

Effect of Preoperative Magnetic Resonance Imaging on Recurrence Outcomes in Patients with Newly Diagnosed Breast Cancer: A Meta-Analysis

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Background: Several studies have evaluated the relationship between preoperative magnetic resonance imaging (MRI) and recurrence; however, their results are inconsistent.

Purpose: To evaluate the influence of preoperative MRI on recurrence outcome in patients with primary breast cancer.

Materials and Methods: Articles published before April 15, 2017 that included the terms "preoperative breast MRI" were searched for using the PubMed/MEDLINE and EMBASE databases. The eligibility criterion was recurrence outcome according to the use of preoperative MRI with comparative data. The pooled estimate of the hazard ratio (HR) for local or locoregional recurrence was calculated. Analyses for local, locoregional, contralateral breast recurrence, and distant metastasis were performed. Sources of bias and heterogeneity testing were assessed.

Results: Twelve studies (32,508 patients) met the inclusion criterion. The pooled estimate of HR for local or locoregional recurrence in 10 studies (6,968 patients) in the MRI group was 0.70 (95% confidence interval [CI], 0.41–1.18; $P=0.18$). HRs for local or locoregional recurrence were heterogeneous between studies ($I^2=47.58$, $P=0.04$) and there was significant publication bias. The pooled HR of locoregional recurrence in four studies (2,238 patients) was 0.50 (95% CI, 0.28–0.90; $P=0.02$) without significant heterogeneity ($I^2=0.00$, $P=0.61$).

Conclusion: Preoperative breast MRI does not reduce the risk of local and contralateral breast recurrence, while the risk of locoregional recurrence is significantly decreased with limited significance. Thus, it

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is necessary to establish an indication for preoperative MRI in patients with newly diagnosed breast cancer.

Index words: Breast cancer; Meta-analysis; Magnetic resonance imaging; Prognosis; Recurrence; Preoperative evaluation

Introduction

Breast magnetic resonance imaging (MRI) is the most sensitive tool for evaluating breast cancer (1, 2). The indications for breast MRI include preoperative image techniques, evaluating treatment responses after neoadjuvant chemotherapy, and it can also be used as a screening tool for high-risk groups with a strong family history of breast or ovarian cancer (3, 4). MRI is useful for preoperative surgical planning for the treatment of breast cancer by providing accurate information concerning the extent of tumor. Furthermore, in this setting, previous studies have demonstrated that MRI resulted in a better performance compared to conventional imaging for detecting additional ipsilateral and contralateral tumors in 5.5–37% of patients with breast cancer (2, 5–7). Therefore, the use of breast MRI has increased worldwide, with the expectation of better surgical outcomes, a decrease in breast cancer recurrence, and a better survival outcome (8, 9). However, recent studies have suggested that preoperative MRI does not improve surgical outcomes and may even be harmful. MRI can lead to higher false-positive rates, re-excision rates, or higher rates of conversion from breast conserving surgery to mastectomy (6, 10–13). Additionally, increasing costs, treatment delays, the use of intravenous contrast media, and the anxiety of patients are other disadvantages of performing breast MRI in the preoperative setting.

Most studies concerning preoperative breast MRI focused on diagnostic accuracy and immediate surgical outcomes alone (1, 6–13). After the initial report by Fischer et al. (14), several studies demonstrating the relationship between the use of

breast MRI and breast cancer recurrence have been published (15–19). Fischer et al. (14) reported that MRI can improve recurrence outcomes; however, others (15–19) have reported that the use of preoperative MRI did not result in any survival gain. The relevant studies, having been conducted many years ago, used old MRI techniques and treatment strategies that differed from current practice, and therefore, their results are not applicable to modern clinical practice. Subsequent to the publishing of an individual person data meta-analysis (20) in 2014, recent studies (21–28) focusing on the long-term outcome of patients have also been conducted and their results are not consistent. Thus, it is necessary to analyze all previous studies to investigate whether the use of preoperative MRI can improve recurrence outcomes.

Therefore, this study aimed to systemically review the literature and conduct a meta-analysis of the prior articles focusing on the effect of the use of preoperative MRI on recurrence outcomes.

Materials and Methods

Search strategy and study selection

A systematic search of previous studies was conducted using the PubMed/MEDLINE and EMBASE database. The search term was "preoperative breast MRI" and included articles listed up to April 15, 2017. No language restrictions were applied and only studies regarding human subjects were included. Titles and abstracts of search results were examined first, and the full-text articles of eligible abstracts were subsequently retrieved. Reference lists of selected articles were scanned

for additional eligible studies. Two independent reviewers (M.R.K and E.S.K) performed the study selection, data extraction, and a review of the studies in consensus.

Eligibility criteria

The inclusion criterion was as follows: peer-reviewed articles concerning human subjects reporting the detailed breast cancer recurrence outcomes of patients who had received preoperative breast MRI (MRI group) and those who had not received MRI (no-MRI group). The exclusion criteria were as follows: case reports; review articles or other non-original research; meta-analysis studies; those presented as an abstract alone; and those with inadequate data for the extraction of the recurrence hazard ratio (HR).

Data extraction and quality assessment

The following data were collected: year of publication; study design (retrospective vs. prospective); whether or not a patient had received an MRI; number of patients; age of patients; tumor size; histological grade; the stage of primary breast cancer; estrogen receptor (ER); progesterone receptor (PR); and human epidermal growth factor receptor 2 (HER2) status; type of initial surgery; whether a patient received adjuvant chemotherapy, adjuvant radiation therapy, or adjuvant endocrine therapy; whether MRI was performed on the affected breast or both breasts.

Recurrence was classified as local, regional, contralateral breast recurrence, and distant metastasis. Definitions were as follows: local recurrence or ipsilateral breast tumor recurrence (IBTR) was defined as any new invasive or *in situ* breast cancer occurring in the treated breast. Regional recurrence was defined as new cancer in the ipsilateral chest wall and/or axillary, infraclavicular, or supraclavicular lymph nodes. If local and regional recurrence were not reported separately, it was collectively referred to as a

locoregional recurrence. Contralateral breast recurrence was defined as any new cancer in the contralateral breast, while distant metastasis was defined as metastasis to other parts of the body, except the breast.

The Newcastle–Ottawa Scale (NOS) was applied for quality assessment in observational studies (29). NOS scores of ≥ 6 were defined as high-quality studies. The Cochrane risk of bias tool was used for randomized controlled trials (RCTs) (30).

Statistical analysis

The study-specific hazard ratios (HRs) of recurrence between the MRI and no-MRI groups were extracted from each study. In studies where the HR was not provided, we calculated HRs on the basis of Kaplan–Meier curves using previously described methods (31). The pooled estimate of HRs for local or locoregional recurrence was calculated with a 95% confidence interval (CI), which was listed in a forest plot in order of the years in which the studies were published. The pooled HRs for local, locoregional, contralateral breast recurrence, and distant metastases were also calculated. HRs from pooled data were estimated and tested using the fixed effects model or the random-effects model.

We performed chi-squared tests and calculated the Higgins I^2 statistic to assess and evaluate the extent of variability attributable to statistical heterogeneity among the studies. Values of $I^2 > 50\%$ were considered to be substantial, and those $< 30\%$ were considered low (32). For the analysis with the number of studies > 3 , if a heterogeneity test produced a P-value < 0.1 or I^2 showed substantial heterogeneity, a random-effects model was applied (30). Publication bias, which is usually caused by a higher probability of studies showing positive results being published, was analyzed by Egger's regression test and was presented in a funnel plot (P > 0.05 suggested a lack of publication bias). The trim and fill method was also applied to the analysis when publication bias was suspected (33). Statistical

analysis was performed using R 3.0.2 (Vienna, Austria; <http://www.R-project.org/>), package 'metafor'. $P < 0.05$ was considered to indicate a significant difference.

Results

Study design and basic description

The systematic search initially retrieved 933 titles in PubMed/MEDLINE and 1713 titles in the EMBASE databases. Three articles were added following a review of the reference lists of the selected articles. After removing duplicates, 1845 studies were screened and 1817 studies were removed based on manual screening of the titles and abstracts. The full text of the 28 identified candidate articles was then read, and 16 were excluded: one article (20) with an individual person data meta-

analysis, nine articles that were non-original articles, four articles with only an abstract available, and two articles that only provided simple proportions and not the essential data for the extraction of HR and 95% CI (14, 18). Twelve articles were finally selected for inclusion in this meta-analysis review (Fig. 1). There was no disagreement between the two readers.

The predominant characteristics of the eligible studies are summarized in Table 1. A total of 32508 patients with breast cancer were included; 12768 patients (39.2%) had undergone MRI, and 19720 (60.7%) had not undergone MRI. One study was an RCT (17) and the remaining 11 were retrospective nonrandomized studies. Four of the studies were matched cohort studies (21, 22, 26, 27). Recent studies (19, 23–27) involved MRI scanning of bilateral breasts. Among them, Yi et al. (21) used

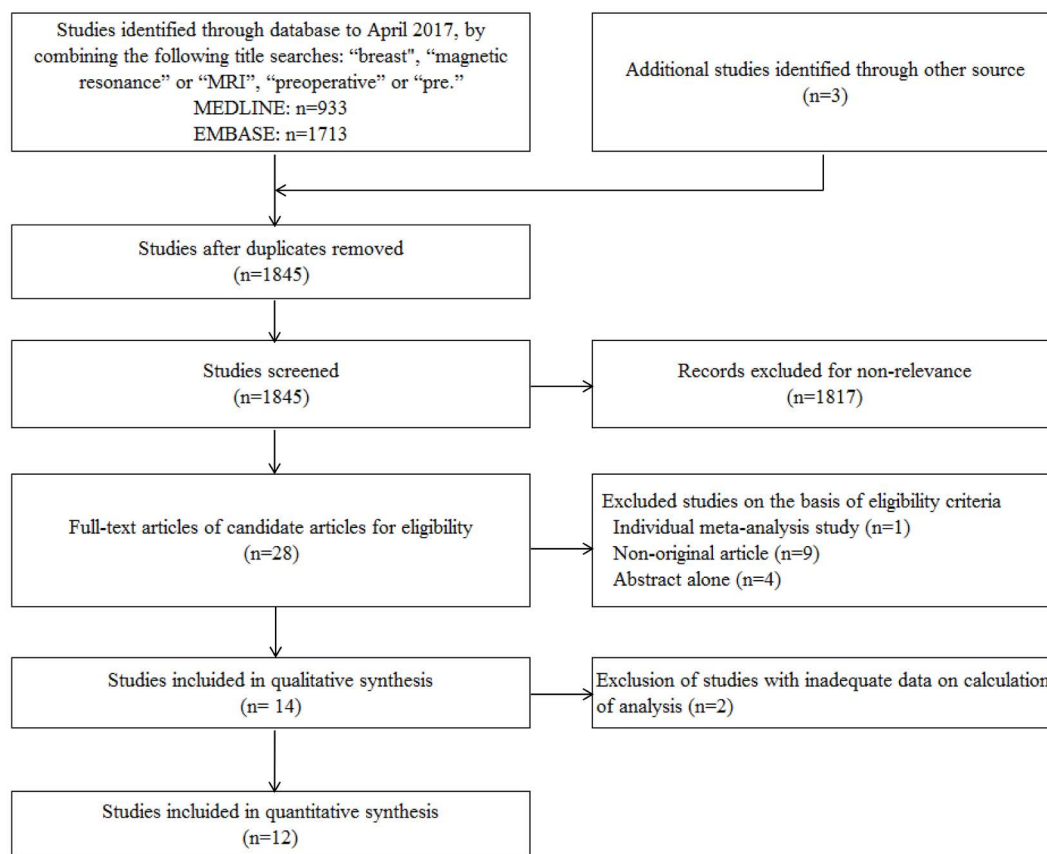


Fig. 1. Flow diagram of article selection process.

Table 1. Characteristics of the Included Studies

Author	Year of publication	Study period	Country	Design	Eligible patients	No. of patients			Age (years)		Recurrence				
						Total	MRI group	No-MRI group	Median (or mean*)	Range	MRI [†]	Local	Locore-gional	Contra-lateral	Distant
Solin (15)	2008	1992-2001	USA	Retrospective	Invasive or in situ early breast cancer, underwent BCT including definitive breast irradiation	756	215	541	53, 57	22-85, 27-89	Uni	Y		Y	
Hwang (16)	2009	1999-2005	Canada	Retrospective	Underwent BCS and definitive adjuvant RT	472	127	345	56.8	25.2-92.8	Uni	Y			
Turnbull (17)	2010	2001-2007	U.K.	Randomised controlled trial	Biopsy-proven breast cancer scheduled for BCS after standard (triple) assessment	1623	816	807	57	50-64	Uni	Y			
Shin (19)	2012	2003-2005	Korea	Retrospective	Underwent BCS for invasive or in situ carcinoma	794	572	222	46.9*	NA	Bi	Y			
Kim (23)	2013	2004-2008	Korea	Retrospective	Unilateral breast cancer, underwent curative surgery	3094	1771	1323	48.2, 46.8*	22-85, 18-81	Bi			Y	
Ko (24)	2013	2005-2006	Korea	Retrospective	Unilateral early stage breast cancer, patients treated BCS including RT	615	229	386	46.6*	19-81	Bi	Y	Y	Y	Y
Sung (22)	2014	2000-2004	USA	Retrospective	Underwent BCS without chemotherapy	348	164	164	55, 52*	NA	Uni		Y	Y	Y
Yi (21)	2015	2004-2006 2007-2009	Korea	Retrospective	Newly diagnosed breast cancer, patients underwent curative surgery without neoadjuvant chemotherapy	742	371	371	48.5	20-89	Uni		Y	Y	Y
Ryu (25)	2016	2007-2010	Korea	Retrospective	Underwent definitive BCS for T1-2 breast cancer	954	743	211	48.9, 50.5*	NA	Bi		Y		
Wang (26)	2016	2004-2009	USA	Retrospective	Diagnosed stage I and II breast cancer from SEER-Medicare database	19131	6377	12754	NA	67-94	Bi			Y	
Wang (27)	2016	2004-2009	USA	Retrospective	Diagnosed DCIS from SEER-Medicare database	3315	1159	2156	NA	67-94	Bi			Y	
Gervais (28)	2017	1999-2005	Canada	Retrospective	Underwent BCS and adjuvant RT for invasive breast cancer	470	127	343	56.8	25-92	NC	Y			

*Mean age is described if no information about median age on report.

[†] Subgroup data (MRI, no-MRI group) are described in order.[‡] bi, bilateral scan; uni, unilateral scan; NA, not available; NC, not clear

BCT, breast conserving treatment; BCS, breast conserving surgery; RT, radiotherapy; CTx, chemotherapy; DCIS, ductal carcinoma in situ; SEER, Surveillance, Epidemiology, and End Results

two different MR imaging protocols according to time period: i.e., from 2004 to 2006, a unilateral MR imaging protocol was used and from 2007 to 2009, a bilateral MR imaging protocol was used. For this reason, their study was regarded as two independent studies to calculate the pooled estimate of HR. One study (28) did not clearly describe whether a unilateral or bilateral MR imaging protocol was used and the other four studies (15–17, 22) performed unilateral breast MRI.

Local or locoregional recurrence

Because three of the studies (23, 26, 27) included only contralateral recurrence data, 10 studies involving 6,968 patients (3,461 in the MRI group; 3487 in the no-MRI group) (15–17, 19, 21, 22, 24, 25, 28) were included for the evaluation of local or locoregional recurrence. Among these studies, the HR of local or locoregional recurrence was substantially heterogeneous ($I^2=47.58$, $P=0.04$). The pooled estimate of the HR of local or locoregional recurrence for the MRI group (versus the no-MRI group) was 0.70 (95% CI: 0.41–1.18) under the random-effects model and was not statistically

significant ($P=0.18$) (Fig. 2). Non-significance was not changed even after the trim-and-fill method was applied to the analysis ($P=0.99$).

Analysis according to the classification of recurrence

A detailed analysis according to the location of recurrence was performed incorporating local (IBTR), locoregional, contralateral breast recurrence, and distant metastasis. Regional recurrence was not evaluated because only 1 study (24) reported this recurrence category.

There was no significant difference in the HR of local recurrence (IBTR) of the MRI group comparing with the no-MRI group (six studies (15–17, 19, 24, 28), 4,730 patients, HR=0.85, 95% CI 0.42–1.72, $P=0.66$ by the random-effects model) (Fig. 3). The non-significance was not changed after the trim-and-fill method was applied ($P=0.65$). The pooled HR of locoregional recurrence in four (21, 22, 25) studies of 2,238 patients was 0.50 (95% CI: 0.28–0.90) and the difference was statistically significant ($P=0.02$ by the fixed-effects model) (Fig. 3). Among the studies, the HR was not significantly

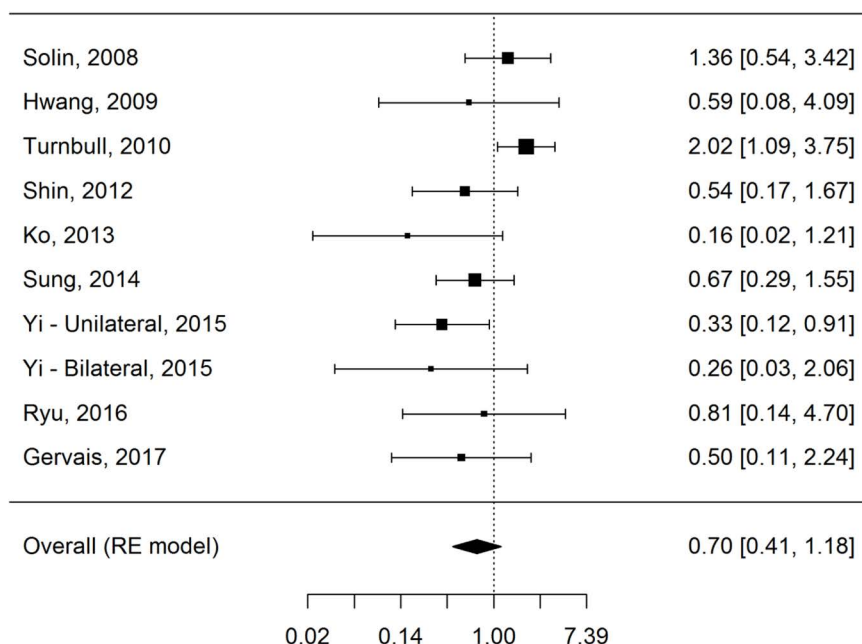


Fig. 2. Forest plot shows study-specific local or locoregional recurrence hazard ratio (HR) according to use of preoperative MRI. The square on each bar represents the HR for an individual trial, and the bar shows the 95% confidence interval (CI). The diamond represents a pooled estimate, with the center of the diamond giving the HR estimate and the extremes of the diamond representing the 95% CI.

heterogeneous ($I^2=0.00$, $P=0.61$).

Seven articles (15, 21–24, 26, 27) provided contralateral breast recurrence data. Two articles were excluded; 1 (22) was inadequate due to lack of essential data for the extraction of HR and 95% CI and 1 (15) was excluded because MRI scanning was performed for the single breast because bilateral MRI is reported as superior to unilateral MRI for detecting contralateral cancer in patients diagnosed with breast cancer (34, 35). Two articles from Wang et al. (26, 27) had a similar study design for contralateral recurrence, but included patients from different populations: invasive ductal cancer (26) and ductal carcinoma *in situ* (DCIS) (27). From these articles, we used metachronous contralateral recurrence data. Five studies involving 26,349 patients (21, 23, 24, 26, 27) were included. There was no significant difference in recurrence between the groups (HR=0.51, 95% CI 0.19–1.32, $P=0.16$ by the random effects model) (Fig. 3). Among the studies, the HR was substantially heterogeneous ($I^2=88.84$, $P=0.01$).

After excluding one study with inadequate data on calculation of analysis (22), three studies (21, 24) involving 1,551 patients were included for analysis of distant metastasis. There was no significant difference in HR between two groups (HR = 0.92, 95% CI 0.47–1.79, $P=0.81$ by the fixed effects model) (Fig. 3).

Quality assessment

Two (19, 25) of the cohort studies were of poor quality (score 4 and 5, respectively), while other nine studies were of high quality, based on assessment by the NOS, indicating they were of acceptable methodological quality for inclusion in the meta-analysis (Table 2). The COMICE trial (17) had a low risk of bias based on the Cochrane risk of bias tool.

Publication bias

The funnel plots for local or locoregional

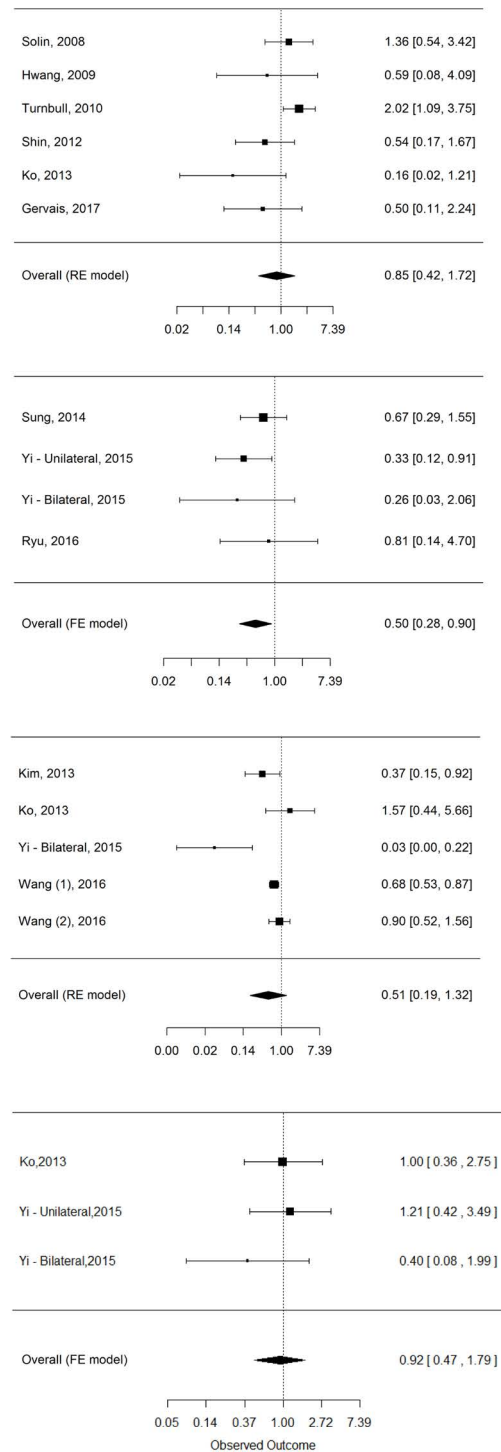


Fig. 3. Forest plot and pooled estimates according to classification of recurrence as follows: local, locoregional, contralateral recurrence and distant metastasis. The square on each bar represents the HR for an individual trial, and the bar shows the 95% confidence interval (CI). The diamond represents a pooled estimate, with the center of the diamond giving the HR estimate and the extremes of the diamond representing the 95% CI.

Table 2. Assessment of Quality of Included Cohort Studies

Newcastle-Ottawa scale									
Reference	Selection			Comparability		Outcome		Overall Quality	
	Representativeness of exposed cohort?	Selection of the non-exposed cohort?	Ascertainment of exposure?	Outcome of interest was not present at start of study?	Study control for age and additional factor?	Assessment of outcome?	Was follow-up of cohort?		Adequacy of follow-up of cohorts?
Solin, 2008 (15)	*	*	*	*	*	*	-	-	6
Hwang, 2009 (16)	*	*	*	*	**	*	-	-	6
Shin, 2012 (19)	*	*	*	-	-	*	-	-	4
Kim, 2013 (23)	*	*	*	-	*	*	*	-	6
Ko, 2013 (24)	*	*	*	*	*	*	*	-	7
Sung, 2014 (22)	*	*	*	*	**	*	*	-	8
Yi, 2015 (21)	*	*	*	*	**	*	*	*	9
Ryu, 2016 (25)	*	*	*	*	-	*	-	-	5
Wang, 2016 (26)	-	*	*	-	**	*	*	-	6
Wang, 2016 (27)	-	*	*	-	**	*	*	-	6
Gervais, 2017 (28)	*	*	*	*	*	*	-	-	6
Cochrane's assessment									
Reference	Sequence generation	Allocation concealment	Blinding	Incomplete outcome data	Selective outcome reporting	Other potential threats to validity			
Turnbull, 2010 (17)	Low risk	Low risk	High risk	Low risk	Low risk	Low risk			

Each asterisk represents if individual criterion within the subsection were fulfilled.

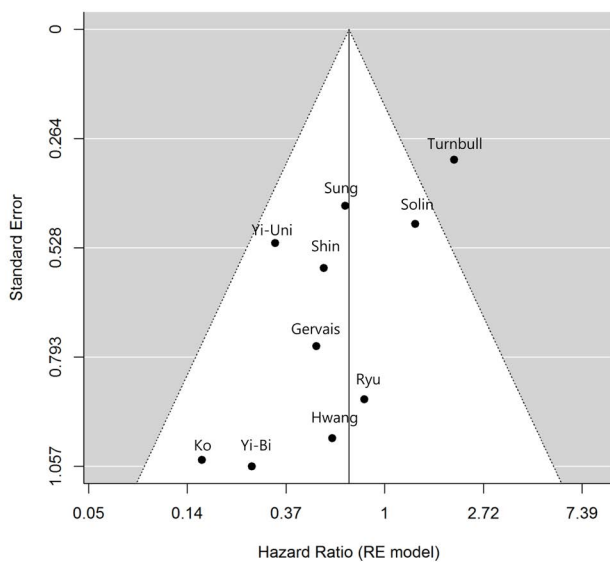


Fig. 4. Funnel plot in studies used for evaluating local or locoregional recurrence. Circles represent the 10 included studies.

recurrence were asymmetric and the P value for Egger's regression test was 0.02, representing significant publication bias (Fig. 4). The P values for Egger's regression test were 0.01 for local recurrence, 0.74 for locoregional recurrence, and 0.51 for contralateral recurrence.

Discussion

Breast MRI is widely used as a diagnostic method in patients with breast cancer owing to remarkable advances in MRI technology (2, 8, 9, 36). Several studies have been conducted to evaluate the effects of the use of preoperative MRI for primary breast cancer (2, 5–24, 34). Although the use of preoperative MRI has many advantages, meta-analysis of immediate surgical outcomes revealed that preoperative breast MRI significantly increased conversion rates from breast conserving surgery to mastectomy by identifying additional disease, and identified a substantial amount of false-positive results. These are negative aspects of the use of preoperative MRI (6, 7, 10–13).

Several studies concerning the effect of

preoperative MRI on recurrence outcomes have been conducted, and showed inconsistent results (14–19, 21–24). Fischer et al. (14) reported a statistically significant reduction of in-breast tumor recurrences although his methodology showed many flaws. Other studies reported no significant correlation between the use of preoperative MRI and local recurrence outcome or disease-free survival (15, 16, 18, 19, 25). One RCT (COMICE trial) even reported that the use of preoperative MRI was associated with a higher risk for local recurrence or death (17). An individual person data meta-analysis (20) from 4 previously published studies revealed that the use of preoperative MRI was unable to reduce the risk of local or distant recurrence (20). However, recently, Ko et al. (24) reported that the no-MRI group had a higher local recurrence rate compared with the MRI group, but the difference was not statistically significant. Recently, Gervais et al. (28) reported that for 10-year follow-up, MRI has not been shown to significantly improve the IBTR rate. However, in the no-MRI group, the IBTR rate was significantly higher than in the high-risk group (triple-negative and HER2-positive). Yi et al. (21) also demonstrated that the use of preoperative MRI was significantly associated with better locoregional recurrence-free survival during the unilateral imaging period. Additionally, during the bilateral period, the MRI group had better contralateral breast cancer recurrence-free survival.

In our study, we failed to show statistically significant improvement of local or locoregional recurrence outcomes by the use of preoperative MRI (HR, 0.70; $P=0.18$). Interestingly, locoregional recurrence was significantly reduced when preoperative MRI was used (HR, 0.50; $P=0.02$). Contrary to the analysis of IBTR, the result for locoregional recurrence was based on more recent studies from 2014, reflecting the development of MRI technology, interpretation techniques, and adjuvant systemic therapy. These factors can lead to a significant reduction of locoregional recurrence

in the MRI group. However, cautious interpretation and a larger study are needed when considering this result was based on just a few studies.

Our study reinforces the results obtained in previous individual person data meta-analyses and several other studies. Some cancers detected only by MRI may have a low malignant potential or be indolent, in which they are biologically inconsequential or clinically not significant, so treatment of these lesions has little effect on outcomes (13, 37). Furthermore, marked development of systemic therapy may inhibit the progression of a number of early stage cancers undetected by conventional imaging (13, 20) and is known to reduce the risk of contralateral breast cancer (38). Based on these prior results, we can speculate that the biological characteristics of tumors are more important in terms of achieving local control, and the complete excision of all cancers may not be necessary. Therefore, it is questionable to perform preoperative MRI in all patients. In consideration of benefits and risks, identifying patients for whom performing preoperative MRI is beneficial may be necessary.

Yi et al. (21) reported that bilateral MRI scans reduced the risk of contralateral breast recurrence as a result of the surveillance of the contralateral breast with high temporal resolution. One study by Kim et al. (23) and two studies by Wang et al. (26, 27) assessed the benefit of MRI use on both synchronous and metachronous contralateral breast cancer recurrence. They reported that preoperative MRI was associated with increased synchronous cancer detection and decreased metachronous contralateral invasive cancer – a shift in stage at diagnosis for contralateral recurrence to an earlier stage. Removal of an earlier detected lesion might reduce the metachronous recurrence rate. However, the decreased incidence of metachronous contralateral cancer did not offset the increased rate of synchronous cancer in the MRI group and was insignificant in the study even when

confined to only patients diagnosed with DCIS (27), suggesting that MRI can lead to overdiagnosis. Our results also showed no significant reduction of contralateral breast cancer recurrence through the use of preoperative MRI. In fact, the use of the term "recurrence" is questionable especially for contralateral metachronous cancer. As Wang et al. reported, unlike with ipsilateral recurrence, contralateral cancer is more likely to be occult primary cancer rather than a true recurrence.

Our study has several limitations. First, most included studies were retrospective studies with the exception of 1 RCT (17). Second, there was substantial heterogeneity in the included studies. All study populations of each of the studies were diagnosed as primary breast cancers; however, they were diverse in terms of detail such as surgery method and history of adjuvant therapy. Therefore, we could not perform further subgroups analysis according to the diverse variables about characteristics of tumors and treatment type. Third, our eligibility criteria required 2 specific groups (i.e., MRI group vs. no-MRI group) for comparison and only a limited numbers of studies addressing this issue were included. Fourth, the study periods of included articles were too long and variable. A substantial amount of the data available was before 2000, which was before advances in MRI technology, interpretation technique, and treatment strategies including HER2-targeted therapy, endocrine therapy, and chemotherapy. Thus, the results may have been different if long-term follow-up data involving more recent treatment strategies or advanced MRI were available. Fifth, our study was based on study-level data from summary data. Until now, regarding this topic, there has been only one meta-analysis (20) including a small number of studies with unilateral breast MRI. Because we wanted to precisely evaluate the effect of preoperative MRI in recent studies, we performed this study. The previous report (20) was conducted using individual person data analysis, which is

considered to be the gold standard of meta-analysis due to the ability of statistical adjustments for confounding factors and minimization of publication bias, whereas our study cannot avoid bias from different studies. However, our study reviewed many more recently published studies. Sixth, we detected significant publication bias but the statistical significance of our findings did not change after applying the trim-and-fill method. The funnel plot showed asymmetry, suggesting a lack of small studies reporting that the use of preoperative MRI increases the risk for recurrence. This may be the result of a reluctance to publish studies showing negative results (39). Therefore, we believe that the publication bias shown in our study is important.

In conclusion, our meta-analysis demonstrated that the use of preoperative breast MRI does not reduce the risk of local and contralateral breast recurrence, but the risk of locoregional recurrence was significantly decreased, with limited significance. Thus, it is necessary to establish indications for preoperative MRI in patients with newly diagnosed breast cancer.

Declaration of Conflicting Interests

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유방암 환자에서 수술 전 자기공명영상의 재발 평가 유용성에 대한 메타 분석

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목적: 유방암 환자에서 수술 전 유방 자기공명영상이 재발에 미치는 영향에 대한 연구들을 메타 분석하고 체계적으로 고찰한다.

대상과 방법: PubMed/MEDLINE 와 EMBASE 데이터베이스를 이용해 2017년 4월 15일까지 출판된 논문 중 “수술 전 유방 자기공명영상”을 포함하는 논문을 검색하였다. 선정 기준은 수술 전 자기공명영상 사용 여부에 따른 재발 결과를 평가한 비교 연구였다. 국소 또는 국소구역 재발에 대한 위험비(hazard ratio)를 분석하였다. 국소, 국소구역, 반대측 유방 재발 및 원격 전이에 대한 각각의 위험도도 함께 분석하였다. 연구간 출판 비뚤림 존재 여부와 이질성 여부를 평가하였다.

결과: 총 12개의 논문(32,508명의 환자)이 연구에 포함되었다. 10개의 논문(6,968명)에서 국소 또는 국소구역 재발 위험비는 0.7(95% 신뢰구간, 0.41-1.18, P=0.18)이었으며 연구간의 이질성 및 유의한 출판 비뚤림이 확인되었다. 4개의 논문(2,238명)에서 국소구역 재발 위험비는 0.5(95% 신뢰구간, 0.28-0.90, P=0.02)이었으며 연구간의 유의한 이질성은 없었다.

결론: 유방암 환자에서 수술 전 유방 자기공명영상은 국소 및 반대측 유방 재발 위험도를 낮추지 못했으나 국소 구역 재발 위험도는 감소시켰다. 유방암 진단 환자의 수술 전 자기공명영상에 대한 적절한 적응증을 설정하는 것이 필요하다.

Index words: Breast cancer; Meta-analysis; Magnetic resonance imaging; Prognosis; Recurrence; Preoperative evaluation

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