postoperatively, the ipsilateral breast was treated with a total dose of 50–50.4 Gy at 1.8–2.0 Gy per fraction. Radiation was delivered through opposed tangential portals to the entire breast. A 10–16 Gy reduced-field electron beam boost was delivered to the tumor bed in most cases. The boost target area was determined by surgical scar or surgical clips in the tumor bed, with margins measuring 1.5–2 cm. Axillary and supraclavicular areas were included in the irradiation field when four or more positive nodes were found.

Adjuvant hormonal/chemotherapy

Irrespective of nodal status, adjuvant chemotherapy was universally administered to most of the patients with invasive breast cancer. Those excluded were patients in the minimal risk group [tumor size < 1 cm, histologic grade I, estrogen receptor (ER) positive, and postmenopausal] or patients who refused further treatment. Most commonly, patients received cyclophosphamide, methotrexate, and fluorouracil (CMF) concurrently with radiation. Anthracycline or taxane-based chemotherapy was considered for patients with four or more positive nodes or HER2/neu overexpressing tumors. When anthracycline or taxane-based chemotherapy was given, radiation was delivered after completion of chemotherapy. If the tumor was proven to be ER-positive, anastrozole was administered to postmenopausal patients. Otherwise, adjuvant tamoxifen was typically indicated. In selected cases, following 5 years of tamoxifen, letrozole was then prescribed if women were postmenopausal.

Follow-up

Patients were followed at least every 6 months by their surgeon and radiation oncologist during the first 5 post-treatment years and annually thereafter. Baseline mammography and/or sonography were performed at 6 months after completion of radiotherapy and annually thereafter. Fine-needle aspiration or core-needle biopsy was performed for further study of suspicious lesions. Diagnostic studies for determination of systemic relapse were performed every 6 months for the first 5 years and annually thereafter.

The mean follow-up time for all patients was 35.0 months (range, 17 to 48 months). The mean follow-up time for the 192 patients with a breast MRI study was 34.3 months (range, 13 to 47 months). The mean follow-up time for the 127 patients without a breast MRI study was 36.0 months (range, 17 to 48 months).

Ipsilateral Breast Tumor Recurrence Definition

IBTR was defined as recurrent invasive and/or in situ disease reappearing in breast parenchyma following initial lumpectomy for invasive carcinoma or DCIS. IBTR was confirmed by histopathologic evaluation of tumors. A regional recurrence was defined as reappearance of

disease that occurred within ipsilateral axillary, supraclavicular, infraclavicular, and/or internal mammary nodal region (s). A distant recurrence was defined as reappearance of disease at any site, except for ipsilateral/contralateral breast or regional areas. Time to any recurrence was calculated from the date of the first lumpectomy procedure to the date of pathologic confirmation.

Statistical analysis

Fisher's exact test was used for comparison of clinical and pathological characteristics between the two groups according to preoperative MRI use.

IBTR rates were calculated by dividing the total number of IBTR by the total number of patients in each group. Fisher's exact test was used for assessment of the

Table 1. Patient, Tumor, and Treatment Characteristics according to use of Breast MRI study

		Breast MRI		P
	Characteristics	Yes (n=192)	No (n=127)	
Age at diagnosis	20-29	3	3	0.505
	30-39	22	10	
	40-49	90	53	
	50-59	51	41	
	60-69	23	15	
	70-79	3	5	
Pathologic T stage	Tis	29	30	0.130
	T1	122	76	
	T2	41	21	
Pathologic N stage	N0	156	111	0.165
	N1	36	16	
Estrogen receptor status	Positive	137	91	0.133
	Negative	50	27	
	Not done/unknown	5	9	
Progesterone receptor status	Positive	112	68	0.164
	Negative	75	50	
	Not done/unknown	5	9	
HER2 status	Positive	32	25	0.107
	Negative	155	93	
	Not done/unknown	5	9	
EIC*	Positive	38	21	0.979
	Negative	108	66	
	Not done/unknown	17	10	
Histologic grade*	1	39	27	0.740
	2	60	31	
	3	45	25	
	Not done/unknown	19	14	
Adjuvant chemotherapy	Yes	133	84	0.624
	No	59	43	
Adjuvant endocrine therapy	Yes	145	93	0.694
	No	47	34	
Surgeon	NWC	157	30	< 0.001
	PNS	23	54	
	MNM	2	33	
	LJI	5	9	
	KHA	5	1	

*limited to patients with invasive carcinoma (n=260).

difference between the MRI and no-MRI groups with respect to IBTR rate. A multivariate Cox proportional hazards (PH) model was used for assessment of the difference between MRI and no-MRI groups after adjusting for treatment and tumor characteristics (12). Confidence intervals (CIs) using the Cox proportional hazards model with covariates were calculated using the method suggested by Link (13).

Statistical software (SPSS, version 15.0; SPSS, Chicago, IL, USA) was used in performance of all analyses, with $p < 0.05$ to indicate a significant difference.

Results

Patient, tumor, and treatment characteristics according to the use of breast MRI are summarized in Table 1. The mean age for patients who underwent breast MRI was 48.5 years (range, 23–79 years), and the mean age for patients who did not undergo breast MRI was 49.8 years (range, 24–74 years). The mean invasive tumor size for patients who underwent breast MRI was 15.8 mm (range, 2–45 mm). That for patients who did not undergo breast MRI was 14.8 mm (range, 3–48 mm). No statistically significant difference was observed between pathologic or treatment characteristics between the two groups according to MRI use, except for surgeon.

The site(s) of first recurrence after treatment are detailed in Table 2. Seven of 192 (3.6%) patients who underwent breast MRI showed recurrence at any site while 12 of 127 (9.4%) patients who did not undergo breast MRI showed recurrence. Only one patient who underwent breast MRI developed contralateral breast cancer. IBTR was higher in patients without a breast MRI, while distant or regional recurrences were similar in the two

groups.

Outcomes according to use of preoperative MRI are shown in Table 3. IBTR rate showed a statistically significant difference between the two groups according to MRI use ($p = 0.039$). However, total recurrence rates failed to reach a statistically significant difference between the two groups ($p = 0.051$). In both groups, mean time to recurrence was 22.5 months (range, 9–40 months). When the recurrence rates were adjusted for surgeon factor on multivariate study, there continued to be no difference in recurrence outcomes observed between the two groups (Hazard ratio 2.6; Cox PH model, $p = 0.16$).

Discussion

Breast MRI is widely used and its advantages are well-known. In particular, it has a high sensitivity for detection of disease in the breast, and for the patient with a known breast carcinoma, MRI is superior to mammography in delineating the extent of tumor in the breast (3, 14–16). The value of MRI may be particularly high in younger patients or patients with dense breast tissue (14, 15, 17). A number of studies have demonstrated an improved yield for screening with breast MRI, compared with mammography alone, in high-risk patient populations (18–20).

For patients considering BCS, in addition to these merits, MRI could influence surgical planning, and, consequently, could affect patients' outcome and quality of life. Identification of clinically unsuspected foci of disease with improved breast imaging using breast MRI could potentially lead to better local control if such foci of disease were treated, for example, with wider surgical excision or mastectomy. In cases of preoperative

Table 2. Site of Recurrence

Site	Breast MRI	
	Yes	No
Ipsilateral breast	0 (0.0%)	5 (3.9%)
Regional	2 (1.0%)	1 (0.8%)
Distant	4 (2.1%)	3 (2.4%)
Regional & distant	0 (0.0%)	3 (2.4%)
Contralateral	1 (0.5%)	0 (0.0%)
None	185 (96.4%)	115 (90.6%)
Total	192	127

Table 3. Outcome according to use of Preoperative MRI

Outcome	Breast MRI		
	Yes	No	P
IBTR rate (%)	0%	3.9%	0.039
Contralateral cancer rate (%)	0.5%	0%	
Total Recurrence rate (%)	3.6%	9.4%	0.051
Time to recurrence (months)	21.3	23.3	—
Recurrence hazard ratio (95% CI)	—	2.55 (0.79–8.19)	0.116

* IBTR: Ipsilateral Breast Tumor Recurrence

staging, a number of potential advantages of adding breast MRI to conventional mammography have been described. Improved preoperative evaluation of the extent of disease should lead to improved tailoring of the surgical procedure (4, 15). Other potential advantages include improved detection of contralateral breast cancers, improved imaging for invasive lobular carcinoma, and improved imaging for patients with dense breast tissue (3, 14, 15, 17, 21).

The opposite side also exists. A number of arguments have been advanced against routine use of breast MRI. Specificity for breast MRI is well known to be suboptimal. Breast MRI often identifies findings that prove benign on biopsy, and might increase the number of biopsy procedures and possibly unnecessary mastectomy. When used routinely, breast MRI adds significantly to cost, especially when additional procedures or equipment are required for evaluation of MRI findings. Furthermore, it is possible that even if undetected multifocal/multicentric/contralateral lesions exist, subsequent RT or systemic therapy could result in eradication of these foci.

Many studies have focused on IBTR after BCS. Since publication of the initial trials that established the suitability of BCS as a breast cancer treatment modality, rates of local recurrence have shown a steady decline. Pass et al. (22) examined the effect of changes in the processes of care between 1981 and 1996 on local recurrence rates in a group of 607 patients treated at a single institution. Between 1981 and 1985, the 5-year rate of IBTR was 8%, and decreased to 1% between 1991 and 1996. In a similar study, Ernst et al. (23) observed a decrease in 8-year rates of locoregional recurrence after BCS from 20.1% between 1985 and 1992, to 5.4% from 1993 to 1999. In contrast, rates of locoregional recurrence after mastectomy did not change between the two time periods. Over time, with improved pathological assessment and imaging techniques, emphasis on achievement of negative margins, and frequent use of effective systemic therapies, these rates have shown a progressive decline. Data from more recent series have documented 10-year actuarial local recurrence, ranging narrowly from 2% to 7% (24).

However, until now, there remains limited retrospective data defining the clinical significance of MRI on IB-

TR outcomes after BCS with RT. Three studies have retrospectively examined the effect of preoperative breast MRI on IBTR. Fischer et al. (8) conducted a retrospective comparison of 121 patients who underwent preoperative MRI with 225 who did not. After a mean follow-up period of approximately 40 months, IBTR occurred in 1.2% of the MRI group and 6.8% of the no-MRI group ($p < .001$). However, although patients in the MRI group were more likely to have T1 tumors (64% vs. 48%), more likely to be node negative (61% vs. 54%), and less likely to have high-grade lesions (13% vs. 28%), no adjustments for differences in tumor characteristics between the groups were made. In addition, despite the more favorable profile of the MRI patients, chemotherapy was administered to 95% of patients in this group with indications for treatment, compared with 82% in the no-MRI group, and no adjustment was made for this difference. The lack of adjustment for major differences in tumor and treatment variables, which affect the incidence of IBTR, prevents reliable conclusions from being drawn from this study. As a second study, Solin et al. (9) also examined the effect of MRI on IBTR in 215 patients who underwent examination, and 541 who did not. Appropriate statistical adjustments were made for differences between patient groups. At 8 years, the rate of IBTR in the MRI group was 3%; it was 4% in the non-MRI group. More recently, Hwang et al. (10) also examined the effect of MRI on IBTR with adjustment for differences between groups. After a median follow-up period of 54 months, the 8-year actuarial rates of local recurrence were 1.8% in the MRI group and 2.5% in the no-MRI group: the difference was not statistically significant ($p = 0.67$).

However, remarkably, in our study, although we performed appropriate statistical adjustment, the opposite result was observed. The rate of IBTR in the MRI group was 0%; it was 3.9% in the no-MRI group ($p = 0.039$). We suspect that the reason for the statistically significant difference of IBTR rate between the two groups in our study, compared with the previous study, can be attributed to development of technology of MRI machines and experience with interpretation of MRI of the breast, which can result in detection of more malignancy. We can speculate that one additional possible cause is the short enrolled-period of our study. In another

study by Solin (9) and Fisher (8), MRI examinations were performed over a long period (nearly 10 years), which can affect results. This means that surgeons could have gained more experience, or possibly even changed; in addition, development of systemic chemotherapy/endocrine therapy, as well as MRI technology, has continued over such a long period of time. Therefore, we believe that our short time period of MRI-performed, about 1.5 year, guarantees the homogeneity of the clinical background; this point is a merit of our study.

How to interpret and manage MRI findings should not be overlooked. Development of one contralateral cancer was observed during the study period in a patient who underwent MRI. Because her MRI showed marked background enhancement, we did not recognize that the lesion already existed as a contralateral cancer. This case shows us that preoperative MRI does not always guarantee perfect eradication of tumor foci according to the interpreting radiologist's experience and quality of MRI images.

Our study has several limitations. First, the number of patients was relatively small. Second, similar to the first, although we performed statistical analysis and obtained results, the number of cases showing any type of recurrence was small. These findings could cause our results to be less persuasive. Third, we used the term "recurrence". However, it is not clear whether all reappearing lesions truly demonstrated recurrence (already exist at the time of surgery, but not excised) of a lesion or a "new" lesion. We did not compare radiologic or immunohistochemistic findings between primary and "recurred" lesions. However, when considering the relatively short follow-up period, we believe that real recurrence from preexisting small malignant foci, rather than new lesions, is more reasonable. Forth, the follow-up period is also relatively short. In our opinion, recurrence occurred despite a short follow-up period (within 2-3 years) means that the lesion probably already existed but was not excised, and if we performed MRI at that time, it could have been detected. We believe this is the real merit of performing preoperative MRI. However, because a mean follow-up period of 35 months is still not sufficient, it is difficult to comment on outcome, such as survival rate. Therefore, our results reflect early

outcome and further study with a longer follow-up period is ongoing.

In summary, for early-stage breast carcinoma treated with BCS and RT, the use of preoperative MRI in the initial diagnosis resulted in improved early IBTR outcomes. However, on multivariate study, no difference in recurrence outcomes according to use of breast MRI was observed between the two groups. Our data suggest that previous opinions that are skeptical of use of preoperative breast MRI in patients with BCS and RT can be reconsidered, at least in terms of IBTR. More dedicated study with a larger population and a longer follow-up period are needed.

References

1. Fisher B, Anderson S, Bryant J, et al. Twenty-year follow-up of a randomized trial comparing total mastectomy, lumpectomy, and lumpectomy plus irradiation for the treatment of invasive breast cancer. *N Engl J Med* 2002;347:1233-1241
2. Veronesi U, Cascinelli N, Mariani L, et al. Twenty-year follow-up of a randomized study comparing breast-conserving surgery with radical mastectomy for early breast cancer. *N Engl J Med* 2002;347:1227-1232
3. Orel SG, Schnall MD. MR imaging of the breast for the detection, diagnosis, and staging of breast cancer. *Radiology* 2001;220:13-30
4. Tillman GF, Orel SG, Schnall MD, Schultz DJ, Tan JE, Solin LJ. Effect of breast magnetic resonance imaging on the clinical management of women with early-stage breast carcinoma. *J Clin Oncol* 2002;20:3413-3423
5. Kelcz F, Santyr G. Gadolinium-enhanced breast MRI. *Crit Rev Diagn Imaging* 1995;36:287-338
6. Van Goethem M, Tjalma W, Schelfout L, Verslegers I, Biltjes I, Parizel P. Magnetic resonance imaging in breast cancer. *Eur J Surg Oncol* 2006;32:901-910
7. Clarke M, Collins R, Darby S, et al. Effects of radiotherapy and of differences in the extent of surgery for early breast cancer on local recurrence and 15-year survival: an overview of the randomized trials. *Lancet* 2005;366:2087-2106
8. Fischer U, Zachariae O, Baum F, von Heyden D, Funke M, Liersch T. The influence of preoperative MRI of the breasts on recurrence rate in patients with breast cancer. *Eur Radiol* 2004;14:1725-1731
9. Solin LJ, Orel SG, Hwang WT, Harris EE, Schnall MD. Relationship of breast magnetic resonance imaging to outcome after breast-conservation treatment with radiation for women with early-stage invasive breast carcinoma or ductal carcinoma in situ. *J Clin Oncol* 2008;26:386-391
10. Hwang N, Schiller DE, Crystal P, Maki E, McCready DR. Magnetic resonance imaging in the planning of initial lumpectomy for invasive breast carcinoma: its effect on ipsilateral breast tumor recurrence after breast-conservation therapy. *Ann Surg Oncol* 2009;16:3000-3009
11. Fleming ID, Cooper JS, Henson DE, et al. *AJCC Cancer Staging Manual*, 5th edn. Philadelphia, PA, Lippincott-Raven Publishers, pp 171-180, 1997

12. Cox DR. Regression models and life tables. Journal of the Royal Statistical Society Series B 1972; 34:187-220
13. Link CL. Confidence intervals for the survival function using Cox's proportional-hazard model with covariates. Biometrics 1984;40: 601-609
14. Schnall MD, Blume J, Bluemke DA, et al. MRI detection of distinct incidental cancer in women with primary breast cancer studied in IBMC 6883. J Surg Oncol 2005;92:32-38
15. Deurloo EE, Peterse JL, Rutgers EJ, Besnard AP, Muller SH, Gilhuijs KG. Additional breast lesions in patients eligible for breast-conserving therapy by MRI: impact on preoperative management and potential benefit of computerised analysis. Eur J Cancer 2005;41:1393-1401
16. Berg WA, Gutierrez L, NessAiver MS, et al. Diagnostic accuracy of mammography, clinical examination, US, and MR imaging in preoperative assessment of breast cancer. Radiology 2004;233:830-849
17. Sardanelli F, Giuseppetti GM, Panizza P, et al. Sensitivity of MRI versus mammography for detecting foci of multifocal, multicentric breast cancer in fatty and dense breasts using the whole-breast pathologic examination as a gold standard. AJR Am J Roentgenol 2004;183:1149-1157
18. Kriege M, Brekelmans CT, Boetes C, et al. Efficacy of MRI and mammography for breast-cancer screening in women with a familial or genetic predisposition. N Engl J Med 2004;351:427-437
19. Kuhl CK, Schrading S, Leutner CC, et al. Mammography, breast ultrasound, and magnetic resonance imaging for surveillance of women at high familial risk for breast cancer. J Clin Oncol 2005; 23:8469-8476
20. Lehman CD, Blume JD, Weatherall P, et al. Screening women at high risk for breast cancer with mammography and magnetic resonance imaging. Cancer 2005;103:1898-1905
21. Lee SG, Orel SG, Woo IJ, et al. MR imaging screening of the contralateral breast in patients with newly diagnosed breast cancer: preliminary results. Radiology 2003;226:773-778
22. Pass H, Vicini FA, Kestin LL, et al. Changes in management techniques and patterns of disease recurrence over time in patients with breast carcinoma treated with breast-conserving therapy at a single institution. Cancer 2004;101:713-720
23. Ernst MF, Voogd AC, Coebergh JW, Poortmans PM, Roukema JA. Using loco-regional recurrence as an indicator of the quality of breast cancer treatment. Eur J Cancer 2004;40:487-493
24. Morrow M. Magnetic resonance imaging in the breast cancer patient: curb your enthusiasm. J Clin Oncol 2008;26:352-353

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유방보존술과 방사선 치료를 받은 관상피내암과 조기유방암 환자에서 수술 전 유방자기공명영상과 조기 예후와의 관계

고은숙 · 한부경 · 노우철² · 최나미³ · 김록범⁴ · 고은영 · 신정희

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목적: 방사선 치료와 유방보존술을 시행 받은 환자에서 수술 전 자기공명영상 촬영 여부가 조기에후에 미치는 영향을 알아보고자 하였다.

대상 및 방법: 2007년 1월부터 2008년 8월까지 조기유방암으로 유방보존술과 방사선 치료를 받은 319명의 환자를 대상으로 하였다. 192명(60.2%)의 환자들이 자기공명영상을 시행 받았고 127명은(39.8%) 시행되지 않았다. 자기공명영상 촬영 여부에 따라 두 군간의 조직병리학적 특징과 예후를 비교하였다. 평균 추적 기간은 35.0개월 이었다.

결과: 자기공명영상을 촬영한 192명 중 7명(3.6%)에서 재발이 발생했으며 자기공명영상을 촬영하지 않은 127명 중 12명(9.4%)에서 재발이 발생했다. 자기공명영상을 촬영하지 않은 군에서 유방 내 재발률이 유의하게 높았다($p = 0.051$). 보정 후 다변량 분석에서는 두 군간 유의한 재발률의 차이를 보이지 않았다.

결론: 유방보존술과 방사선 치료를 받는 환자에서의 수술 전 자기공명영상이 환자의 조기 예후를 향상시키지는 못했지만 유방 내 재발은 유의하게 낮았다.

Index words: MRI; Breast; Breast cancer; Staging; Recurrence