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Original Research

Circumscribed Masses on Breast MRI: Can MRI Features Guide Management?

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Abstract

Objective: Management of circumscribed breast masses seen on MRI is largely extrapolated from mammography and US data with limited MRI-specific data available. This study aimed to assess clinical and MRI imaging features of malignant circumscribed breast masses.

Methods: In this IRB-approved retrospective study, breast MRIs performed between April 1, 2008, and August 30, 2020, containing circumscribed masses, excluding multiple bilateral circumscribed masses, were reviewed. Clinical and imaging features of all eligible masses were recorded, and associations with malignant outcomes were assessed using Fisher's exact test and Wilcoxon rank sum test, with $P < 0.05$ considered significant.

Results: For the 165 masses that met study criteria in 158 women, the mean age was 48 years (SD 12.0 years). Nine of 165 masses were malignant (5.5%). Round masses were significantly more likely to be malignant (7/37, 18.9%) compared to oval masses (2/128, 1.7%) ($P < 0.001$). Among masses with available dynamic contrast kinetics data, the malignancy rate was 0/84 (0%) for persistent kinetics, 2/23 (8.7%) for plateau kinetics, and 4/24 (16.7%) for washout kinetics ($P = 0.002$). The malignancy rate for oval masses without washout kinetics was 0% (0/92). T2 hyperintense masses had a malignancy rate of 7/104 (6.7%), and homogeneously enhancing masses had a malignancy rate of 5/91 (5.5%).

Conclusion: These data support the use of mass shape and dynamic contrast enhancement kinetics to guide management of circumscribed breast masses seen by MRI, with oval masses without washout kinetics and any circumscribed mass with persistent kinetics showing no malignancies in this study.

Key words: circumscribed masses; breast MRI; MRI BI-RADS 3.

Introduction

Circumscribed masses are a commonly encountered breast imaging finding. When circumscribed masses are multiple and bilateral (at least three total and at least one in each breast), they may be considered benign (1). Circumscribed masses seen by mammography or US that are not multiple and bilateral have clear evidence-based guidelines for their management (2,3), with short-term follow-up recommended for solitary circumscribed masses on a baseline exam and biopsy recommended for new solitary circumscribed masses. However, there are limited data regarding circumscribed masses seen by MRI, and more data are needed to guide their management.

Key Messages

- Circumscribed breast masses on MRI (excluding multiple bilateral circumscribed masses) had a malignancy rate of 9/165 (5.5%) in this study, which is above the 2% threshold of a BI-RADS 3 assessment category.
- However, circumscribed masses with persistent kinetics had a 0% malignancy rate (0/84 with available kinetics data). Oval circumscribed masses without washout kinetics had a 0% malignancy rate (0/92 with available kinetics data).

Previous studies reporting outcomes of circumscribed masses on MRI have found a wide range of malignancy rates from 0 to 24% (4–12) with one study reporting an unusually high malignancy rate of 58% (15). Specifically, the reported malignancy rate ranges from 0 to 19% for Breast Imaging Reporting and Data System (BI-RADS) assessment category 3 (BI-RADS 3) circumscribed masses (6–8,10–12), from 7% to 58% for BI-RADS 4 circumscribed masses (4,5,9,15) and from 0 to 5% in studies with mixed BI-RADS 3 and BI-RADS 4 patient populations (13,14). This wide variability may reflect variation in methodologies and patient populations. Notably, although several studies report a malignancy rate of 2% or less (7,11,12,14), the majority of previous studies report a malignancy rate of more than 2% (4–6,8–10,13,15), raising concerns of whether a circumscribed mass seen by MRI should ever be assigned a BI-RADS 3 assessment category, which is defined as having a malignancy rate of 2% or lower (16). Additionally, almost all these previous studies have sample sizes of fewer than 100 patients, which supports the need for further data on this topic.

Breast MRI is unique among the breast imaging modalities because of its ability to provide physiologic information in addition to anatomic morphology such as shape and margins. For example, the internal T2 signal, internal enhancement pattern, and dynamic contrast enhancement kinetics provide physiologic information only available by MRI. There is sparse literature reporting MRI features that can be used to reliably triage circumscribed masses seen on MRI into a BI-RADS 3 assessment category (those with less than 2% chance of malignancy that can safely undergo short term follow-up imaging) rather than a BI-RADS 4 assessment category (those requiring biopsy). This study aims to report the malignancy rate of circumscribed masses seen on breast MRI at our institution and to assess whether specific clinical or imaging features are associated with malignancy.

Methods

In this retrospective, Health Insurance Portability and Accountability Act–compliant, institutional review board–approved study, the need for informed consent was waived. Breast MRI exams performed between April 1, 2008, and August 30, 2020, that contained the keywords "circumscribed" and "mass" in the radiology report were reviewed. This patient population has not been previously reported by any of the authors for this research question. Exams were considered eligible if (1) a circumscribed mass was assigned a BI-RADS 3 assessment and either had two years of stable breast imaging follow-up or was declared benign during follow-up due to a decrease in size, or (2) a circumscribed mass was assigned a BI-RADS 4 assessment with available pathology for the mass. Exclusion criteria included (1) masses that were one of multiple, bilateral, circumscribed masses; (2) findings measuring less than 5 mm because typically these findings are considered foci at our institution; (3) masses that had already undergone biopsy; and (4) masses that yielded high risk pathology at core-needle biopsy but were not excised and had less than two years of breast imaging follow-up. Note that this was a study evaluating circumscribed masses only; masses with irregular or spiculated margins were excluded. In this study, high-risk lesions were defined as those lesions that are typically referred for surgical consultation for possible excision at our institution. At our institution, these include atypical ductal hyperplasia, atypical lobular hyperplasia, lobular carcinoma in situ, flat epithelial atypia, papilloma, radial scar/complex sclerosing lesion, fibroepithelial lesion, mucinous lesions, and vascular proliferation.

Image Acquisition

During the study period, breast MRIs may have been performed on one of several MRI units, most commonly a 1.5T Discovery (GE Healthcare, Chicago, IL) scanner using a 16-channel dedicated breast coil (Invivo Sentinelle, Dunlee, The Netherlands), a 3T Skyra (Siemens Healthineers, Erlangen, Germany) scanner using a 16-channel breast coil (Siemens Healthineers), or a 3T Trio (Siemens Healthineers) scanner using a 16-channel breast coil (Invivo Sentinelle). Sequences acquired at our institution included a T1-weighted series without fat saturation, a T2-weighted series with fat saturation, and pre- and post-contrast axial T1-weighted images with fat saturation after the administration of 0.1 mmol/kg gadolinium-based contrast agent. Prior to 2013, pre- and post-contrast images were acquired in the sagittal plane at some locations within our institution. After 2013, all images were acquired in the axial plane.

Data Collection

Retrospective chart review was performed by six breast imaging radiologists (experience 3 to 25 years) to obtain clinical information for each eligible exam, including patient age, the indication for the exam, risk factors for breast cancer, the availability of prior exams, biopsy details, pathology outcomes, and follow-up data. MRI features were also reviewed and recorded by the same radiologists, including size, shape, internal enhancement pattern, signal intensity on the T2-weighted series, and dynamic contrast enhancement kinetics (if available). If the only available prior exam was

performed with an acquisition protocol so different from the current exam that reliable comparison was thought to be compromised, this was recorded as a "limited comparison."

Statistical Analysis

Associations between categorical variables and malignancy were assessed using Fisher's exact test, and associations between numeric variables and malignancy were assessed using Wilcoxon rank sum test. To estimate the odds ratio of malignancy, Firth logistic regressions estimated using penalized likelihood were fitted to the data to reduce small-sample bias in maximum likelihood estimation (17). All statistical analyses were performed using Stata (version 17, Statacorp, College Station, TX), and for all analyses $P < 0.05$ was considered statistically significant.

Results

Between April 1, 2008, and August 30, 2020, a total of 511 potentially eligible MRI exams were performed. Three hundred and forty-nine did not meet study criteria, yielding a total of 165 eligible circumscribed masses in 158 female patients (Figure 1). Five patients had one circumscribed mass in each breast, and two patients had more than one ipsilateral circumscribed mass. The mean patient age was 48 years (range 25 to 72 years, SD 12.0 years), with most women undergoing breast MRI for high-risk screening (83/165, 50%) or extent of disease (52/165, 31.5%) (Table 1). Twenty one of 165 masses (12.7%) were in patients with a known genetic predisposition for breast cancer.

Malignancy Rate and Pathology Outcomes

The overall malignancy rate of circumscribed masses was 9/165 (5.5%). Of the eligible masses, 38/165 (23.0%) were initially assigned a BI-RADS 3 assessment, and 127/165 (77.0%) were assigned a BI-RADS 4 assessment. The malignancy rate among BI-RADS 3 masses was 0/38 (0%), and among BI-RADS 4 masses it was 9/127 (7.1%). Of the BI-RADS 3 masses, 26/38 (68.4%) showed at least two years of stability, 5/38 (13.2%) decreased or resolved during the follow-up, 3/38 (7.9%) underwent biopsy because of patient preference (all with a benign result), and 6/38 (15.8%) underwent biopsy during the follow-up period with a benign result. Among the BI-RADS 4 masses, 60/127 (47.2%) underwent successful MRI-guided biopsy, 1/127 (0.8%) underwent attempted MRI-guided biopsy that was canceled because of nonvisualization (with 4.7 years of subsequent MRI follow-up), 54/127 (42.5%) underwent US-guided biopsy, 1/127 (0.8%) underwent stereotactic-guided biopsy, 2/127 (1.6%) underwent surgical excision without preceding core-needle biopsy, and 10/127 (7.9%) did not undergo biopsy but either decreased in size during follow-up or showed at least two years of imaging stability. The method of biopsy was not associated with malignancy ($P = 0.651$).

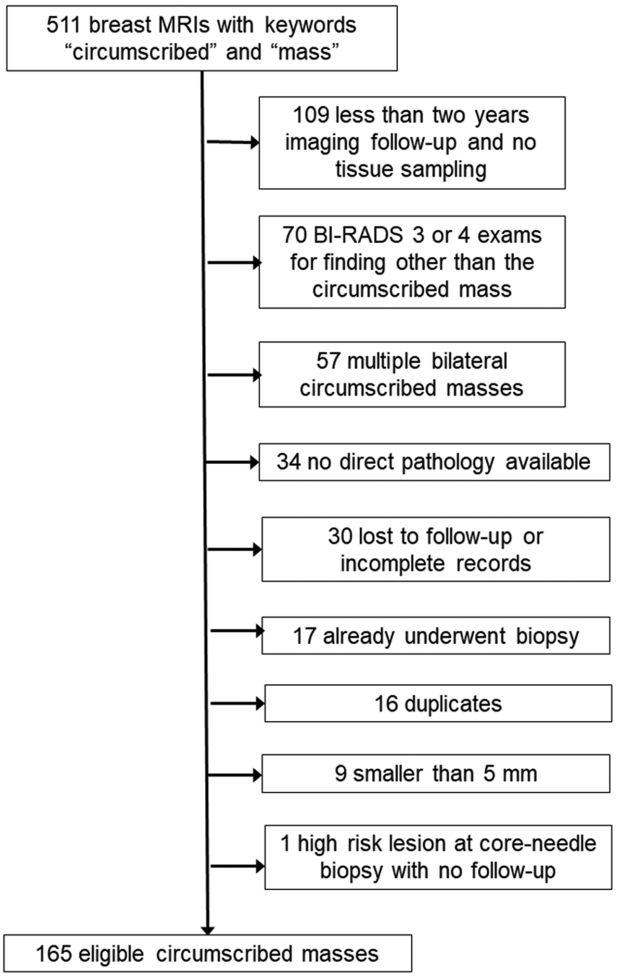

Figure 1. Flowchart of circumscribed breast masses seen by MRI, yielding 165 eligible masses.

The specific pathology results of the eligible masses are shown in Table 2. Nine of the 165 masses (5.5%) yielded a malignant result, with invasive ductal carcinoma being the most common malignancy subtype (7/9, 77.8%) (Figure 2). The remaining 156/165 (94.5%) of masses were declared benign, including 39/165 (23.6%) that did not undergo tissue sampling but were declared benign after at least two years of imaging stability or decreased in size during follow-up. Of the 117 masses with benign pathology, the most common pathology was fibroadenoma (47/117, 40.2%) (Figure 3). Twenty-two of the 165 masses (13.3%) represented high-risk lesions that were not upgraded at surgical excision and/or demonstrated more than two years imaging stability. Only one lesion considered to be high-risk at our institution did not undergo excision, which was a 6 mm fibroepithelial lesion. Because the mass demonstrated 32 months of MRI stability, it was considered benign.

Associations Between Clinical Characteristics and Malignancy

There was no significant difference in patient age for benign masses (mean 48.1 years, SD 11.9 years) compared

Table 1. Clinical Characteristics of 165 Circumscribed Masses and Odds of Malignancy

Clinical Characteristic	Incidence, *n* (%) *N* = 165	Malignant Masses, *n* (%) *N* = 9	Odds Ratio (95% CI)	*P*-value
Indication for MRI				0.59
High-risk screening	83 (50.3)	4 (4.8%)	1.0 (ref)	-
Extent of disease	52 (31.5)	4 (7.7%)	1.6 (0.4–6.4)	-
Physical exam finding including nipple discharge	12 (7.3)	1 (8.3%)	2.3 (0.3–16.2)	-
Further evaluation of imaging findings	18 (10.9)	0 (0%)	0.5 (0.02–9.3)	-
Current breast cancer				0.004*
Yes, ipsilateral	15 (9.1)	1 (6.7%)	1.0 (ref)	-
Yes, contralateral	31 (18.8)	1 (3.2%)	0.5 (0.05–5.0)	-
Metastasis to ipsilateral axilla with unknown primary	2 (1.2)	2 (100%)	48.3 (1.5–1554)	-
No	117 (70.9)	5 (4.3%)	0.5 (0.1–1.1)	-
Strong family history				0.69
Yes	42 (25.5)	3 (7.1%)	1.0 (ref)	-
No	123 (74.5)	6 (4.9%)	0.6 (0.2–2.4)	-
Personal history of breast cancer				0.6
Yes	19 (11.5)	0 (0%)	1.0 (ref)	-
No	146 (88.5)	9 (6.2%)	2.7 (0.2–48.2)	-
Genetic predisposition for breast cancer				0.34
Yes	21 (12.7)	2 (9.5%)	1.0 (ref)	-
No	65 (39.4)	2 (3.1%)	0.3 (0.05–1.9)	-
Unknown	79 (47.9)	5 (6.3%)	0.6 (0.1–2.8)	-

*Statistically significant.

to malignant masses (mean 54.3 years, SD 10.6 years) ($P = 0.12$). There was no association between any risk factor for breast cancer (strong family history of breast cancer, personal history of breast cancer, genetic predisposition for breast cancer) and malignancy ($P > 0.05$ for all) (Table 1). Both cases of circumscribed masses ipsilateral to a known axillary metastasis (with unknown primary tumor location) were malignant (2/2, 100% malignancy rate) compared to 1/15 (6.7%) in patients with ipsilateral cancer, 1/31 (3.2%) in patients with contralateral cancer, and 5/117 (4.3%) in patients without current breast cancer ($P = 0.004$).

Associations of Imaging Features and Malignancy

Round shape, compared to oval shape, was significantly associated with malignancy because 7/37 (18.9%) round masses were malignant compared to 2/128 (1.7%) oval masses (OR 12.4, 95% CI: 2.8–54.9) ($P < 0.001$) (Table 3). The only two malignant oval masses both demonstrated washout kinetics, such that the malignancy rate for oval masses with washout kinetics was 2/19 (10.5%), compared to no malignancies for oval masses with persistent kinetics, plateau kinetics, or kinetics below the color threshold (0/92, 0%) ($P = 0.028$). There was also a significant association between the dynamic contrast kinetics of a mass and malignancy, with a malignancy rate of 0/84 (0%) for masses with persistent kinetics, 2/23 (8.7%) for masses with plateau kinetics, and 4/24 (16.7%) for masses with washout kinetics ($P = 0.002$). Kinetics were below the color threshold for 7/165 (4.2%) masses and unavailable for 27/165 (16.4%) masses.

Although the malignancy rate for masses in patients with almost entirely fat tissue (1/5, 20%) and scattered fibroglandular tissue (4/30, 13.3%) was higher than in patients with heterogeneous fibroglandular tissue (3/94, 3.2%) and extreme fibroglandular tissue (1/36, 2.8%), this was not statistically significant ($P = 0.057$). There was no association between malignancy and the signal intensity on T2-weighted images, internal enhancement pattern, the presence of up to two gentle lobulations, or the degree of background parenchymal enhancement ($P > 0.05$ for all). Similarly, there was no statistically significant difference in the distribution of lesion size between benign masses (median 7 mm, 25th to 75th percentile: 6 to 9 mm) and malignant masses (median 6 mm, 25th–75th percentile: 6 to 7 mm) ($P = 0.14$).

The malignancy rate for new circumscribed masses was 3/23 (13%), but this was not significantly different compared to the malignancy rate among masses that were increased in size (1/16, 6.3%), stable (0/14, 0%), had a limited

Table 2. Pathology Results of 165 Circumscribed Masses on Breast MRI

Pathology Result	*n*/*N* (%)
Malignant	9/165 (5.5)
IDC	7/9 (77.8)
IMC	1/9 (11.1)
DCIS	1/9 (11.1)
High-risk lesion[a]	22/165 (13.3)
ADH	5/22 (22.7)
LCIS	3/22 (13.6)
ALH	2/22 (9.1)
Papilloma without atypia	8/22 (36.4)
Papilloma with atypia	1/22 (4.5)
Fibroepithelial lesion	1/22 (4.5)
Radial scar/ complex sclerosing lesion	1/22 (4.5)
Vascular proliferation or hemangioma	1/22 (4.5)
Benign	95/165 (57.6)
Fibroadenoma	47/95 (49.5)
fibrocystic change	12/95 (12.6)
Fibroadenomatoid change	8/95 (8.4)
Stromal fibrosis	6/95 (6.3)
Adenosis	5/95 (5.3)
Dense fibrosis	3/95 (3.2)
Benign breast tissue	3/95 (3.2)
Fat necrosis	2/95 (2.1)
Micropapilloma	2/95 (2.1)
Lymph node	2/95 (2.1)
PASH	2/95 (2.1)
Papillary apocrine metaplasia	1/95 (1.1)
Cystic apocrine metaplasia	1/95 (1.1)
Myofibroblastoma	1/95 (1.1)
Benign by imaging follow-up[b]	39/165 (23.6)

Abbreviations: ADH, atypical ductal hyperplasia; ALH, atypical lobular hyperplasia; DCIS, ductal carcinoma in situ; IDC, invasive ductal carcinoma; IMC, invasive mammary carcinoma; LCIS, lobular carcinoma in situ; PASH, pseudoangiomatous stromal hyperplasia.
[a]All benign high-risk lesions underwent surgical excision or demonstrated at least two years of breast imaging stability.
[b]Either by at least two years of imaging stability or decrease in size at follow-up; pathology not available.

comparison (0/3, 0%), or had no prior exams available (5/109, 4.6%). The only two malignant oval masses were new masses in patients with a known genetic predisposition for breast cancer, and both masses also showed washout kinetics. Only 15 masses in this study were in patients with a known ipsilateral breast cancer: 11/15 (73.3%) were oval (malignancy rate 0/11, 0%), and 4/15 (26.7%) were round (malignancy rate 1/4 (25.0%).

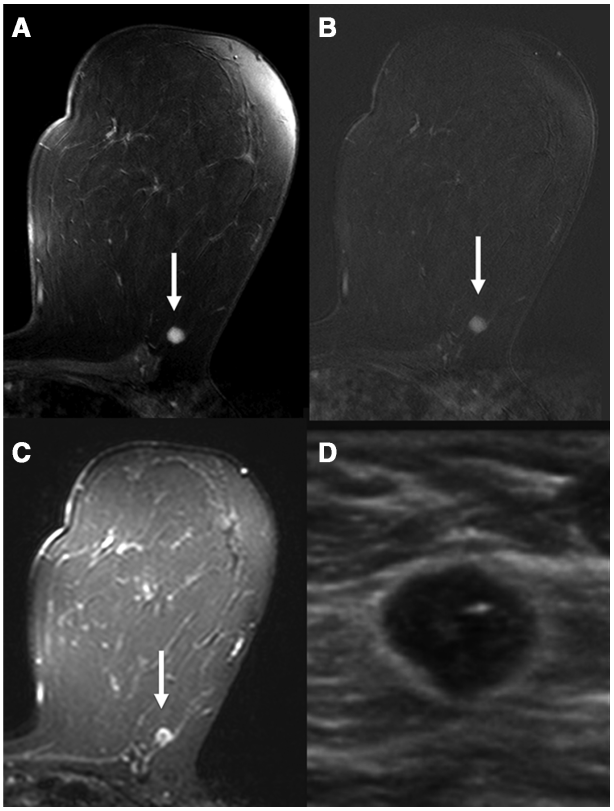

Figure 2. Images of a 56-year-old female with a new diagnosis of right breast cancer and a round, circumscribed, T2 hyperintense mass (arrows) with homogeneous enhancement in the left breast upper outer quadrant seen on axial T1-weighted post-contrast (**A**), axial subtraction series (**B**), and axial T2-weighted series (**C**) of a breast MRI performed to evaluate the extent of disease in the right breast. Kinetics data were not available for this mass. MRI-directed US was performed (**D**), with US-guided biopsy yielding invasive ductal carcinoma.

Imaging Follow-up

For the 121/165 (73.3%) masses that were not excised (including the 39 masses that did not undergo sampling and the 82 masses with benign pathology result that were not excised), mean follow-up time was 20.3 months (SD 25.5 months, range 0 to 115.0 months). Eleven of the 39 (28.2%) unsampled masses decreased or resolved during follow-up and were declared benign. The remaining 28 unsampled masses that did not decrease or resolve during follow-up demonstrated imaging stability during a mean follow-up time of 40.0 months (SD 22.4 months, range 24 to 115 months).

Discussion

There are limited MRI data to guide the management of circumscribed masses seen on breast MRI. In this study, the malignancy rate among all eligible circumscribed MRI breast masses was 5.5% (9/165), which is similar to previous reports and higher than the 2% threshold needed to assign a BI-RADS 3 assessment category (16). However, two

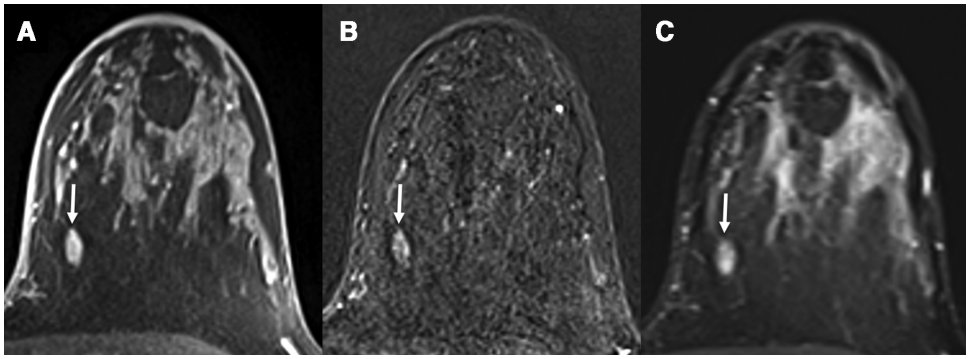

Figure 3. Images of a 45-year-old female undergoing high-risk screening breast MRI due to family history of breast cancer who was found to have an oval, circumscribed, T2 hyperintense enhancing mass (arrows) with dark internal septations in the left breast upper inner quadrant on axial T1-weighted post-contrast **(A)**, axial subtraction series **(B)**, and axial T2-weighted series **(C)**. MRI-guided biopsy yielded a fibroadenoma. The finding was stable at follow-up MRI 11 months later.

subgroups of circumscribed masses did show malignancy rates of 0% in this study: oval shape without washout kinetics (0/92) and persistent kinetics (0/84).

Current management guidelines group all circumscribed mammographic masses into one management guidance category (2), but this may be less appropriate for MRI, which provides additional physiologic information. One possible explanation is that a round circumscribed mammographic mass may, in fact, represent a complicated cyst but is nonetheless included in the data for round circumscribed masses. Similarly, US findings of an oval circumscribed mass or a solitary complicated cyst (which is often round and circumscribed) on a baseline exam are both indications for a BI-RADS 3 Assessment Category (3). However, there is an overlap in the sonographic appearance of complicated cysts and round circumscribed solid masses, with prior studies demonstrating that less than 2% of presumed complicated cysts are actually solid malignant masses (18,19). In contrast, MRI can reliably and definitively diagnose a complicated cyst, such that reported enhancing round circumscribed MRI breast masses typically represent solid masses.

There are scarce data regarding the malignancy rate of round versus oval circumscribed masses seen by mammogram or US. Multiple studies have evaluated round versus oval shape for mammographic and sonographic masses with any margin (20–24); however, these studies included masses with noncircumscribed margins. Although these studies report a different population than the current study, it is important to note that round shape with any margin has been shown to have a higher malignancy rate than oval shape and is included as a sonographic feature favoring malignancy in a pictorial review by Raza et al (25).

Although the malignancy rate of oval circumscribed masses was <2% in our study, it is noted that Price et al (4) reported a malignancy rate of 2/37 (5%) for oval circumscribed masses and Grimm et al (6) reported a malignancy rate of 1/44 (2.3%) for oval masses with any margin. Slice thickness for exams performed at our institution were similar to that reported by Price et al (4), with slice thickness not reported in the study by Grimm et al (6). The subgroup of oval circumscribed masses without washout kinetics had a 0% malignancy rate (0/92) in this study. This emphasizes the need for larger studies to further define whether oval circumscribed masses, especially those without washout kinetics, meet the 2% malignancy rate threshold of a BI-RADS 3 assessment category as these data suggest. Additionally, although the American Cancer Society recommends supplemental MRI screening for women with >20% lifetime risk for breast cancer, screening mammography without MRI is recommended for average-risk women (26). The difference in outcomes of mammography findings compared to MRI findings could therefore also be impacted by a difference in the populations undergoing the exams.

Although it is well established that MRI breast masses with persistent kinetics have a lower malignancy rate than plateau or washout kinetics, there are limited data regarding whether the malignancy rate of MRI masses with both circumscribed margins and persistent kinetics have a malignancy rate of <2%, as such subgroup analyses of masses are not available in the literature (4,6). In this study, circumscribed breast MRI masses that show persistent kinetics had a 0% malignancy rate (0/84), suggesting that a BI-RADS 3 assessment category may be appropriate if a malignancy rate of <2% is confirmed with larger studies.

T2-hyperintensity and a homogeneous internal enhancement pattern are often considered benign-appearing features (27). In this study, both features showed a malignancy rate of >2% but with no statistically significant difference compared to other T2-signal categories or other internal enhancement patterns, respectively. Our findings could possibly be due to the total sample size of 165 masses, but they also suggest the possibility that other MRI features (such as oval versus round shape and kinetics information) could provide a stronger association with benignity than T2 signal or internal enhancement pattern for circumscribed masses. Larger studies are needed to clarify whether these features alone have a malignancy rate below the BI-RADS 3 assessment category threshold of 2%.

Table 3. MRI Features of 165 Circumscribed Masses and Odds of Malignancy

Imaging Feature	Incidence, *n* (%) *N* = 165	Malignant Masses, *n* (%) *N* = 9	Odds Ratio (95% CI)	*P*-value
Shape				<0.001*
Oval	128 (77.6)	2 (1.7)	1.0 (ref)	
Round	37 (22.4)	7 (18.9)	12.4 (2.8–54.9)	
T2				0.84
Low	10 (6.1)	0 (0)	1.0 (ref)	
Isointense	51 (30.9)	2 (3.9)	1.1 (0.05–23.7)	
High	104 (63.0)	7 (6.7)	1.6 (0.1–30.3)	
Kinetics				0.002*
Below color threshold	7 (4.2)	0 (0)	1.0 (ref)	
Persistent	84 (50.9)	0 (0)	0.1 (0.002–4.8)	
Plateau	23 (13.9)	2 (8.7)	1.7 (0.1–40.6)	
Washout	24 (14.5)	4 (16.7)	3.3 (0.2–68.8)	
Not available	27 (16.4)	3 (11.1)	2.1 (0.1–46.3)	
Lobulations				0.69
One or two gentle lobulations	32 (19.4)	2 (6.2)	1.0 (ref)	
None	133 (80.6)	7 (5.3)	0.7 (0.2–3.2)	
Comparison to prior exams				0.46
New mass	23 (13.9)	3 (13)	1.8 (0.2–13.3)	
Increased in size	16 (9.7)	1 (6.3)	1.0 (reference)	
Stable	14 (8.5)	0 (0)	0.4 (0.01–9.5)	
Limited comparison	3 (1.8)	0 (0)	1.5 (0.05–44.4)	
No comparisons available	109 (66.1)	5 (4.6)	0.5 (0.1–3.6)	
Amount of fibroglandular tissue				0.057
Fatty	5 (3.0)	1 (20.0)	1.0 (ref)	
Scattered	30 (18.2)	4 (13.3)	0.5 (0.1–4.2)	
Heterogeneous	94 (57.0)	3 (3.2)	0.1 (0.01–1.0)	
Extreme	36 (21.8)	1 (2.8)	0.1 (0.01–1.5)	
Background parenchymal enhancement				0.68
Minimal	28 (17.0)	2 (7.1)	1.0 (ref)	
Mild	67 (40.6)	5 (7.5)	0.9 (0.2–4.5)	
Moderate	56 (33.9)	2 (3.6)	0.5 (0.1–3.0)	
Marked	14 (8.5)	0 (0)	0.4 (0.02–8.1)	
Internal enhancement pattern				0.12
Homogeneous	91 (55.2)	5 (5.5)	1.0 (ref)	
Heterogeneous	36 (21.8)	0 (0)	0.2 (0.01–4.0)	
Rim enhancement	6 (3.6)	1 (16.7)	4.3 (0.6–31.7)	
Dark internal septations	32 (19.4)	3 (9.4)	1.9 (0.5–7.6)	

*Statistically significant.

The malignancy rate for circumscribed masses that were new compared to the prior exam (3/23, 13%) was higher than for masses that increased in size (1/16, 6.3%) and those seen on a baseline exam (5/109, 4.6%), although this did not reach statistical significance (P = 0.46). However, the malignancy rate of 13% for new masses supports the current standard of care to biopsy masses that are new, regardless of the margins of the mass unless definitively benign by another modality. Although there were no malignancies in our study among oval masses without washout kinetics or

in circumscribed masses with persistent kinetics, even if new, larger studies are needed to define management in these specific clinical situations. Two circumscribed masses were detected on breast MRI performed to evaluate for an unknown primary in patients with known axillary lymph node metastases, and both were malignant (2/2, 100%). This supports a high level of suspicion for circumscribed masses seen in the setting of ipsilateral axillary metastasis with unknown primary site. The two malignant oval masses were both new masses with washout kinetics in patients with a known genetic predisposition for breast cancer. Only 21/165 (12.7%) of the masses in this study were in patients with a known genetic predisposition for breast cancer, and larger studies in this population are needed.

Our study has several limitations. Although our study of circumscribed breast masses seen by MRI is large compared to other studies, the sample size is still relatively small, such that additional studies are needed to further define which masses may be appropriately given a BI-RADS 3 assessment. Kinetics data were not available for 16.4% (27/165) of masses. This study was retrospective and also was performed at a large academic center with dedicated breast radiologists, such that results may not be generalizable to other practice settings. Additionally, over the 12-year study period, multiple MRI scanners and protocols were used, including different sequence parameters and different magnet strength MRI machines. However, this variation may be representative of general practice.

Conclusion

In this study, 5.5% (9/165) of circumscribed breast masses seen by MRI were malignant. The only imaging features with <2% malignancy rate were oval shape without washout kinetics (0/92, 0%) and persistent kinetics (0/84, 0%). If confirmed with larger studies, these features may allow for a more targeted approach for the management of circumscribed breast masses on breast MRI.

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Conflict of Interest Statement

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Supplementary Material

Supplementary material is available at *Journal of Breast Imaging* online.

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