İstanbul Med J 2026; 27(4): 299-307
DOI: 10.4274/imj.galenos.2026.82652

Breast Manifestations of Hematologic Malignancies: Imaging Spectrum and Clinicopathologic Correlation in a Two-Center Retrospective Cohort

Mehmet Ali Nazlı[1], Emel Esmerer[1], Canan Kelten Talu[2]

[1]University of Health Sciences Türkiye, Başakşehir Çam and Sakura City Hospital, Clinic of Radiology, İstanbul, Türkiye
[2]University of Health Sciences Türkiye, İzmir Tepecik Training and Research Hospital, Department of Pathology, İzmir, Türkiye

ABSTRACT

Introduction: To characterize the clinicopathologic features and multimodality imaging spectrum of breast involvement by hematologic malignancies and to identify imaging findings that may facilitate differentiation from primary breast carcinoma.

Methods: This retrospective two-center study included consecutive patients with histopathologically confirmed breast involvement by hematologic malignancies between January 2015 and December 2025. Clinical records, pathology reports, mammography, ultrasonography, magnetic resonance imaging (MRI), and fluorodeoxyglucose positron emission tomography/computed tomography (FDG PET/CT) examinations were reviewed. Imaging findings were analyzed with emphasis on lesion morphology, distribution pattern, laterality, nodal involvement, and systemic disease burden.

Results: Seventeen patients with breast involvement by hematologic malignancies were identified among approximately 5.300 malignant breast biopsy specimens (0.3%). Mean age was 52.8 years (range, 18-86 years), and 15 patients (88.2%) were female. Histopathologic diagnoses included lymphoma (76.5%), leukemia/chronic lymphocytic leukemia (17.6%), and plasma cell neoplasm (5.9%). Solitary breast lesions were observed in 52.9% of patients, multiple lesions in 47.1%, and bilateral involvement in 41.2%. Associated nodal disease was present in 47.1% of cases. Mammographically suspicious calcifications were absent in all patients. The predominant imaging presentation consisted of oval, round, or mildly lobulated masses with circumscribed or partially circumscribed margins. Three principal sonographic patterns were identified: solitary nodular lesions, multifocal or bilateral nodular disease, and diffuse infiltrative involvement. MRI frequently demonstrated enhancing masses with diffusion restriction or extensive non-mass enhancement, whereas FDG PET/CT commonly revealed concurrent nodal and systemic disease.

Conclusion: Breast involvement by hematologic malignancies demonstrates substantial imaging heterogeneity. Multifocal or bilateral disease, circumscribed nodular lesions, absence of suspicious calcifications, associated lymphadenopathy, and concurrent systemic involvement should raise suspicion for a hematologic origin and prompt appropriate clinicopathologic correlation.

Keywords: Hematologic malignancies, breast involvement, lymphoma, leukemia, breast imaging.

Introduction

Breast involvement by hematologic malignancies is an uncommon clinical entity that encompasses a heterogeneous group of disorders, including lymphomas, leukemias, and, less frequently, plasma cell neoplasms. Although hematologic malignancies represent one of the most common non-mammary malignancies involving the breast, breast manifestations remain rare compared with primary breast carcinoma and account for only a small proportion of all malignant breast lesions (1-4). Breast involvement may occur either as the initial manifestation of an underlying hematologic malignancy or as secondary involvement in patients with known systemic disease. Accurate recognition is clinically important because management strategies differ fundamentally from those used for primary breast cancer, and misdiagnosis may result in unnecessary surgery, inappropriate staging, and delays in hematologic treatment (5,6).

The imaging appearance of hematologic malignancies involving the breast is heterogeneous and frequently overlaps with that of primary breast carcinoma (2,7-10). Lesions may present as solitary or multifocal masses, diffuse infiltrative disease, or bilateral breast involvement, and often demonstrate a relatively circumscribed morphology without suspicious calcifications. Consequently, histopathologic confirmation and clinic radiologic correlation remain essential for accurate diagnosis (5,11).

Address for Correspondence: Mehmet Ali Nazlı, MD, University of Health Sciences Türkiye, Başakşehir Çam and Sakura City Hospital, Clinic of Radiology, İstanbul, Türkiye
E-mail: mnazli46@yahoo.com **ORCID ID:** orcid.org/0000-0003-4605-7822
Cite this article as: Nazlı MA, Esmerer E, Kelten Talu C. Breast manifestations of hematologic malignancies: imaging spectrum and clinicopathologic correlation in a two-center retrospective cohort. İstanbul Med J. 2026; 27(4): 299-307

Received: 15.06.2026
Accepted: 26.07.2026
Publication Date: 30.10.2026

©Copyright 2026 by the University of Health Sciences Türkiye, İstanbul Training and Research Hospital/İstanbul Medical Journal published by Galenos Publishing House.
Licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 (CC BY-NC-ND) International License

Among hematologic malignancies, lymphoma represents the most frequently reported breast manifestation, whereas breast involvement by leukemia is considerably less common and remains largely described in isolated case reports and small series (2,3,9). Furthermore, hematologic malignancies may involve the breast through diverse biological mechanisms, including hematogenous dissemination, lymphatic spread, diffuse stromal infiltration, or direct extension from adjacent lymphatic structures. Despite increasing recognition of this entity, the available literature remains limited. Most published studies have focused on primary breast lymphoma, isolated leukemia cases, pictorial reviews, or mixed cohorts of secondary breast involvement from various extramammary malignancies (1-3,10-12). Comprehensive studies evaluating the multimodality imaging spectrum of both lymphoma and leukemia with detailed clinicopathologic correlation remain scarce.

Therefore, the aim of this study was to characterize the clinicopathologic features and the multimodality imaging spectrum of breast involvement by hematologic malignancies in a two-center retrospective cohort.

Methods

Study Design and Patient Population

Patients were identified through a systematic search of institutional pathology databases, radiology information systems, picture archiving and communication systems (PACSs), and electronic medical records. Search terms included the following: "lymphoma," "leukemia," "hematologic malignancy," "breast involvement," "breast infiltration," and related diagnostic terminology. Consecutive patients with histopathologically confirmed breast involvement by hematologic malignancies, diagnosed between January 2015 and December 2025, were eligible for inclusion.

Breast involvement was defined as histopathologically confirmed infiltration of breast tissue by lymphoma, leukemia, or other hematolymphoid neoplasms. Both patients with previously established hematologic malignancies and patients in whom breast involvement represented the initial manifestation of disease were included. Cases with insufficient imaging examinations, indeterminate pathologic diagnosis, inadequate clinicopathologic information, or unavailable pathology material for review were excluded. The final cohort included patients with lymphoma, leukemia/chronic lymphocytic leukemia (CLL), and plasma cell neoplasms involving the breast.

Clinical and Pathologic Evaluation

Clinical information was retrospectively retrieved from electronic medical records and pathology archives. Recorded variables included age, sex, presenting symptoms, lesion laterality, lesion multiplicity, largest lesion diameter, history of hematologic malignancy, breast involvement as the initial manifestation of the disease, and concurrent systemic disease.

Histopathologic diagnoses were established using ultrasound-guided core needle biopsy, vacuum-assisted biopsy, excisional biopsy, surgical specimens, or lymph node biopsy when clinically indicated. All available pathology reports, histologic slides, and immunohistochemical findings were reviewed by dedicated hematopathologists and breast pathologists at the participating institutions.

Histologic classification was performed according to the 5th edition of the World Health Organization (WHO) Classification of Haematolymphoid Tumours. Breast involvement by a hematologic malignancy was diagnosed based on characteristic morphologic findings and immunophenotypic confirmation.

For lymphoma cases, the diagnosis was established through morphological assessment and immunophenotypic characterization using lineage-specific markers when appropriate, including CD20, CD3, CD5, CD10, CD23, BCL2, BCL6, MUM1, Cyclin D1, CD30, ALK, and Ki-67. Lymphoma subtypes were classified according to current WHO criteria.

In cases of leukemia, the diagnosis was established using morphologic findings together with immunophenotypic and immunohistochemical markers, including CD45, TdT, MPO, CD34, CD117, CD13, CD33, CD19, CD79a, CD10, and other lineage-specific markers, according to the underlying leukemia subtype. When available, bone marrow biopsy findings, flow cytometry results, and cytogenetic analyses were reviewed to support the diagnosis.

Particular attention was paid to differentiating hematologic malignancies from primary breast carcinoma and from secondary breast involvement by solid tumors. Cases demonstrating atypical morphology, bilateral disease, diffuse infiltration, multiple lesions, or clinic radiologic-pathologic discordance underwent expanded immunohistochemical evaluation. Breast-specific markers, including estrogen receptor (ER), progesterone receptor (PR), human epidermal growth factor receptor 2, GATA3, mammaglobin, and gross cystic disease fluid protein-15, were used when clinically indicated. In all evaluated cases, the absence of mammary epithelial marker expression supported a hematolymphoid origin rather than a primary mammary origin. Pathologists were specifically informed that the biopsy specimens originated from breast lesions suspicious for either primary breast carcinoma or hematologic involvement, and clinic radiologic correlation was systematically performed in all cases.

The final diagnosis was established through the integration of histopathologic findings, immunophenotypic profile, clinical history, imaging findings, and multidisciplinary clinicopathologic correlation.

Imaging Analysis

Available mammography (MG), ultrasonography (US), breast magnetic resonance imaging (MRI), and fluorodeoxyglucose positron emission tomography/computed tomography (FDG PET/CT) examinations were retrospectively reviewed. All imaging studies were independently evaluated by two fellowship-trained breast radiologists with more than 10 years of experience. The review was performed using the institutional PACS. Any discrepancies were resolved by consensus.

Imaging findings were assessed according to the American College of Radiology Breast Imaging Reporting and Data System (BI-RADS) lexicon, where applicable. Mammographic variables included breast density, lesion type, shape, margins, calcifications, architectural distortion, skin thickening, nipple retraction, and associated axillary findings.

Ultrasonographic assessment included lesion size, shape, orientation, margins, echogenicity, posterior acoustic features, internal vascularity, lesion distribution, skin involvement, chest wall extension, and regional lymph node status.

MRI examinations were reviewed for lesion morphology, mass vs. non-mass enhancement, internal enhancement characteristics, T2-weighted signal intensity, diffusion restriction, apparent diffusion coefficient values, dynamic enhancement kinetics, time-to-peak enhancement, multifocality, multicentricity, skin involvement, chest wall invasion, and associated regional nodal disease.

FDG PET/CT examinations were assessed for the presence, distribution, and intensity of FDG uptake in the breast. Maximum standardized uptake values (SUVmax) were recorded when available. Additional variables evaluated included regional nodal involvement, extranodal disease burden, bone marrow involvement, extranodal organ involvement, and disseminated systemic disease.

Based on overall imaging appearance, breast involvement was categorized into four major imaging patterns: solitary mass-forming lesion, multiple lesions, diffuse infiltrative involvement, and bilateral involvement.

Study Endpoints

The primary endpoint of the study was to characterize the clinicopathologic and multimodality imaging spectrum of breast involvement by hematologic malignancies.

Secondary endpoints included evaluation of lesion distribution patterns, systemic disease burden, and imaging features potentially suggestive of hematologic breast involvement.

Statistical Analysis

Descriptive analyses were performed using IBM SPSS Statistics, version 30.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean (range) or median (range), as appropriate, and categorical variables as frequencies and percentages. Given the small cohort size, no formal hypothesis testing was performed.

Ethics Statement

This study was conducted under ethics approval granted for a broader retrospective investigation of breast involvement by non-primary breast malignancies (Approval No: 2026-60; Date: 04.02.2026). The current analysis represents the hematologic malignancy subgroup of the approved study. The study was conducted in accordance with the Declaration of Helsinki.

Results

Patient Characteristics

During the study period, approximately 5.300 breast biopsy specimens demonstrating malignant involvement were identified across the two participating institutions. Among these cases, 17 patients were diagnosed with breast involvement from hematologic malignancies, corresponding to approximately 0.3% of all malignant breast biopsy specimens. A total of 17 patients with breast involvement by hematologic malignancies were included in the final study cohort. The mean age at diagnosis was 52.8 years (range, 18-86 years). Fifteen patients (88.2%) were female, and two (11.8%) were male. Detailed demographic, clinical, and pathologic characteristics are summarized in Table 1.

Histopathologic diagnoses included lymphoma in 13 patients (76.5%), chronic lymphocytic leukemia (CLL) in three patients (17.6%), and plasma cell neoplasm (multiple myeloma) in one patient (5.9%) (Table 1). The lymphoma subgroup comprised diffuse large B-cell lymphoma, follicular lymphoma, mucosa-associated lymphoid tissue lymphoma, plasmablastic lymphoma, high-grade B-cell lymphoma, lymphoblastic lymphoma, non-Hodgkin lymphoma, and lymphoma not otherwise specified.

Breast involvement occurred both in patients with previously established hematologic malignancies and in those in whom breast findings represented the initial manifestation of disease. Notably, no patient demonstrated isolated breast-confined lymphoma in the absence of regional nodal or systemic disease. Both male patients had lymphoma and presented with bilateral multifocal breast involvement. Overall, breast manifestations most commonly occurred in association with regional lymphadenopathy and/or concurrent systemic disease.

Distribution Pattern

Breast involvement demonstrated a heterogeneous spectrum of imaging findings. Solitary breast lesions were observed in 9 of 17 patients (52.9%), whereas multiple lesions were observed in 8 patients (47.1%). Bilateral breast involvement was present in 7 patients (41.2%), while unilateral disease was observed in 10 patients (58.8%). In three patients, the dominant manifestation was nodal involvement rather than a conventional breast mass pattern. Detailed lesion distribution patterns and imaging characteristics are summarized in Table 2.

Associated nodal disease was common, occurring in at least 8 patients (47.1%). Regional lymphadenopathy frequently accompanied breast

Table 1. Clinicopathologic characteristics of patients with breast involvement by hematologic malignancies (n=17)

Variable	n	%
Female	15	88.2
Male	2	11.8
Mean age, years (range)	52.8 (18–86)	
Histopathology		
Lymphoma	13	76.5
Leukemia/CLL	3	17.6
Plasma cell neoplasm (multiple myeloma)	1	5.9
Distribution pattern		
Unilateral involvement	10	58.8
Bilateral involvement	7	41.2
Solitary lesion	9	52.9

Lymphoma subtypes included diffuse large B-cell lymphoma, follicular lymphoma, MALT lymphoma, plasmablastic lymphoma, high-grade B-cell lymphoma, lymphoblastic lymphoma, non-Hodgkin lymphoma, and lymphoma not otherwise specified. CLL: Chronic lymphocytic leukemia, MALT: Mucosa-associated lymphoid tissue

Table 2. Multimodality imaging characteristics of breast involvement by hematologic malignancies

Imaging finding	n	%
Overall imaging pattern		
Predominantly nodular (mass-forming) pattern	14	82.4
Diffuse infiltrative/non-mass pattern	3	17.6
Distribution characteristics		
Bilateral involvement	7	41.2
Multiple lesions	8	47.1
Nodal-type breast involvement	3	17.6
Associated axillary lymphadenopathy	8	47.1
Mammographic findings		
Suspicious calcifications	0	0
Architectural distortion	Rare	—
Spiculated margins	Rare	—
Ultrasonographic findings*		
Hypoechoic echotexture	9	69.2
Heterogeneous echotexture	4	30.8
Circumscribed or partially circumscribed margins	8	61.5
Non-circumscribed margins	5	38.5

*Percentages were calculated from available examinations for each imaging modality

lesions and in several cases represented the dominant imaging manifestation. Representative examples of solitary nodular disease, multifocal or bilateral involvement, and nodal-type breast lesions are illustrated in Figures 1-3.

Mammographic and Ultrasonographic Findings

The predominant imaging presentation was nodular disease. Most lesions appeared as oval, round, or mildly lobulated masses with circumscribed or partially circumscribed margins. Multifocal nodular disease and bilateral involvement were particularly frequent among lymphoid neoplasms.

Suspicious mammographic calcifications were absent in all patients (0/17, 0%). Likewise, architectural distortion and spiculated margins were uncommon. Consequently, many lesions lacked the classic mammographic appearance of primary invasive breast carcinoma.

On US, lesions were predominantly hypoechoic and frequently demonstrated internal vascularity on Doppler evaluation. Several lesions exhibited an intramammary nodal appearance, characterized by oval, hypoechoic masses resembling lymph nodes.

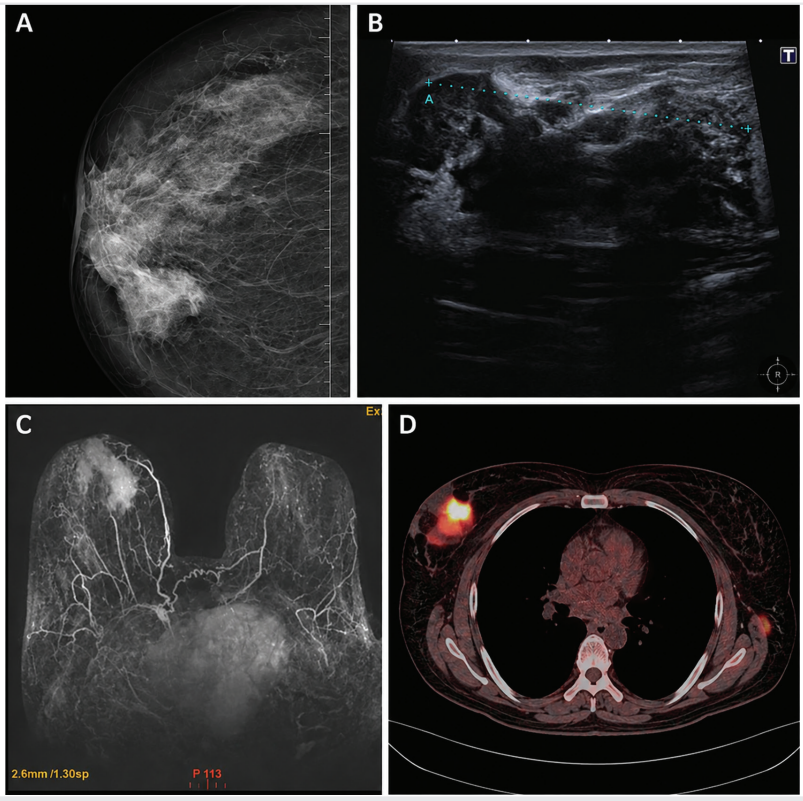

Figure 1. Solitary nodular breast involvement by diffuse large B-cell lymphoma. A 48-year-old woman presented with histopathologically confirmed diffuse large B-cell lymphoma involving the breast. (A) The craniocaudal mammogram demonstrates an irregular, high-density mass in the right breast without associated suspicious calcifications. (B) Targeted ultrasonography reveals a heterogeneous hypoechoic solid lesion with lobulated and partially indistinct margins. (C) Maximum-intensity-projection contrast-enhanced breast MRI demonstrates avid enhancement corresponding to the breast lesion. (D) An axial fused FDG PET/CT image demonstrates intense hypermetabolic uptake within the breast mass and associated metabolically active nodal disease. Histopathologic examination confirmed diffuse large B-cell lymphoma. MRI: Magnetic resonance imaging, FDG PET/ CT: Fluorodeoxyglucose positron emission tomography/computed tomography

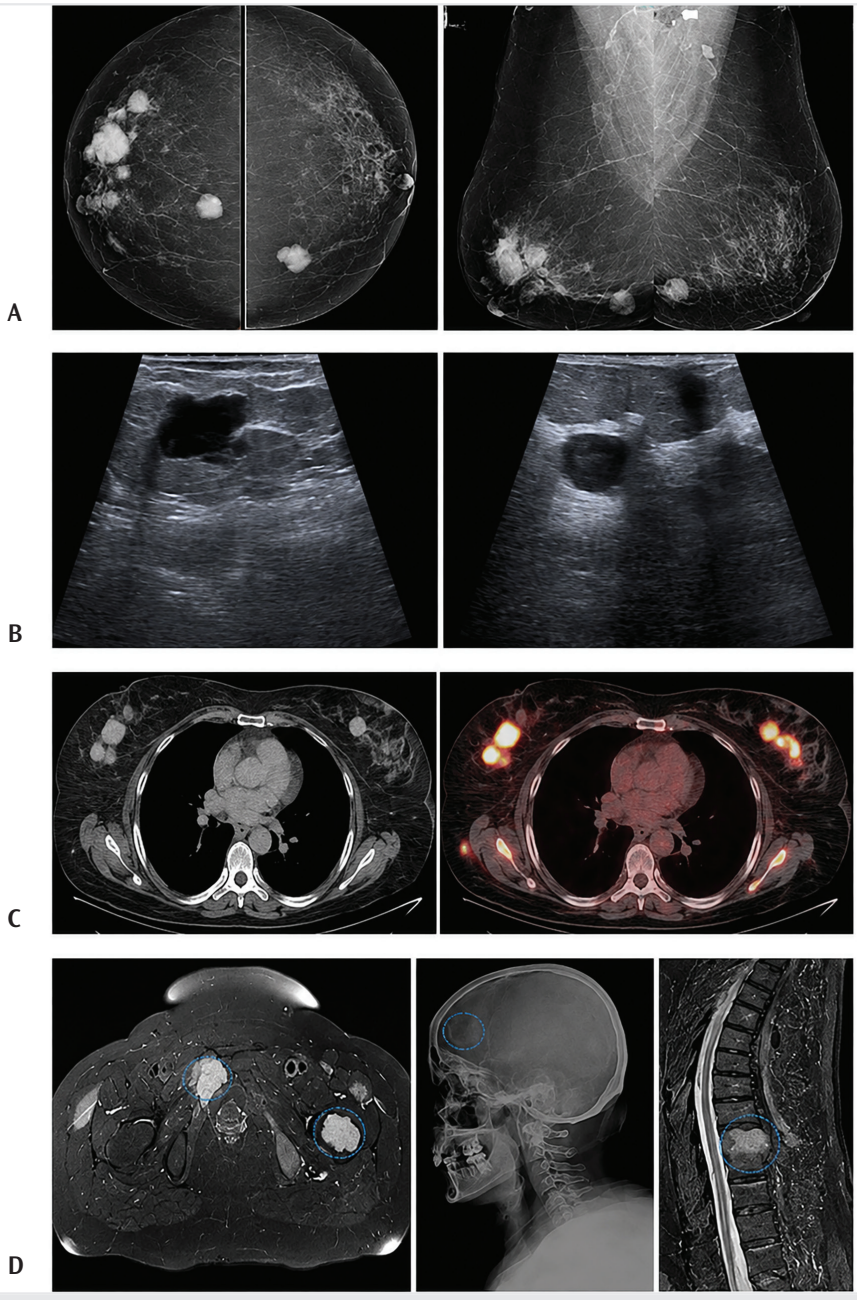

Figure 2. A 58-year-old woman with known multiple myeloma presenting with bilateral breast involvement. (A) Bilateral craniocaudal and right mediolateral oblique mammograms demonstrate multiple circumscribed high-density masses in both breasts without suspicious calcifications. (B) Targeted ultrasonography reveals multiple oval hypoechoic solid lesions with predominantly circumscribed margins. (C) Axial CT and fused FDG PET/CT images demonstrate multifocal bilateral breast lesions with associated metabolic activity. (D) Additional imaging demonstrates extramammary manifestations of systemic disease, including soft-tissue plasmacytomas and skeletal involvement. Histopathologic examination confirmed breast involvement by a plasma cell neoplasm (multiple myeloma). FDG PET/ CT: Fluorodeoxyglucose positron emission tomography/computed tomography

Three principal sonographic patterns were identified:

1. Solitary nodular lesions

2. Multifocal and/or bilateral nodular lesions

3. Diffuse heterogeneous infiltrative involvement without a dominant mass

Diffuse infiltrative disease, observed in a minority of patients, was characterized by heterogeneous parenchymal echotexture, ill-defined hypoechoic infiltration, trabecular thickening, and skin thickening.

MRI Findings

Breast MRI was performed in 12 patients and demonstrated variable imaging appearances depending on the pattern of involvement. Nodular disease was the predominant MRI presentation, observed in 10 of 12 patients (83.3%); diffuse infiltrative involvement was identified in 2 patients (16.7%). Nodular lesions typically appeared as oval, round, or mildly lobulated, enhancing masses with circumscribed margins and associated restricted diffusion. Dynamic contrast-enhanced MRI frequently demonstrated rapid early enhancement, with variable

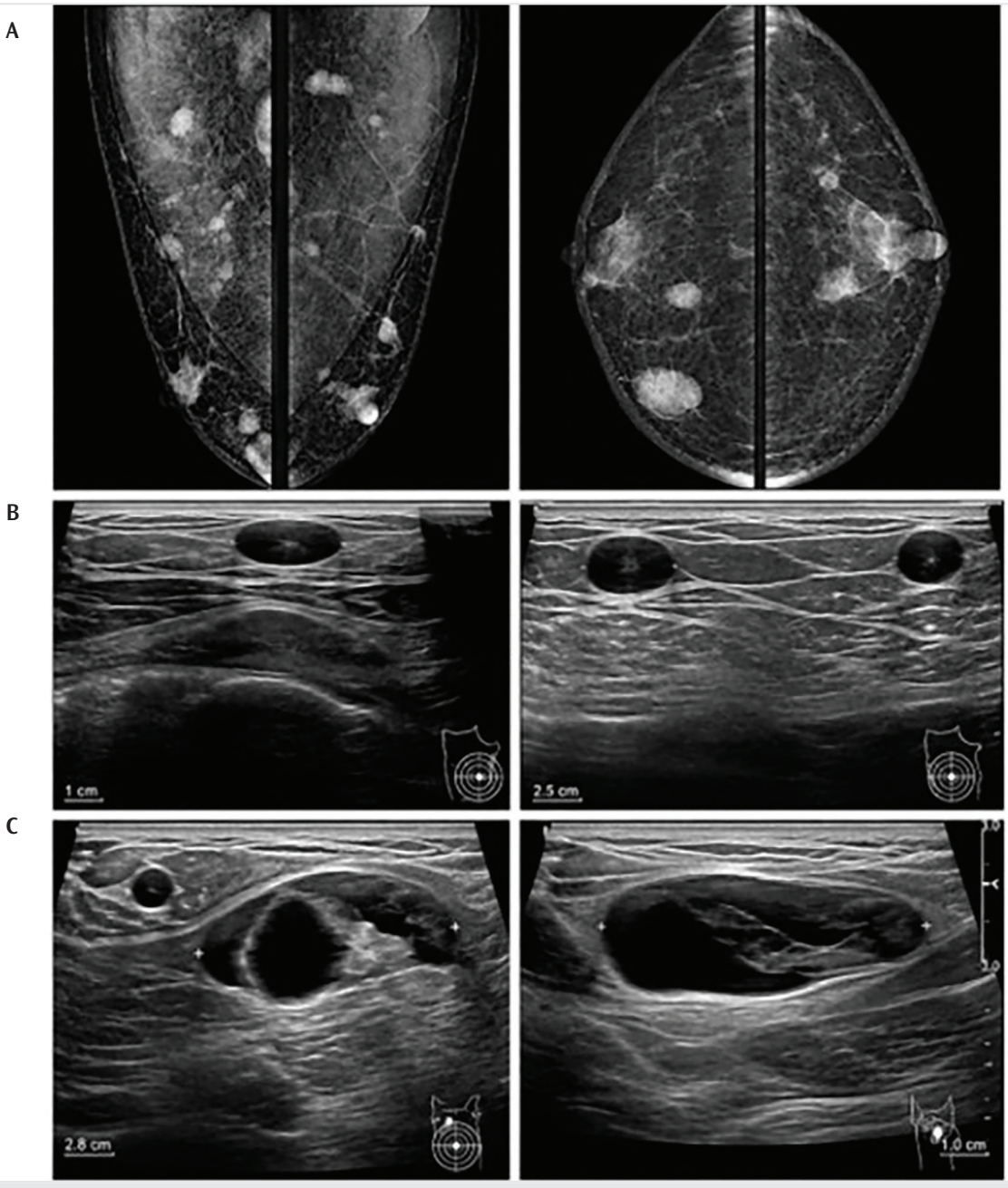

Figure 3. A 70-year-old man presented with secondary breast involvement by non-Hodgkin lymphoma. (A) Bilateral craniocaudal and mediolateral oblique mammograms demonstrate multiple circumscribed nodules in both breasts without associated suspicious calcifications. (B) Targeted breast ultrasonography reveals multiple superficial oval hypoechoic nodules with predominantly circumscribed margins. (C) Axillary ultrasonography demonstrates abnormal lymph nodes with cortical thickening and hilar effacement. Histopathologic examination confirmed lymphomatous involvement.

delayed-phase kinetic patterns. Diffusion restriction was observed in all MRI-evaluated lesions.

Several nodular lesions demonstrated imaging features resembling those of pathologic lymph nodes, including cortical thickening, deformity, and partial or complete loss of the fatty hilum.

In patients with diffuse infiltrative disease, MRI demonstrated extensive heterogeneous non-mass enhancement involving large portions of the breast parenchyma, occasionally extending toward the skin and subcutaneous tissues. MRI was particularly useful for assessing disease extent, multifocality, bilateral involvement, skin extension, and associated regional nodal disease.

FDG PET/CT Findings

Among patients with available PET/CT examinations, breast lesions demonstrated moderate FDG avidity (mean SUVmax, 6.3; range, 3.8–10.0). In addition to breast involvement, PET/CT frequently identified regional lymphadenopathy, extranodal organ involvement, bone marrow infiltration, skeletal lesions, and disseminated systemic disease. No patient presented with breast-confined lymphoma; breast

manifestations were invariably associated with nodal and/or systemic disease. Accordingly, the principal contribution of FDG PET/CT was comprehensive whole-body staging and assessment of disease burden, rather than detailed characterization of breast lesions.

Summary of Imaging Findings

Overall, hematologic malignancies involving the breast demonstrated substantial imaging heterogeneity. The most frequently encountered patterns included nodular breast lesions, multifocal or bilateral disease, intramammary nodal-type lesions, diffuse infiltrative involvement, and associated axillary lymphadenopathy. Suspicious calcifications were absent in all patients, and the classic spiculated desmoplastic morphology typical of primary invasive breast carcinoma was rarely observed. Rather than presenting as an isolated breast-confined disease, breast involvement most commonly occurred in association with regional nodal or systemic hematologic disease.

Discussion

Breast involvement by hematologic malignancies is uncommon and poses a diagnostic challenge because imaging findings frequently overlap with those of primary breast carcinoma and benign breast lesions. In the present two-center cohort, hematologic breast involvement accounted for approximately 0.3% of all malignant breast biopsy specimens and was predominantly associated with lymphoma, followed by leukemia/CLL and plasma cell neoplasms. These findings are consistent with previous reports demonstrating that lymphoid neoplasms constitute the majority of hematologic malignancies involving the breast and remain substantially less common than primary breast carcinoma. Previous series by Talwalkar et al. (3), Surov et al. (6), and Guilbert et al. (4) similarly identified lymphoma as the predominant histologic subtype among breast hematologic malignancies, highlighting the rarity of leukemic and plasma cell infiltrates within breast tissue (5,12-14).

The histopathologic distribution observed in our cohort also deserves attention. Lymphoma accounted for more than three-quarters of all cases, whereas leukemia/CLL and plasma cell neoplasms were substantially less frequent. This distribution closely mirrors previous clinicopathologic series, in which lymphoid neoplasms consistently represented the predominant form of hematologic breast involvement, while leukemic infiltration and breast plasmacytoma remained distinctly uncommon entities (3-6,12-14). The predominance of lymphoma likely reflects both the greater overall incidence of lymphoid neoplasms involving extranodal sites and the propensity of breast tissue to serve as a site of secondary lymphomatous involvement. Conversely, breast manifestations of leukemia and plasma cell neoplasms are typically reported in small institutional series or isolated case reports, underscoring their rarity in routine breast imaging practice (12-13). Although breast lymphoma should remain the primary diagnostic consideration when evaluating hematologic breast lesions, radiologists should be aware that a broader spectrum of hematolymphoid neoplasms may occasionally involve the breast and mimic primary breast malignancy.

One of the most important observations in our study was the heterogeneous pattern of breast involvement. Although solitary lesions represented the most common presentation, nearly half of patients demonstrated multiple lesions, and more than 40% exhibited bilateral disease. These findings closely parallel previous imaging studies by Surov et al. (6), Yang et al. (9), Wienbeck et al. (10), Durhan and Demirkazık (11), and the recently published series by Pehlivan and Ozdemir (15), all of which reported a relatively high frequency of multifocal and bilateral breast involvement compared with primary breast carcinoma (8).

Recently, Pehlivan and Ozdemir (15) reported a contemporary series of breast involvement by hematologic malignancies and similarly demonstrated frequent multifocal disease together with imaging features that often differed from those typically encountered in primary breast carcinoma. Our findings are consistent with these observations and further support the applicability of contemporary BI-RADS terminology in describing the heterogeneous imaging spectrum of hematologic breast involvement (16). Beyond imaging characterization, our study incorporated comprehensive clinicopathologic correlation, evaluation of disease distribution patterns, and assessment of systemic disease burden. This multimodal approach allowed a broader characterization of hematologic involvement of the breast across lymphoma, leukemia/CLL, and plasma cell neoplasms. Notably, multifocality, bilateral disease, and associated nodal involvement were common findings, supporting the concept that breast manifestations of hematologic malignancies frequently represent part of a broader systemic disease process rather than isolated breast-confined pathology. In daily practice, the presence of bilateral or multifocal breast lesions, particularly when accompanied by regional lymphadenopathy or a known history of hematologic malignancy, should prompt consideration of hematologic involvement. Furthermore, FDG PET/CT frequently demonstrated concurrent nodal, extranodal, and bone marrow involvement, underscoring that breast manifestations are often one component of disseminated systemic disease rather than an isolated breast process (2,6).

Our results further emphasize that hematologic involvement of the breast often lacks several classic imaging hallmarks of primary invasive breast carcinoma. Suspicious calcifications were absent in all patients, while spiculated margins and architectural distortion were uncommon. Instead, most lesions appeared as oval, round, or mildly lobulated masses with circumscribed or partially circumscribed margins. Similar observations have been consistently reported by Glazebrook et al. (1), Raj et al. (2), Yang et al. (9), Surov et al. (6), Wienbeck et al. (10), and Durhan and Demirkazık (11), who demonstrated that hematologic malignancies frequently exhibit relatively non-aggressive morphologic features despite representing malignant disease (10). The absence of a pronounced desmoplastic response may partially explain these imaging characteristics. Consequently, reliance solely on conventional morphologic criteria may lead to under-recognition of hematologic breast involvement, underscoring the importance of clinical history and pathologic confirmation (5,17). Similar observations have also been reported in broader series evaluating secondary breast malignancies from extramammary tumors, where circumscribed morphology, absence of calcifications, and multifocal disease patterns were more common than in primary breast carcinoma (18).

Another noteworthy finding was nodal-type breast involvement in approximately one-fifth of patients (17.6%). These lesions demonstrated

imaging features resembling those of pathologic intramammary lymph nodes, including cortical thickening, loss of the fatty hilum, and oval morphology. Although intramammary nodal involvement has been described previously, it remains underemphasized in most radiologic reviews (1,2,6,9). Recognition of this pattern is important because the pattern may represent a manifestation of systemic lymphoid disease rather than a true primary breast mass. Awareness of this presentation may facilitate earlier consideration of hematologic malignancy and guide appropriate tissue sampling strategies.

MRI demonstrated considerable heterogeneity in the pattern of involvement. Among the 12 patients who underwent breast MRI, nodular disease was the predominant presentation (10/12, 83.3%), whereas diffuse infiltrative involvement was observed in 2 patients (16.7%). Nodular lesions frequently showed avid enhancement and diffusion restriction despite maintaining a relatively circumscribed morphology. In contrast, diffuse infiltrative cases demonstrated extensive, heterogeneous, non-mass enhancement involving large portions of the breast parenchyma and, occasionally, extending toward the skin. Raj et al. (2) described similar MRI appearances in both primary and secondary breast lymphoma, emphasizing the value of MRI in depicting both focal mass-forming lesions and diffuse infiltrative patterns of disease. Notably, diffusion restriction was consistently observed in all patients who underwent MRI, supporting the high cellularity typically associated with hematologic malignancies. Despite their often benign-appearing morphology on MG and US, these MRI findings underscore the biologically aggressive nature of the underlying disease.

A particularly important observation in our cohort was the close association between breast lesions and systemic disease burden. No patient demonstrated truly isolated breast-confined lymphoma without regional nodal or systemic involvement. Regional lymphadenopathy, extranodal disease, or disseminated hematologic manifestations were frequently identified, supporting the concept that breast involvement often represents one component of a broader systemic disease process rather than an isolated organ manifestation. Similar observations have been reported by Talwalkar et al. (3), Surov et al. (6), and Pehlivan and Ozdemir (15), who noted that disseminated disease is substantially more common than localized breast-confined involvement. Notably, approximately two-thirds of the patients in the series reported by Surov et al. (6) were classified as having secondary breast lymphoma, further supporting the close association between breast involvement and systemic disease burden. Although primary breast lymphoma has been well described in the literature, our findings further support the concept that breast involvement by hematologic malignancies frequently represents part of a broader systemic disease process rather than a truly organ-confined entity.

Perhaps the most important finding of our study was the apparent discrepancy between lesion morphology and overall disease burden. Many lesions demonstrated relatively benign morphological characteristics, including an oval shape, circumscribed margins, and absence of suspicious calcifications. Nevertheless, these findings frequently coexisted with multifocal disease, lymphadenopathy, and disseminated hematologic malignancy. Therefore, radiologists should be cautious when interpreting apparently benign breast lesions in patients with known hematologic malignancies or with accompanying systemic findings. Radiologic-pathologic correlation remains particularly important because secondary breast malignancies may mimic both benign lesions and primary breast cancer, resulting in potential diagnostic delay or inappropriate management (19).

Study Limitations

The present study has several limitations. First, its retrospective design limited the standardization of imaging acquisition protocols, staging evaluations, and clinical assessments across the study period. Second, although this study represents one of the larger contemporary two-center cohorts specifically focused on hematologic breast involvement, the sample size remained limited because of the rarity of the condition. Third, not all patients underwent the full spectrum of imaging modalities, particularly breast MRI and FDG PET/CT, which limited comprehensive modality-to-modality comparisons and may have led to underestimation of certain imaging features or systemic disease manifestations. Fourth, the heterogeneity of histologic subtypes precluded meaningful subtype-specific statistical analyses and limited the direct comparison among lymphoma, leukemia/CLL, and plasma cell neoplasms. Finally, the descriptive nature of the study and the limited sample size restricted the ability to perform robust multivariable analyses. Nevertheless, the study provides a comprehensive, contemporary clinicopathological and multimodality imaging assessment of hematologic malignancies involving the breast and offers valuable insights into their patterns of presentation, imaging spectrum, and association with systemic disease burden.

Conclusion

Breast involvement by hematologic malignancies is a rare manifestation of systemic disease and demonstrates a broad and often deceptive imaging spectrum. Multifocal or bilateral disease, circumscribed nodular masses, intramammary nodal-type lesions, diffuse infiltrative involvement, and the absence of suspicious mammographic calcifications were the most characteristic imaging findings in our cohort. Importantly, breast lesions were almost invariably associated with regional nodal or systemic disease rather than representing isolated breast-confined involvement. Recognition of these imaging patterns, combined with clinicopathologic correlation and comprehensive systemic evaluation, may facilitate earlier diagnosis, guide appropriate tissue sampling, prevent unnecessary breast-directed surgery, and promote timely hematologic management.

Ethics

Ethics Committee Approval: The study protocol was approved by the Başakşehir Çam and Sakura City Hospital Scientific Research Ethics Committee No. 2 (protocol no. 2026-60; decision no. 60; approval date: 04.02.2026).

Informed Consent: The informed consent was waived because of the retrospective nature of the study.

Footnotes

Authorship Contributions: Concept - M.A.N., E.E., C.K.T.; Design - M.A.N.; Data Collection or Processing - M.A.N., E.E., C.K.T.; Analysis or Interpretation - M.A.N.; Literature Search - M.A.N., E.E., C.K.T.; Writing - M.A.N.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Glazebrook KN, Zingula S, Jones KN, Fazzio RT. Breast imaging findings in haematological malignancies. Insights Imaging. 2014; 5: 715-22.
2. Raj SD, Shurafa M, Shah Z, Raj KM, Fishman MDC, Dialani VM. Primary and secondary breast lymphoma: clinical, pathologic, and multimodality imaging review. Radiographics. 2019; 39: 610-25.
3. Talwalkar SS, Miranda RN, Valbuena JR, Routbort MJ, Martin AW, Medeiros LJ. Lymphomas involving the breast: a study of 106 cases comparing localized and disseminated neoplasms. Am J Surg Pathol. 2008; 32: 1299-309.
4. Guilbert MC, Hornick JL, Chikarmane SA, Lester SC. Hematologic malignancies of the breast: a contemporary series investigating incidence, presentation, accuracy of diagnosis on core needle biopsy, and hormone receptor expression. Breast Cancer (Auckl). 2019; 13: 1178223419830982.
5. Cheah CY, Campbell BA, Seymour JF. Primary breast lymphoma. Cancer Treat Rev. 2014; 40: 900-8.
6. Surov A, Holzhausen HJ, Wienke A, Schmidt J, Thomssen C, Arnold D, et al. Primary and secondary breast lymphoma: prevalence, clinical signs and radiological features. Br J Radiol. 2012; 85: e195-205.
7. Alaggio R, Amador C, Anagnostopoulos I, Attygalle AD, Araujo IBO, Berti E, et al. The 5th edition of the World Health Organization Classification of haematolymphoid tumours: lymphoid neoplasms. Leukemia. 2022; 36: 1720-48. Erratum in: Leukemia. 2023; 37: 1944-51.
8. Sabaté JM, Gómez A, Torrubia S, Camins A, Roson N, De Las Heras P, et al. Lymphoma of the breast: clinical and radiologic features with pathologic correlation in 28 patients. Breast J. 2002; 8: 294-304.
9. Yang WT, Lane DL, Le-Petross HT, Abruzzo LV, Macapinlac HA. Breast lymphoma: imaging findings of 32 tumors in 27 patients. Radiology. 2007; 245: 692-702.
10. Wienbeck S, Meyer HJ, Uhlig J, Herzog A, Nemat S, Teifke A, et al. Radiological imaging characteristics of intramammary hematological malignancies: results from a german multicenter study. Sci Rep. 2017; 7: 7435.
11. Durhan G, Demirkazık F. Breast involvement of hematological malignancies: imaging and clinical findings. Egypt J Radiol Nucl Med. 2021; 52: 172.
12. Surov A, Wienke A, Abbas J. Breast leukemia: an update. Acta Radiol. 2012; 53: 261-6.
13. Li D, Xin Y, Zhu J. Imaging findings of breast leukaemia: a case series. Br J Hosp Med (Lond). 2024; 85: 1-15.
14. Surov A, Holzhausen HJ, Ruschke K, Arnold D, Spielmann RP. Breast plasmacytoma. Acta Radiol. 2010; 51: 498-504.
15. Pehlivan UA, Ozdemir H. Multimodality imaging findings of hematological malignancies involving the breast: a retrospective analysis based on the updated BI-RADS v2025 Manual. Ir J Med Sci. 2026; 195: 1475-83.
16. Newell MS, Destounis SV, Leung JWT, DeMartini WB, Lee CH, Eby PR. ACR BI-RADS® Atlas and Manual. 6th ed. Reston (VA): American College of Radiology; 2025.
17. Lee AH. The histological diagnosis of metastases to the breast from extramammary malignancies. J Clin Pathol. 2007; 60: 1333-41.
18. Bitencourt AGV, Gama RRM, Graziano L, Negrão EMS, Sabino SMPS, Watanabe AHU, et al. Breast metastases from extramammary malignancies: multimodality imaging aspects. Br J Radiol. 2017; 90: 20170197.
19. Huayanay Espinoza JL, Mego Ramírez FN, Guerra Miller H, Huayanay Santos JL, Guelfguat M. A spectrum of metastases to the breast: radiologic-pathologic correlation. J Breast Imaging. 2023; 5: 209-29.