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Case Report

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Radiotherapy for Isolated Breast Myeloid Sarcoma

Jean-Marc Bourque[a, e], Jasmine Gaudet[b], Arsene Manengue[a], Christopher Bredeson[c], Rajiv Samant[d]

Abstract

Myeloid sarcoma (MS) is an uncommon solid extramedullary tumor composed of malignant myeloid blasts that can be located in various tissues. It is often associated with acute myeloid leukemia (AML), but it can also be found in patients suffering from myeloproliferative disorders or myelodysplastic syndrome. Despite the lack of consensus on the best treatment for MS, this tumor is acknowledged to be radiosensitive. We report the case of a 33-year-old female diagnosed with MS involving the breast treated with salvage radiation, after having initially undergone systemic chemotherapy and an allogeneic hematopoietic cell transplant. The purpose of this report is to discuss the significant impact of local radiotherapy in patients suffering from this unique condition.

Keywords: Myeloid sarcoma; Radiotherapy; Breast tumor; Acute myeloid leukemia; Hematologic malignancies

Introduction

Myeloid sarcoma (MS), also referred to as granulocytic sarcoma (GS) or chloroma, is an extramedullary tumor that proliferates and invades the tissues in which it is found. The tumor is composed of malignant immature white blood cells of myeloid lineage. It often occurs with acute myeloid leukemia (AML) or can present at the time of AML relapse. However, it can be diagnosed independent of bone marrow infiltration or circulating leukemia cells [1-5]. Patients' clinical presentation varies largely depending on the location of the mass. Although it can be in almost any tissue, it is frequently found in the soft tissues, peritoneum, bone, skin and lymph nodes [1, 2, 3, 5] Due to the rarity of MS presentation in the breast, it is often misdiagnosed and requires a high index of suspicion when identifying the lesion. Early recognition may save the patient from unnecessary procedures and allows for the appropriate treatment to be initiated [2, 6, 7]. Due to the lack of treatment consensus guidelines, the approach to MS in the breast may pose challenges. However, systemic and local therapy (radiotherapy (RT) and surgery) are indicated in many cases [1-5].

Here, we report a case of MS localized to the breast without evidence of circulating leukemia cell or bone marrow infiltration, responding favorably to salvage local RT after initially being treated with standard AML treatment including multiagent chemotherapy and allogeneic stem cell transplant.

Case Report

A previously well 33-year-old female, with no relevant past medical history, presented in October 2013 with a lump in her right breast. The lesion was biopsied, and the morphology and immunochemistry performed revealed an MS, most often associated with a form of AML. However, further investigations such as peripheral blood count, blood and bone marrow morphology were normal, indicating no evidence of AML. Subsequently, the patient underwent two cycles of chemotherapy which she tolerated well; the first, "7 + 3", consisted of cytarabine (araC) and daunomycin, and two cycles of high-dose cytarabine (HDAC). The breast mass quickly resolved after the first cycle of chemotherapy. After initial induction chemotherapy, the patient was reviewed by several hematologists at two separate tertiary care hospitals. The patient, despite being in clinical remission, was keen for aggressive upfront management because of the fear of relapse and requested further treatment similar to the management of AML. Therefore, in May 2014, the patient underwent a matched unrelated donor (MUD) allogeneic stem cell transplant following a traditional myeloablative busulfan, cyclophosphamide, and anti-thymocyte globulin (BuCyATG) conditioning regimen. Graft-vs-host disease (GVHD) prophylaxis consisted of traditional tacrolimus and a short course of methotrexate. The transplant was well tolerated, and no major complications were encountered. She did not develop GVHD requiring systemic immunosuppressive therapy and was quickly tapered off tacrolimus.

In September 2014, she noticed another lump in her right breast, and ultrasound imaging confirmed a mass measuring 1.6 × 1.1 cm mass. Repeat biopsy confirmed recurrent MS at the site of original disease. She was referred for localized RT

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[a]Department of Radiation Oncology, Centre Hospitalier de l'Universite de Montreal (CHUM), Montreal, QC, Canada
[b]Department of Medicine, Universite de Montreal, Montreal, QC, Canada
[c]Department of Hematology, The Ottawa Hospital Cancer Centre, Ottawa, ON, Canada
[d]Department of Radiation Oncology, The Ottawa Hospital Cancer Centre, Ottawa, ON, Canada
[e]Corresponding Author: Jean-Marc Bourque, Department of Radiation Oncology, Centre Hospitalier de l'Universite de Montreal (CHUM), Montreal, QC H2X 3E4, Canada. Email: jean-marc.bourque.med@ssss.gouv.qc.ca

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and underwent salvage treatment in November 2014. The entire right breast was treated to a cumulative dose of 25 Gy in 10 fractions over 2 weeks, using a conformal RT technique with medial and lateral breast tangents. She tolerated her RT well, with no significant toxicity. She is now more than 10 years post-completion of salvage radiation, with no evidence of local recurrence or systemic relapse.

Discussion

MS, commonly referred to as GS in the published literature, is a rare tumor located outside of the bone marrow and composed of immature myeloid cells [1-5]. It was first reported in 1811 by Allen Burns [8]. It was then attributed the term "chloroma" by King [9] in 1853 to describe the tumors greenish appearance (in Greek "*chloros*" means green) in the presence of myeloperoxidase stain. In 1902, Dock et al [10] reported the association between GS and AML. Approximately 2.5% to 9.1% of AML patients have concomitant GS [1, 3, 5, 11]. Nonetheless, GS can also be found in patients with chronic myeloid leukemia, myelodysplastic syndrome and other myeloproliferative diseases. It can also occur as an isolated tumor in absence of medullary involvement [1-5].

MS presenting as a breast mass and only involving the breast is quite rare, and therefore the prognosis and natural history are not well defined. Also, there are no standard treatment guidelines for the management of localized MS of the breast [2, 4]. Treatment modalities include systemic therapy with chemotherapy, and local therapy with surgical excision and/or RT. The majority of patients receive systemic chemotherapy, with or without local treatment [1-5]. This combination has shown high remission rates, although the prognosis is poor in cases of relapses with generally limited overall survival [3, 7]. We reviewed recent studies and compiled a table summarizing case reports from the past 10 years published in the English literature (Table 1) [2, 4, 12-21].

RT can play an important role in local disease control, palliation of symptoms and potentially increasing overall survival in some patients. Further, MS is known to be radiosensitive, and the successful use of low-dose RT (20 - 30 Gy with conventional fractionation) has been reported. Yet, specific total dose and fractionation have not been standardized [1, 3-5, 11, 22-24]. This report highlights the excellent outcome that can be achieved with the use of 2.5 Gy per fraction for MS involving the breast. Chak et al [22] studied the correlation between total RT dose and response to treatment among 33 patients suffering from symptomatic extramedullary involvement by non-lymphocytic leukemia treated at Stanford University Hospital. Patients who received less than 10 Gy had 18±9% probability of attaining a complete response, whereas those who received 10 to 19.99 Gy had 43±11%. Patients with response rates of 86±14% and 89±10% received 20 to 29 and over 30 Gy, respectfully. Therefore, Chak et al suggest at least 30 Gy in 15 fractions over a 3-week period to treat symptomatic lesions after failed response to chemotherapy [22].

Similarly, the efficacy of low-dose RT on chloroma patients was demonstrated by Bakst et al [3] in 2012. Local control was attained in 97% of the patients treated with a median dose of 20 Gy and median fraction size of 2 Gy. RT was well tolerated with an absence of significant toxicity. Bakst et al suggested that RT is useful for symptom palliation, consolidation following chemotherapy, and in patients who relapse after allogeneic transplant or after failure to response to chemotherapy. A dose of 24 Gy in 12 fractions is recommended [3].

Consistent with the other studies, Chen et al [5] showed that median dose RT of 20 Gy (range 6 - 35 Gy) in fractions of 1.5 - 3.5 Gy have a significant impact on complete remission (CR) and partial remission (PR). Of the 20 patients receiving RT, 13 (65%) responded with CR, five (25%) with PR and two (10%) maintained a stable disease. Furthermore, RT provided symptom relief in 19 patients: six during the treatment and 13 within the 3-months post-treatment [5]. This is supported by Oertel ed al [23] who demonstrated a CR in 32 out of 45 patients (71%) and PR in nine (20%) using a median dose of 26 Gy.

Although optimal dose remains uncertain, Bakst e al [11] recently provided specific recommendations concerning RT indications and dose selection. Consistent with other studies, Bakst et al stated that RT is indicated in patients with local MS, those with inadequate response to chemotherapy, with recurrence post-allogeneic stem cell transplant and for patients requiring symptom palliation. A low-dose RT regimen of 24 Gy in 12 fractions is suggested for most patients, providing long-term disease control without significant toxicity. Lower doses such as 6 to 20 Gy given in 2 Gy fractions are sometimes recommended in the setting of palliation in advanced stage disease [11].

While RT remains an effective local treatment for breast MS, particularly in achieving durable remission as highlighted in the current case, systemic management of residual disease or relapse remains challenging. In this context, emerging targeted therapies are gaining interest. Lessi et al [25] conducted a retrospective study where they showed the efficacy of FLT3 inhibitors, such as gilteritinib, in *FLT3*-mutated extramedullary AML, including isolated breast lesions. Venetoclax, a BCL-2 inhibitor, combined with hypomethylating agents, has also induced significant responses in breast MS, offering a potential alternative or adjunct to conventional chemotherapy (Jian et al [26], 2024). However, larger series and prospective studies are needed to better define the efficacy, safety, and optimal integration of these therapies in breast MS.

The case presented in the current study is a 33-year-old female diagnosed with a recurrent MS at the site of original disease in the right breast. She was treated with 25 Gy in 10 fractions over the course of 2 weeks, a dose corresponding to the recommendations in the literature. She tolerated her RT well and has now been in CR of her disease for more than 8 years.

Conclusions

There is currently no consensus in the treatment guidelines for MS, whether it is isolated or accompanying a hematological neoplasia. Treatment modalities include systemic therapy with chemotherapy, and local therapy with surgical excision

Table 1. Recent Case Reports of Breast Myeloid Sarcoma (2014 - 2025): Clinical, Imaging, and Treatment Features

References	Patient age (yrs)/gender	Presentation/ symptoms	Past hematologic disease	Imaging findings	Histopathology/IHC	Systemic/surgical treatment	Radiotherapy	Outcome/ follow-up
Goncalves et al, 2014 [4]	35/F	Tender left breast nodule, 25 mm, upper outer quadrant	N/A	US/mammography: solid heterogeneous nodule about 22 mm, small ipsilateral axillary LN; MRI post-chemo: persistent lesion about 60 mm, later resolved	Myeloid sarcoma: MPO^+, $CD45^+$, $CD68^+$, $CD34^+$, $CD31^+$, $CD43^+$, $Cam5.2^-$, $CD117^-$, $CD3^-$, $CD20^-$, TdT^-, $CD10^-$	Tumorectomy; chemo: idarubicin + ara-C, consolidation 4 × ara-C	30 Gy/15 fx, 3D conformal	26-month follow-up: asymptomatic, no relapse
Huang et al, 2015 [12]	58/F	Painless, palpable left breast mass (4 × 3 cm), 1-year duration	AML-M6 diagnosed 2 years prior; treated with 5 cycles idarubicin + ara-C	Mammography: single irregular, poorly defined mass, no calcification; MRI T2: ill-defined in homogeneous hyperintense mass	Myeloid sarcoma: small-sized cells, hyperchromatic nuclei, scant cytoplasm; MPO^+, $CD68^+$ ER^-, PR^- $HER2^-$, $p120^-$	Excisional biopsy; post-op chemo: 3 cycles ara-C + idarubicin	N/A	Complete remission; follow-up every 3 months with US, CXR, BM aspiration
Ozsoy et al, 2016 [13]	21/F	Bilateral painless palpable masses (largest 4.5 cm), lower quadrants, for 4 months	N/A (normal BM, peripheral smear)	US: multiple lobulated, hypoechoic solid masses, circumscribed contours, largest 4.5 × 2.7 cm	Myeloid sarcoma: $CD34^+$, $CD43^+$, $CD99^+$, TdT^+, $Bcl\text{-}2^+$, CD79a & CD117 weak-moderate, MPO focal, CD68 variable	Excisional biopsy; chemo: high-dose ara-C + idarubicin	N/A	Disease-free during 2-year follow-up
Sharma et al, 2018 [14]	52/F	Painless right breast lump, 8 × 6 cm, skin changes, nipple retraction	N/A (normal CBC, BM biopsy)	US: homogeneous hypoechoic mass, well-defined margins	Myeloid sarcoma: MPO^+, $CD34^+$, $CD117^+$; ER^-, PR^-, $HER2^-$, CK^-	Lumpectomy; consolidation chemo: 3 cycles ara-C + idarubicin	N/A	Complete remission; disease-free at 1-year follow-up
Zhai et al, 2018 [15]	34/F	Palpable right breast mass (about 2.6 × 3.5 cm, superior lateral quadrant), painless	AML-M2, 3 years prior	Mammogram: 2.5 × 2.4 cm, well-defined, irregular margins; 2nd mass 1.4 × 1.1 cm; US: hypoechoic 3.7 × 2.6 cm, another 1.8 × 1.1 cm, axillary LN 1.8 cm	Myeloid sarcoma: MPO^+, $CD43^+$, LCA^+; weakly $CD20^+$, kappa/lambda, PR^+; negative for CD79α, CD3, CD10, CD5, CD56, AE1/AE3, ER, C-erbB2	Lumpectomy; post-op consolidation chemo: 4 cycles idarubicin + ara-C	N/A	Remission; disease-free at 1.5-year follow-up
Gomaa et al, 2018 [16]	29/F	Left breast lump for 3 months	N/A	US: well-defined mass; mammography: possible hamartoma; MRI: suggested hamartoma	Sheets/cords of pleomorphic neoplastic cells infiltrating parenchyma, sparing ducts/lobules IHC: LCA^+, MPO^+, $CD68^+$, focal $CD34^+$, $CD117^+$	Surgery + chemo	Yes, but no description available	6 months: BM biopsies negative, normal WBC, no blasts
Wu et al, 2019 [2]	42/F	Palpable right breast mass (4 months), mobile right axillary LN	N/A (normal BM, no AML)	US: irregular 2 × 1.8 cm lesion, axillary LN about 2 × 0.7 cm; mammography: mass, no calcification; MRI: right breast mass with axillary LN, bilateral dotted lesions; CT: proliferative lesion in right lung	Myeloid sarcoma: MPO^+, LCA^+, $BCL\text{-}2^+$, $C\text{-}myc^+$, Ki-67 □60%	Modified radical mastectomy + SLNB; chemo: 2 cycles IA (inhibition + cytosine arabinoside), then HA (homoharringtonine and cytosine arabinoside)	N/A	Complete remission; disease-free at 1-year follow-up

Table 1. Recent Case Reports of Breast Myeloid Sarcoma (2014 - 2025): Clinical, Imaging, and Treatment Features - *(continued)*

References	Patient age (yrs)/gender	Presentation/ symptoms	Past hematologic disease	Imaging findings	Histopathology/IHC	Systemic/surgical treatment	Radiotherapy	Outcome/ follow-up
Khoshnaw et al, 2019 [17]	30/F	Bilateral breast pain and tenderness (2 weeks), post-AML remission	AML-M1, post-induction/consolidation/high-dose ara-C	US: oval heterogeneous masses right: 41 × 26 mm, left: 22 × 14 mm; MRI: multiple round-shaped masses bilaterally, irregular outlines, largest 45 × 40 mm	Myeloid sarcoma: medium-sized blastic cells, perivascular arrangement, frequent mitoses; IHC: $CD117^{+}$, $CD45^{+}$, $Ki67^{+}$, $CD34^{-}$, ER^{-}, PR^{-}, $HER2^{-}$	FLAG-IDA chemo	N/A	Patient died due to disease progression
Kim et al, 2019 [18]	24/F	Hard, painless right breast lump (2 days), upper outer quadrant	AML (18 months prior), multiple extramedullary relapses, haploidentical stem cell transplant 6 months prior	US: 4.3 cm, indistinct, oval, heterogeneous-echoic mass with posterior enhancement, increased vascularity, stiff on elastography	Myeloid sarcoma: hypercellular sheets of immature mononuclear cells, MPO focal positivity	Core needle biopsy; ongoing chemo for relapsed AML	N/A	N/A
Huang et al, 2021 [19]	34/F	Bilateral breast masses (left 3.0 × 1.2 cm, right 2.3 × 1.64 cm), rapid growth	AML-M4, post-allo-HSCT (mother donor), partial response after multiple chemo regimens	US/MRI: multiple well-defined hypoechoic oval lesions, axillary nodules; enhanced masses with small fluid necrosis	Myeloid sarcoma: medium-sized malignant cells, MPO^{++}, $CD34^{+++}$, $CD43^{+++}$, $CD68^{+}$, $CD117^{+}$, Ki67 40%; *FLT3*-ITD mutation positive	Chemo: multiple regimens (IL-2 + decitabine + thalidomide, azacitidine + ara-C + IL-2, MTX, MTX + venetoclax)	N/A	Patient died March 2021 due to AML cranial invasion
Amirarian et al, 2022 [20]	63/F	Rapidly enlarging bilateral breast masses (2 weeks)	AML (relapsed), history of ovarian cancer	Mammography: multiple high-density masses (left breast), single right breast mass; US: complex hypoechoic central portion, hyperechoic halo bilaterally	Myeloid sarcoma: medium-large myeloid blasts, MPO^{-}, $lysozyme^{-}$, $pan\text{-}CK^{-}$, $CD33^{+}$, $CD43^{+}$, $CD34^{+}$; FISH: monosomy 7	Core biopsy; planned salvage chemo and future allo-HSCT	N/A	Patient died shortly after diagnosis
Mahfouz et al, 2025 [21]	20/F	Painless left breast mass (55 × 33 mm), slow onset; additional nodules (face, axilla, under eyes)	N/A	US: central retroareolar large hypoechoic mass, moderate vascularity; smaller area in right breast; suspicious bilateral axillary and left infraclavicular nodes; mild skin thickening/edema; PET-CT: FDG-avid bilateral masses	Myeloid sarcoma: diffuse infiltration of small-medium neoplastic cells, MPO^{+}, $CD34^{+}$ LCA^{+}; $CD117\ focal^{+}$, ERG^{+}; Ki67 high; CD20, CD3, CD79a negative	Core needle biopsy; chemo: CHOP protocol (cyclophosphamide + doxorubicin + vincristine + prednisolone) followed with 4 cycles of high-dose ara-C	N/A	Complete metabolic and morphologic response; awaiting BMT.
Current case	33/F	Right breast lump (October 2013)	N/A	US: recurrent mass 1.6 × 1.1 cm (2014)	Myeloid sarcoma (IHC consistent with MS)	Chemo: 7 + 3 (ara-C + daunorubicin), 2 × HDAC → remission; allo-HSCT (MUD, BuCyATG conditioning, tacrolimus + MTX GVHD prophylaxis)	25 Gy/10 fx, conformal tangents	> 8 years post-RT: no local recurrence or systemic relapse

F: female; yrs: years; US: ultrasound; WBC: white blood cell; post-op: postoperative; CT: computed tomography; 3D: three-dimensional; CBC: complete blood count; MRI: magnetic resonance imaging; BM: bone marrow; BMT: bone marrow transplantation; LN: lymph node; allo-HSCT: allogeneic hematopoietic stem cell transplant; MPO: myeloperoxidase; IHC: immunohistochemistry; CXR: chest X-ray; RT: radiotherapy; fx: fractions; ara-C: cytarabine; SLNB: sentinel lymph node biopsy; AML: acute myeloid leukemia; N/A: not available/not applicable; IL: interleukin; FLAG-IDA: fludarabine, cytarabine (ara-C), granulocyte colony-stimulating factor (G-CSF), and idarubicin; HDAC: high-dose cytarabine; Chemo: chemotherapy; MUD: matched unrelated donor; BuCyATG: busulfan, cyclophosphamide, and anti-thymocyte globulin; MTX: methotrexate; GVHD: graft-vs-host disease; PET-CT: positron emission tomography-computed tomography; FDG: fluorodeoxyglucose; ITD: internal tandem duplications.

and/or RT. The benefit of RT on disease- or progression-free survival has not been clearly described in the literature. However, low-dose RT between 20 and 30 Gy with conventional fractionation provides excellent local control and palliation of symptoms with minimal toxicity.

MS of the breast is a rare entity and often associated with a poor prognosis. Our case, in accordance with the literature, illustrates the efficacy of low-dose RT in treating a patient with relapsed MS of the breast without evidence of circulating leukemia cell or bone marrow infiltration. The salvage treatment of 25 Gy in 10 fractions over 2 weeks resulted in a lasting local remission with minimal toxicity. Future prospective studies or larger case series are needed to validate the efficacity of RT and optimize treatment strategies for isolated breast MS.

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None to declare.

Conflict of Interest

The authors declare no conflict of interest.

Informed Consent

Informed consent was obtained.

Author Contributions

JMB: conceptualization, manuscript drafting, and final approval. JG: literature review, manuscript drafting and editing. AM: literature review, manuscript drafting. CB: clinical input on hematologic aspects and manuscript review. RS: radiation oncology expertise and manuscript review.

Data Availability

The authors declare that data supporting the findings of this study are available within the article.

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