Radiology Case Reports 20 (2025) 3898–3902

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/radcr

Case Report

Streamlining diagnosis of melanoma metastasis to the breast: A case report emphasizing distinctive MRI features as crucial diagnostic tool ☆,☆☆

Andrew Chan, MD[a], *Hal Berman, MD*[b], *Saeed Kamil Zaid, MD*[b], *Sandeep Ghai, MD*[a], *Supriya Kulkarni, MD*[a], *Vivianne Freitas, MD, MSc*[a,*]

[a] *Joint Department of Medical Imaging, University of Toronto, University Health Network, Sinai Health System, Women's College Hospital, 610 University Avenue, Toronto, Ontario M5G 2M9, Canada*

[b] *Department of Laboratory Medicine and Pathobiology, Laboratory Medicine Program, University of Toronto, University Health Network, 200 Elizabeth Street, 11-E444, Toronto, Ontario M5G 2C4, Canada*

ARTICLE INFO

Article history:
Received 5 February 2025
Revised 13 April 2025
Accepted 17 April 2025

Keywords:
Breast neoplasm
Metastasis melanoma
Mammography
Ultrasound
Magnetic resonance imaging (MRI)
Positron emission tomography
Computed tomography (PET-CT)

ABSTRACT

This article describes the case of a 60-year-old woman with a remote history of uveal melanoma who presented with breast metastasis. The breast imaging findings are thoroughly discussed, covering conventional imaging, MRI, and PET-CT, with particular emphasis on the unique imaging characteristics of metastatic melanoma on MRI, which is notably different from other breast pathologies due to the paramagnetic properties of melanin. These properties contribute to a characteristic signal pattern that aids in distinguishing melanoma from other breast lesions, facilitating the diagnosis.

Introduction

Melanoma, distinguished by its malignant melanocytes, stands as the sixth most prevalent cancer in Canada and the fifth in the U.S. as of 2023 [1]. A major risk factor for developing melanoma is exposure to ultraviolet (UV) radiation. The historical increase in sun exposure without appropriate sun protection measures likely contributes to the ongoing rise in melanoma incidence [2]. This malignancy predominantly affects the skin but can also appear in mucosal membranes like the uvea, representing about 5% of melanoma cases [3,4]. Fur-

☆ Competing Interests: All authors declare that there are no financial disclosures and personal relationships with other people or organizations that could inappropriately influence (bias) our work.

☆☆ Acknowledgments: There are no financial disclosures from any author.

* Corresponding author.
E-mail address: vivianne.freitas@uhn.ca (V. Freitas).

https://doi.org/10.1016/j.radcr.2025.04.081

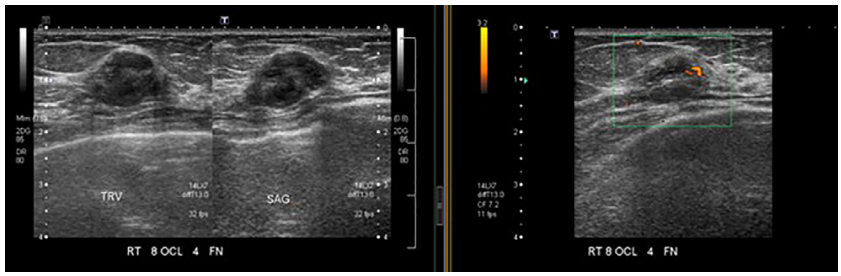

Fig. 1 – Ultrasound: Ultrasound of the right breast demonstrates an ovoid circumscribed hypoechoic mass, corresponding to the biopsy-proven melanoma metastasis.

thermore, distant metastasis is observed in 4% of melanoma cases, with its likelihood varying depending on the stage at diagnosis [5]. The most common sites for melanoma metastasis include the skin, subcutaneous tissue, lungs, liver, bone, and brain [6].

Although rare, melanoma is the most frequent solid tumor to metastasize to the breast [7], representing less than 5% of all cases [5]. It typically manifests as palpable masses [8–10]. Radiologically, the imaging features are often nonspecific, which can complicate diagnosis. However, the paramagnetic properties of melanin are associated with a distinctive signal on MRI, often hyperintense on T1-weighted images and hypointense on T2, providing a valuable imaging clue that can help differentiate metastatic melanoma from other breast lesions [11].

This article presents a case of metastatic uveal melanoma to the breast, highlighting key imaging features across modalities, with particular emphasis on MRI. The unique signal characteristics seen on MRI correlated well with gross and histopathological findings, reinforcing MRI's diagnostic value in detecting melanoma metastasis in atypical locations such as the breast.

Case report

A 60-year-old woman with a history of left uveal melanoma, treated with plaque brachytherapy 13 years ago, presented with an asymmetry detected during mammographic screening of the right breast (Fig. 1). The patient was entirely asymptomatic, with no personal or family history of breast cancer or melanoma. Subsequent ultrasound revealed an irregular, oval, and circumscribed predominantly hypoechoic vascular solid mass at the 8 o'clock position (Fig. 2). A biopsy of this mass confirmed a pathologic diagnosis of malignant melanoma. Staging with a PET scan showed focal FDG metabolic activity in the corresponding region in the breast, aligning with the biopsy results (Fig. 3). There was no evidence of metastatic disease elsewhere. An MRI revealed its distinct appearance due to the paramagnetic properties of melanin, characterized by high T1-weighted signal intensity centrally and low signal peripherally. Conversely, the T2-weighted STIR sequence displayed low signal intensity centrally and high T2 signal peripherally (Fig. 4).

A seed-guided lumpectomy was performed to remove the mass. Pathological examination confirmed the MRI findings, showing high tumor cellularity (70%) with central melanin presence, consistent with malignant melanoma of the right breast (Fig. 5), which, in the clinical setting, presumably is metastatic from the previously treated uveal melanoma. A sentinel node biopsy from the right axilla was negative for malignancy.

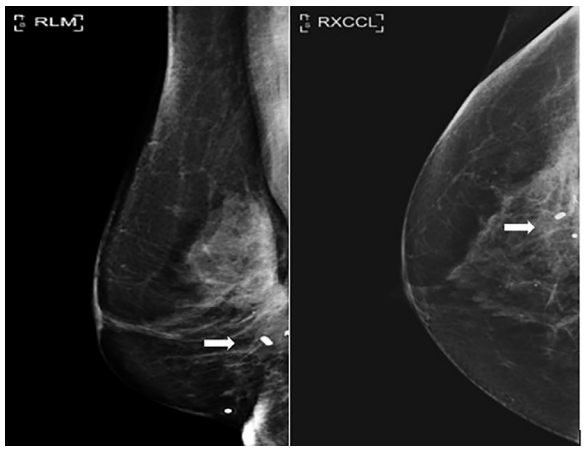

Fig. 2 – Mammogram: Mammogram mediolateral oblique (MLO) and exaggerated cranio-causal (XCC) views after preoperative seed localization demonstrate a partially visualized ovoid mass containing a postbiopsy clip and localization seed, partially obscured by overlapping breast tissue (arrow).

Discussion

This detailed case is centered on a patient with metastatic melanoma, focusing on the manifestations of the disease across various imaging modalities and its pathological correlations. Notably, the MRI features of this case, which are uncommon in other breast pathologies, play a crucial role in facilitating the diagnosis of this rare condition. The article offers a comparison between imaging results and the macroscopic and microscopic findings in pathology, providing an integrated perspective on the disease's characteristics.

Breast metastasis from melanoma is infrequent, yet the typical initial indicator is the emergence of a new breast mass as observed in this case and corroborated by previous studies [8–10]. Therefore, for patients with a history of melanoma,

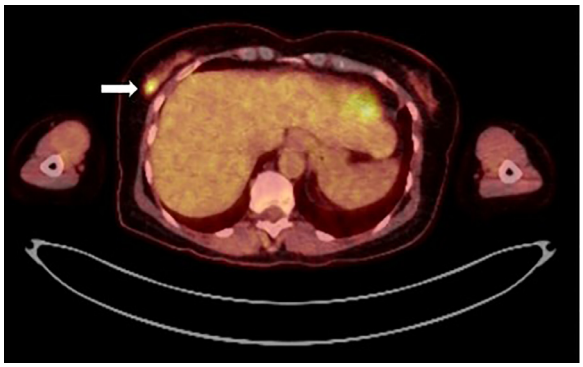

Fig. 3 – MRI: Biopsy-proven malignant melanoma in the right breast (arrow). (A) Axial nonfat saturated T1-weighted sequence showing the hyperintense signal centrally and low signal peripherally, which is an imaging key for diagnosis, secondary to the paramagnetic properties of melanin (arrow) (B) Axial T2-weighted STIR sequence (short tau inversion recovery) displays low signal intensity centrally and high T2 signal peripherally (C) Axial contrast-enhanced fat-saturated subtracted T1-weighted sequence shows an enhancing mass with an internal susceptibility artifact from the postbiopsy clip.

such presentations should raise suspicions of metastatic disease.

Our study revealed that metastasis is presented as a solitary lesion, a finding consistent with previous research, which indicates that solitary lesions are more common than multiple or bilateral involvement [12,13]

Traditional imaging techniques like mammography and ultrasound often yield nonspecific results, displaying features that might mimic other breast lesions, including either benign or primary invasive ductal carcinoma [10,14–16].

Metastatic melanoma to the breast can closely mimic primary breast malignancies both clinically and radiologically; however, key distinguishing features can assist in differentiation [14]. Primary breast carcinomas often exhibit spiculated margins and architectural distortion and may present with microcalcifications, which are findings that reflect an associated desmoplastic response and are well-recognized on mammography and ultrasound [17,18]. In contrast, metastatic lesions, including those from melanoma, typically appear as well-circumscribed, noncalcified masses, often lacking the fibrotic reaction that characterizes primary malignancies. On ultrasound, these lesions are generally hypoechoic and do not exhibit the posterior acoustic shadowing commonly seen in invasive ductal carcinoma [19].

While PET imaging is highly sensitive in detecting melanoma due to its high metabolic activity, it lacks specificity and may not reliably distinguish between primary and metastatic lesions in the breast [20]. MRI, on the other hand, proves particularly valuable not only in differentiating metastatic melanoma from primary breast cancer but also from other types of breast metastases [21,22]. A hallmark feature of melanin-containing melanoma metastases is their unique signal profile, hyperintensity on T1-weighted images, and hypointensity on T2-weighted images, reflecting the paramagnetic properties of melanin, a finding that is rarely seen in primary breast tumors [11,23].

As illustrated in the presented case, there is a strong correlation between imaging and pathology. The MRI findings of a centrally hyperintense lesion on T1 and hypointense on T2 align with the gross pathological appearance of a central pigmented tumor surrounded by normal breast parenchyma. This radiologic-pathologic concordance reinforces the diagnostic value of MRI in the identification of metastatic melanoma in the breast. Recognizing these characteristic imaging features, especially when considered alongside a patient's oncologic history, is essential for guiding accurate diagnosis and appropriate clinical management.

In conclusion, this article highlights the diverse imaging appearances of metastatic melanoma in the breast across multiple modalities, emphasizing the diagnostic value of MRI. Among all techniques, MRI provides the most distinctive features, with signal characteristics, particularly intrinsic T1 hyperintensity, and T2 hypointensity, attributable to melanin's paramagnetic properties. These findings are uncommon in primary breast malignancies and can serve as important radiologic clues pointing toward a metastatic origin, especially in patients with a known history of melanoma. Recognizing

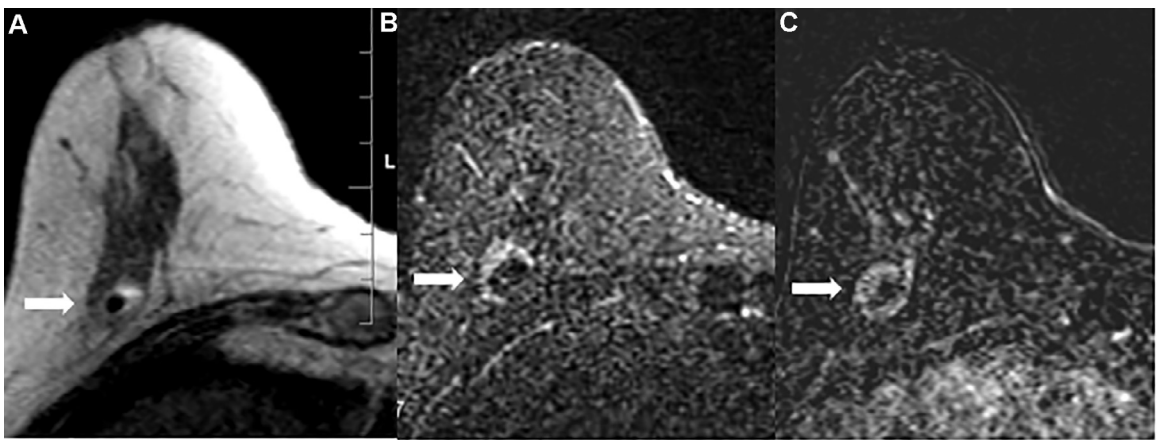

Fig. 4 – PET-CT shows focal FDG-uptake within the biopsy-proven melanoma metastasis (arrow).

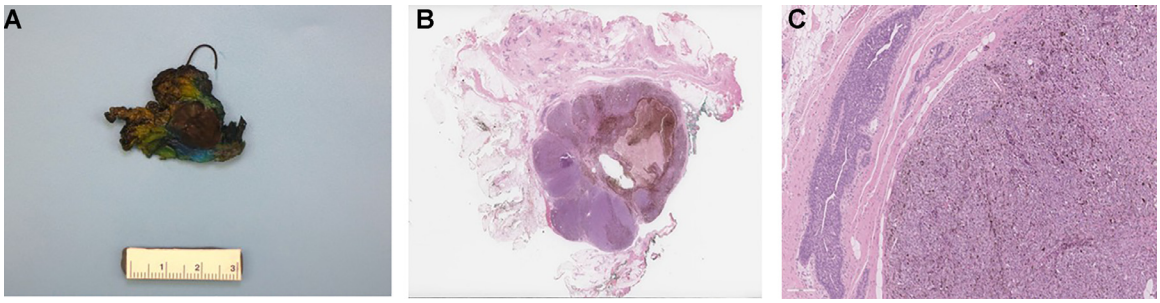

Fig. 5 – Pathology. (A) Gross pathology: The representative slice of the breast lumpectomy specimen demonstrates the central pigmented tumor surrounded by adjacent breast tissue. (B) Low power photomicrograph shows a circumscribed pigmented tumor with necrosis in breast tissue. (C) High power photomicrograph shows a tumor composed of large epithelioid cells with abundant pigmented cytoplasm and enlarged nuclei with prominent nucleoli. Adjacent benign breast tissue is seen on the left-hand side.

this unique imaging phenotype has significant implications in clinical practice. It encourages radiologists and clinicians to include metastatic melanoma in the differential diagnosis, prompting a more targeted diagnostic approach. In such cases, instead of following the standard pathway for suspected primary breast cancer, clinicians may opt for core needle biopsy with immunohistochemical staining for melanoma markers (e.g., S-100, HMB-45, Melan-A). This approach improves diagnostic accuracy and helps avoid unnecessary procedures and delays in initiating appropriate systemic therapy.

Author contributions

All authors contributed equally to the manuscript.

Patient consent

The patient provided informed consent and necessary permissions for the inclusion of case details and images in this report, ensuring that all personal health information and identifying details remain protected.

REFERENCES

[1] Canadian Cancer Statistics 2023. Toronto, ON: Canadian Cancer Society; 2023. Available at cancer.ca/Canadian-Cancer-Statistics-2023-EN. Accessed August 03, 2024.
[2] National Skin Cancer Prevention Committee. Exposure to and protection from the sun in CanadaA report based on the 2006 second National Sun Survey. Toronto, ON: Canadian Partnership Against Cancer; 2010.
[3] Kaliki S, Shields CL. Uveal melanoma: relatively rare but deadly cancer. Eye (Lond) 2017;31(2):241–57.
[4] Chattopadhyay C, Kim DW, Gombos DS, Oba J, Qin Y, Williams MD, et al. Uveal melanoma: from diagnosis to treatment and the science in between. Cancer 2016;122(15):2299–312.
[5] Key statistics for melanoma skin cancer. American Cancer Society. Available at https://www.cancer.org/cancer/types/melanoma-skin-cancer/about/key-statistics. Accessed December 23, 2023.
[6] Sundararajan S, Thida AM, Yadlapati S, Mukkamalla SKR, Koya S. Metastatic melanoma. StatPearls, Treasure IslandFL: StatPearls Publishing; 2024. Copyright © 2024StatPearls Publishing LLC..
[7] Akçay MN. Metastatic disease in the breast. Breas 2002;11(6):526–8. doi:10.1054/brst.2002.0467.
[8] Mastoraki A, Gkiala A, Theodoroleas G, Mouchtouri E, Strimpakos A, Papagiannopoulou D, et al. Metastatic malignant melanoma of the breast: report of a case and review of the literature. Folia Med (Plovdiv) 2022;64(2):354–8.
[9] Sharma S, Long DS, Sharma S. Metastatic melanoma presenting as a breast mass – role of radiologist as a clinician. Radiol Case Rep 2020;15(10):2031–5. doi:10.1016/j.radcr.2020.08.009.
[10] Kim Y, Cho KR, Seo BK, Woo OH, Lee JH, Cho SB. Radiologic findings of metastatic malignant melanoma of the breast: mammographic, sonographic, DynamicContrast-enhanced breast MRI, and18F-FDGPET-CTFeatures. Iran J Radiol 2017;14(3):e38392.
[11] Gaeta M, Cavalaro M, Vinci SL, et al. Magnetism of materials: theory and practice in magnetic resonance imaging. Insights into Imaging 2021;12:179. doi:10.1186/s13244-021-01125-z2021.
[12] Amichetti M, Perani B, Boi S. Metastases to the breast from extramammary malignancies. Oncology 1990;47(3):257–60.
[13] McCrea ES, Johnston C, Haney PJ. Metastases to the breast. AJR Am J Roentgenol 1983;141(4):685–90. doi:10.2214/ajr.141.4.685.
[14] Chung SY, Oh KK. Imaging findings of metastatic disease to the breast. Yonsei Med J 2001;42(5):497–502. doi:10.3349/ymj.2001.42.5.497.
[15] Vizcaino I, Torregrosa A, Higueras V, Morote V, Cremades A, Torres V, et al. Metastasis to the breast from extramammary malignancies: a report of four cases and a review of literature. Eur Radiol 2001;11(9):1659–65. doi:10.1007/s003300000807.
[16] Yang WT, Muttarak M, Ho LW. Nonmammary malignancies of the breast: ultrasound, CT, and MRI. Semin Ultrasound CT MR 2000;21(5):375–94.
[17] Yang WT, Metreweli C. Breast metastases from extramammary malignancies: sonographic features. AJR Am J Roentgenol 1999;173(2):317–22.

[18] Lee AH. The histological diagnosis of metastases to the breast from extramammary malignancies. J Clin Pathol 2007;60(12):1333–41.
[19] Bohman LG, Bassett LW, Gold RH, Voet R. Breast metastases from extramammary malignancies. Radiology 1982;144(2):309–12.
[20] Nijhuis AAG, Dieng M, Khanna N, Lord SJ, Dalton J, Menzies AM, et al. False-positive results and incidental findings with annual CT or PET/CT surveillance in asymptomatic patients with resected stage III melanoma. Ann Surg Oncol 2019;26(6):1860–8.
[21] Ho LW, Wong KP, Chan JH, Chow LW, Leung EY, Leong L. MR appearance of metastatic melanotic melanoma in the breast. Clin Radiol 2000;55(7):572–3. doi:10.1053/crad.1999.0102.
[22] Premkumar A, Marincola F, Taubenberger J, Chow C, Venzon D, Schwartzentruber D. Metastatic melanoma: correlation of MRI characteristics and histopathology. J Magn Reason Imaging 1996;6(1):190–4.
[23] Surov A, Fiedler E, Holzhausen HJ, et al. Diverse primary tumors metastasizing to the breast: a meta-analysis. Breast Cancer Res Treat 2010;120(2):441–9.