Primary Cutaneous Marginal Zone Lymphoma: A Comprehensive Review

Jordyn Puccio, BS[1]; Teja Mallela, BS[1]; Nassim Idouraine, BS[1]; Matthew Gallardo, BS[1]; Catherine Chung, MD[2,3]; Kirsten Johnson, MD, PhD[2]; Brittany Dulmage, MD[2]

[1]The Ohio State University College of Medicine, Columbus, OH, USA

[2] Department of Dermatology, The Ohio State University Wexner Medical Center, Columbus, OH, USA

[3]Department of Pathology, The Ohio State University Wexner Medical Center, Columbus, OH, USA

Abstract

Primary cutaneous marginal zone lymphoma (PCMZL) represents a subset of primary cutaneous B-cell lymphomas (PCBCL) and an even smaller subset of all cutaneous lymphomas. Due to PCMZL's indolent nature, the differentiation between PCMZL and other more aggressive PCBCLs can be challenging and result in the delay of diagnosis and treatment. The diagnosis of PCMZL requires clinical evaluation combined with immunohistochemical analysis to differentiate it from other lymphoma and non-lymphoma pathologies. The condition's wide range of treatment options, including novel therapies, have led to various outcomes for patients diagnosed with PCMZL. This comprehensive review article emphasizes the clinical presentation and the methods of diagnosis, including appropriate pathologic evaluation, differentiating factors from other non-PCMZL conditions, and current treatment options for PCMZL.

Keywords: oncodermatology, oncology, treatment options, clinical research

Academic Dermatology (2025) 3(1):1-14 | https://doi.org/10.18061/ad.v3i1.9994

Published: July 18, 2025.

Contact author: brittany.dulmage@osumc.edu

INTRODUCTION

Primary cutaneous marginal zone lymphoma (PCMZL), formerly known as immunocytoma and non-myelomatous plasmacytoma, accounts for 25-57% of primary cutaneous B-cell lymphomas (PCBCL) and 7-9% of all cutaneous lymphomas.[1,2]

Because of its indolent nature, it is important to distinguish PCMZL from other, more aggressive PCBCLs, such as primary cutaneous follicle center lymphoma (PCFCL) and primary cutaneous B-cell lymphoma leg-type (PCBCL-LT), as well as from cutaneous involvement secondary to a systemic lymphoma. [1,3] Treatment selection for patients with PCMZL is influenced by the extent of the disease and may be challenging, as there is no standard therapeutic ladder. This review provides a comprehensive overview of diagnostic features, work-ups, and treatments available for PCMZL.

DEMOGRAPHICS

PCMZL predominantly occurs in adult males, typically during the fifth to sixth decades.[4,5] However, PCMZL also represents 10% of cutaneous lymphomas in younger patients.[2,6] Although rare, childhood PCMZLs occur most commonly in teenagers, with similar features to adult disease.[7,8] The youngest case reported was in a 5-year-old boy.[7]

WORK UP AND DIAGNOSIS

Diagnosis of PCMZL requires a thorough clinical evaluation combined with a constellation of histologic, immunophenotypic, and sometimes molecular genetic findings. The International Society of Cutaneous Lymphoma/European Organization for Research and Treatment of Cancer (ISCL/EORTC) and National Comprehensive Cancer Network (NCCN) recommend a thorough history, a review of systems, a physical exam, and an excisional or punch biopsy, followed by an immunohistochemical analysis; imaging and additional histopathological markers are needed to exclude the possibility of systemic disease.[9,10]

Physical Exam

Clinically, PCMZL presents as asymptomatic or mildly pruritic lesions that slowly enlarge, sometimes to over 3 centimeters in diameter.[11,12] Extracutaneous disease is exhibited more commonly in the B-cell predominate subtype compared to the T-cell predominate subtype; they are usually red to violaceous papules, nodules, or plaques, with a shiny surface and no desquamation (Figure 1A).[13,14] Lesions are predominantly located on the trunk and extremities, specifically the upper extremities (Figure 1B).[15,16] However, up to one-third of PCZML patients can exhibit head and neck involvement, which should be distinguished from extranodal MZL secondarily involving the skin.[13,17] PCMZL lesions may present as solitary or multifocal.[16,18] Although rare, patients may exhibit widely disseminated cutaneous lesions.[19] Rare clinical presentations of PCMZL include an anetodermic form and an agminated form. The anetodermic form of PCMZL is associated with the presence of antiphospholipid antibodies.[20] The agminated form is similar in clinical appearance to granulomatous rosacea. Both can be misdiagnosed as inflammatory diseases.

While local symptoms like pruritus are seen in nearly half of patients, ulceration and pain are not expected.[12,21] Systemic symptoms such as fever, weight loss, or night sweats are typically absent.[12,22]

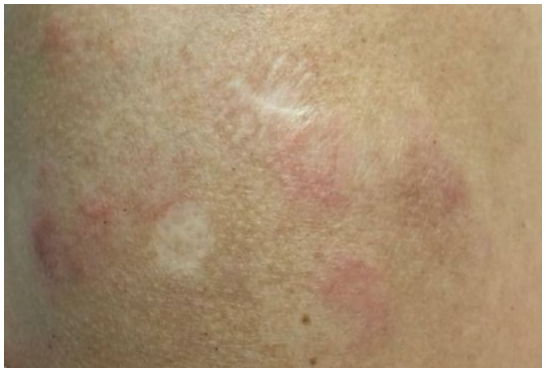

Figure 1a. *Red to violaceous shiny plaques presenting on the left shoulder.*

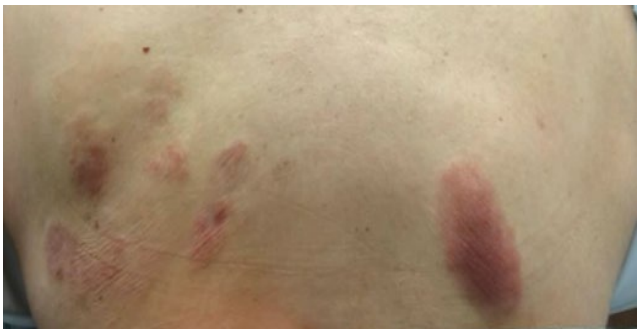

Figure 1b. *Numerous red nodules presenting on the back.*

Biopsy

An excisional biopsy of a suspected lesion is preferred to an incisional punch biopsy and should include the reticular dermis and fat to achieve sufficient thickness and margins.[23,24]

Histopathology

PCMZL generally shows a nodular and variably diffuse dense dermal perivascular and periappendageal infiltrate.[25,26] The epidermis is typically spared, and the subcutaneous fat is occasionally involved.[27,28] Cellular infiltrates demonstrate: small lymphocytes; small or medium marginal zone cells with pale cytoplasm; plasma cells; lymphoplasmacytoid cells; possibly large, transformed lymphoid cells; and macrophages.[29] Reactive follicles with mantle zones can be present.[4,30] Plasma cells and/or lymphoplasmacytoid cells are found at the periphery of the infiltrates or subepidermal border.[22,31] Plasma cells with Kappa or Lambda light chain restriction are present in about 70% of cases (Figure 2).[11,32] Other inflammatory cells can be present, such as histiocytes, mast cells, and eosinophils (25% of cases).[1,4] Though B cells predominate, T cells can account for about 50-75% of the infiltrate.[32,33] Associated T cells can be polyclonal or monoclonal.[13]

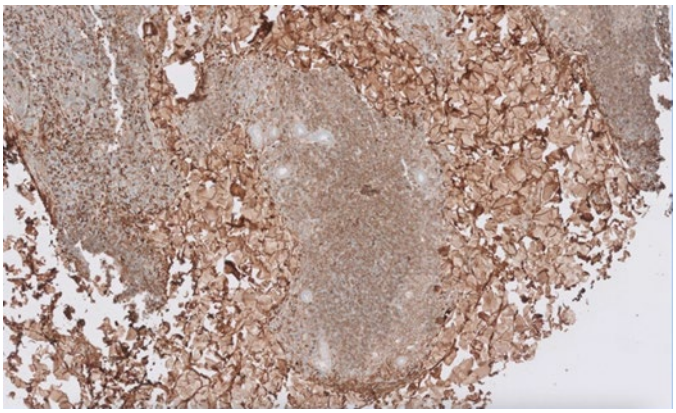

Figure 2. *Kappa light chain restriction in PCMZL: Histology demonstrating kappa light chain restriction in PCMZL.*

Cell Markers

PCMZL neoplastic B cells generally express CD19, CD20, CD79a, CD22, PAX5, and BCL2 (Figure 3A-B).[2,34] Conversely, CD5,[5] CD10, BCL6,[11] CD23, MUM 1, and cyclin D1 are typically negative.[29,35] Some cases have up to 10% CD30-positive large cells, while CD15 expression is rarely reported.[2] Two studies described low proliferative rates (Ki 67/MIB-1 of around 15%).[36] Additionally, although infrequent, aggregates of plasmacytoid cells may exhibit Dutcher bodies.[27,37]

Figure 3a. *CD20 expressed in PCMZL: Diffuse CD20 expression in PCMZL.*

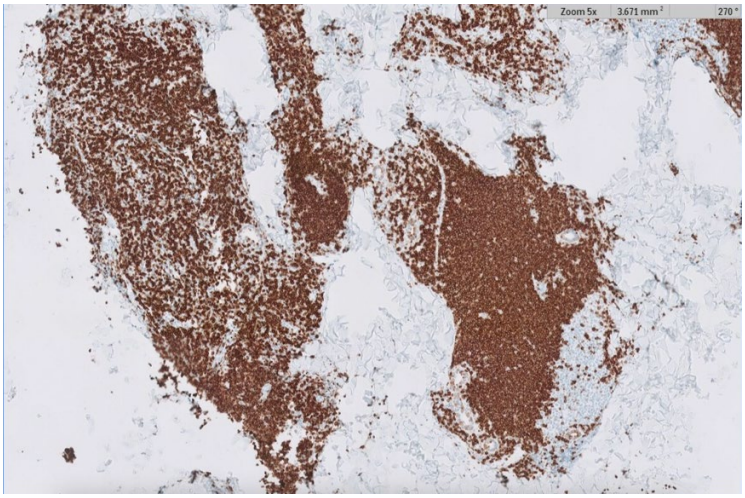

Figure 3b. *CD20 expressed in PCMZL: Diffuse BCL2 expression in PCMZL.*

Light Chain Restriction

Light chain restriction is investigated using either immunohistochemistry, in situ hybridization, and/or IgH or IgK gene rearrangement clonality via multiplex PCR.[38] Clonal IgH gene rearrangements are often seen.[18,26] However, the clonality of IgH or IgK has been demonstrated in benign cutaneous lymphoid proliferations.[2] IgH gene rearrangement studies are positive in only 60-70% of PCMZL cases.[16] While some studies report that flow-cytometric immunophenotyping can be helpful to confirm clonal light chain expression within B cells,[1,2] this technique may be less useful in cases of inadequate biopsies or small populations of B cells.[2]

Imaging

After biopsy, imaging of the neck, chest, abdomen, and pelvis with computed tomography (CT), positron emission tomography (PET), or PET/CT are used for staging.[12,22] Although imaging aids in the detection of extracutaneous involvement, it is not used to monitor cutaneous lesions.[21] Therefore, imaging is typically only performed at the time of initial staging and not in follow-up unless there is concern for extracutaneous involvement.[23] Ultrasound may be used to investigate lymph node involvement in a particular nodal basin.[24] Imaging may not be necessary for solitary localized lesions, and a recent report suggests that almost half of the imaging studies conducted for suspected PCMZL resulted in false positives.[2]

Labs

NCCN recommends a laboratory workup that includes a serum lactate dehydrogenase, serum chemistries, and complete blood count.[34,38] For PCMZL diagnosis, ESR, liver and renal function tests, and serum beta-2-microglobulin are typically within normal limits.[39,40] Serum antibodies against *Borrelia* species, PCR identification of *Borrelia* DNA, and in situ hybridization of Epstein-Barr virus (EBV) can also be evaluated. This is particularly useful in European patients; however, it is not recommended if histological findings are definitive.[27,38] Additionally, paraproteinemias detected by serum protein electrophoresis and quantitative immunoglobulin abnormalities have increased incidence in patients with PCMZL and should be considered as part of the workup for older individuals.[23] One study recommended also routinely checking an antinuclear antibody panel, Ro and La serology, thyroid, and liver function tests, particularly if the family history or the review of symptoms raises concern for autoimmune disease.[38]

In patients with unexplained cytopenias or lymphocytosis with suspicion for extracutaneous disease, bone marrow biopsy or peripheral blood flow cytometry is used to exclude cutaneous involvement of a systemic lymphoma.[20,33] However, bone marrow biopsies are not performed in the majority of cases.[2]

Link to Infectious Disease

Although some studies in European populations suggest an association between PCMZL and *Borrelia burgdorferi*,[41] North American and Asian studies have not corroborated this finding.[10,39] Specifically, IgM-positive PCMZL is thought to be more frequently associated with a *Borrelia burgdorferi* infection.[42] Other studies have demonstrated an association with hepatitis C viral infection;[2] however, evidence of its role in PCMZL pathogenesis has not been identified.[20,27] Additional associations of PCMZL reported in the literature include *Helicobacter pylori* colonization of the stomach, immunization against influenza or hepatitis A, arthropod bites, traumatic injuries, tattoos, gastrointestinal disorders, and autoimmune diseases.[2,5]

DIFFERENTIAL DIAGNOSIS

Cutaneous T-cell lymphomas and lymphoproliferative disorders such as primary cutaneous CD4-positive small/medium T-cell lymphoproliferative disorder (PC-SMTLPD), angioimmunoblastic T-cell lymphoma (AITL), and peripheral T-cell lymphomas can mimic PCMZL.[2,13] Cutaneous AITLs can contain plasma cells and B cells that mimic PCMZL. For these cases, T-cell and B-cell clonality studies can be helpful in detecting T-cell clonal receptor gene rearrangements to help differentiate among these similar entities. Next generation sequencing has also been effective in distinguishing between PC-SMTLPD and PCMZL.[75]

Reactive cutaneous lymphoid infiltrates, such as cutaneous lymphoid hyperplasia (CLH, B-cell pseudolymphoma, lymphocytoma cutis, and lymphoadenoma benign cutis) should also be included in the differential.[18,43] The histology of CLH is similar to PCMZL. However, CLH does not exhibit marginal zone cells or sheets of plasma cells. To differentiate the two, the immunophenotype of the B cells and plasma cells should be characterized.[43] Clonal IgH or IgK re-arrangements may be ambiguous for the differentiation of clonal CLH or cutaneous B-cell lymphomas. For this reason, distinguishing between CLH and PCMZL can be challenging and may necessitate continued clinical observation with repeated biopsies.[2]

IgG4-related disease (IgG4-RD) is a benign fibroinflammatory condition that presents with lesions on the head and neck and can mimic the IgG4-positive plasma cell subset.[2] However, IgG4-RD does not express monotypic plasma cells, arises from extracutaneous disease, and demonstrates an elevated serum IgG4 level.[2,43]

Although rarely involving the skin, small lymphocytic lymphoma or B-cell chronic lymphocytic leukemia (CLL) can also mimic PCMZL; these can be distinguished with immunophenotyping (CLL cells express CD20, CD79a, CD5, CD23, and CdD3).[11,20] An extramedullary plasmacytoma or AL amyloidoma may also have

overlapping features with PCMZL.[1,41] In the latter, a bone marrow biopsy is needed to rule out the secondary cutaneous involvement of multiple myeloma.[41]

Of note, cutaneous infiltration of an extranodal MALT lymphoma can appear histologically and clinically identical to PCMZL, except for the presence of class-switched immunoglobulins, chemokine receptors, translocations, and infectious agents.[20] Some even consider these to be two entities on the same disease spectrum. Accordingly, there have been recent shifts regarding PCMZL classification. The European Organization for Research and Treatment of Cancer (EORTC)/World Health Organization (WHO) published an updated classification in 2018 which recognizes PCMZL as a distinct disease.[4] The 2022 International Consensus Classification (ICC) designates PCMZL as primary cutaneous marginal zone lymphoproliferative disease rather than lymphoma.[18] And, the most recent WHO Classification regarding hematopoietic and lymphoid tissue tumors have assigned PCMZL to the mucosal-associated lymphoid tissue (MALT) family, more specifically an extranodal MZL.[74]

Table 1a. *Differential diagnoses for PCMZL.*

Differential Diagnosis	Similarities	Differences	Testing to Differentiate
Cutaneous T-cell lymphomas and lymphoproliferative disorders with monotypic plasma cells and/or B cells	Contain admixed B cells, and rarely, monotypic B cells and/or plasma cells	Most cases will lack plasma cells but a multifaceted approach with clinical correlation is necessary to truly differentiate	B- and T-cell clonality studies
Cutaneous lymphoid hyperplasia (lymphocytoma cutis, lymphoadenoma benign cutis)	Shows a nodular perivascular and periappendageal distribution, or a diffuse dermal infiltration of small lymphoid cells; reactive germinal centers and other inflammatory cells are not always present	CLH lacks marginal zone cells and sheets of plasma cells	Immunophenotype of the B cells and plasma cells needs to be sought out
B-cell pseudolymphoma	Multifocal lesions, relapsing clinical course, and light chain monoclonality	N/A	IgH gene clonality is needed to confirm the diagnosis
IgG4-related disease subtype containing IgG4-positive plasma cells	Can mimic the IgG4-positive plasma cell subset	Does not express monotypic plasma cells, arises from extracutaneous disease, and demonstrates an elevated serum IgG4 level	B-cell clonality studies

Table 1b. *Other differentials to consider in diagnosing PCMZL.*

Other Differentials to Consider
Primary cutaneous follicle center lymphoma
Pseudolymphomatous folliculitis (PLF), rosacea, and marginal zone hyperplasia of the skin
Borrelia-associated lymphocytoma cutis lymphoplasmacytic plaque, cutaneous plasmacytosis and plasmacytoma (pediatric patients)
Arthropod bites, amelanotic melanoma, and basal cell carcinoma
Small lymphocytic lymphoma or B-cell chronic lymphocytic leukemia (CLL/SLL)
Extramedullary plasmacytoma
AL amyloidoma
Extranodal MALT lymphoma

PROGNOSIS

PCMZL prognosis is excellent, with a 99% 5-year survival rate.[1] Although up to 50% of patients relapse, prognosis remains unaffected.[22,27] Recurrence of PCMZL has rarely been reported to be PCFCL or a non-specified cutaneous B-cell lymphoma.[44] Extracutaneous metastasis is uncommon (<10% of patients).[12,29] Two studies noted that systemic spread is often preceded by large cell transformation with t(14; 18)(q32; q21) IGH-BCl2 and t(14; 18)(q32; q21) IGH-MALT1 translocations.[11,20] Transformation to more aggressive forms is a negative prognostic factor due to treatment resistance, resulting in increasing mortality rates.[12,45] Blastic transformation, defined by the 30% of the infiltrate consisting of large, transformed cells, is also rare.

TREATMENT

Treatment modalities for PCMZL include observation, surgical excision, and a wide range of local and systemic options.[13,28] PCMZL management is determined largely by skin disease severity and associated symptoms.

Conservative treatment is generally preferred in patients presenting with asymptomatic solitary or localized lesions, since these can regress spontaneously.[1] In addition to watchful waiting, follow-up appointments should be scheduled every six months for thorough skin and lymph node exams.[12]

Across the current literature, 90% of PCMZL patients experience complete remission after initial conservative treatment.[5,46] Although the PCMZL 5-year survival rate is excellent, recurrence rates are high, regardless of treatment options. Therefore, it is imperative to monitor patients for the development of new lesions.[47,48]

Traditional Therapies

Table 2, below, highlights topical therapies used to manage PCMZL. Topical imiquimod can be used for PCBCL. However, it is shown to be more efficacious for primary cutaneous T-cell lymphomas.[48] In one study, there was a 31% complete response rate for patients with PCBCL, where imiquimod was applied for 6 hours to all affected areas 3 times weekly for 3-4 months.[49] Another small study reported that, of 3 patients with PCBCL treated with imiquimod, two had a partial response, and one patient had no response to topical imiquimod therapy used three times per week.[50]

Intralesional (IL) steroids are effective and safe for many PCMZL cases, particularly when there is a single lesion or a small number of lesions present. One study reports the use of triamcinolone for two lesions over the course of 25 weeks, resulting in the complete resolution of lesions.[51] Another study observed that intralesional triamcinolone also resulted in the complete resolution of lesions in 4 out of 9 patients diagnosed with PCMZL.[51] Additionally, the concurrent use of IL steroids plus radiation or rituximab has been used without long-term relapse.[52]

Surgical management is also frequently pursued. One study suggests wide local excision prevents disease recurrence as compared to immunochemotherapy, but this is not yet verified in large-scale investigations.[39] Another PCMZL study reserved surgical excision for small solitary lesions, while multiple lesions in a regional distribution were treated with local radiotherapy. In the same study, 116 out of 118 patients achieved complete remission with a 95% 5-year survival rate with surgical excision, local radiotherapy, or a combination of both interventions.[53] Importantly, surgery may have particular efficacy in early-stage PCMZL and in isolated lesions.[26,54]

Radiotherapy is associated with a high response rate in PCMZL for single-lesion, multifocal, and widespread involvement.[10] One study reported a 75% complete remission rate after radiotherapy with excellent survival and minimal toxicity.[55] Another study demonstrated that low-dose electron beam radiation exhibited a 97.6% response rate.[26] One challenge of radiotherapy is determining a safe therapeutic dosage, as there is no overall consensus on these parameters. For example, one study cites sufficient local disease control with doses ranging between 4 Gy and 12 Gy.[24] Although radiotherapy is an effective treatment for PCMZL and has an excellent prognosis with a low toxicity profile, there is evidence of higher relapse rates, specifically for head and neck lesions. Combining radiotherapy with surgical management for initial and recurrent PCMZL appears to result in more successful treatment overall.[56]

Antibiotic indication, efficacy, and treatment course for PCMZL remain unclear based on current literature.[48] In a limited case series, penicillin elicited rapid, significant partial resolution of PCMZL in 5 patients with *Borrelia*-negative PCMZL.[57] Cases in which 100 mg of doxycycline was given to PCMZL patients twice daily for three weeks reported some patients responded, some achieved partial remission, and some did not respond.[7,24] In one study, the use of cefuroxime 500 mg twice daily and doxycycline 100 mg twice daily led to remission in 6 of 14 PCMZL patients with positive *B. burgdorferi* serology.[48] There are several plausible explanations for why PCMZL patients respond minimally to antibiotic therapy, even in the setting of *Borrelia* infection. The presence of a different *Borrelia* strain, an ineffective immune response, or a poor clearance of the *Borrelia* antigen could explain persistent disease when treating PCMZL with antibiotics.[58] Overall, the current literature shows limited support for antibiotic use in patients with PCMZL.[59]

Rituximab plays a crucial role in treating symptomatic and disseminated lesions of PCMZL, with complete remission rates ranging from 83-89% in current literature.[10,12] However, studies suggest it is not an ideal first-line agent for PCMZL due to the high cost of treatment and overall good prognosis of the disease with more conservative treatment.[3] As such, Rituximab use in PCMZL may be reserved for difficult-to-treat areas, such as the face and scalp and for patients with systemic symptoms such as fever, chills, and headache.[60]

Although clinically similar in presentation to adult disease, cases of PCMZL in the pediatric population require unique therapeutic approaches. Surgery and radiation should be avoided as first-line therapies, as each may result in disfiguration and bone growth disorders.[61,62] Topical or intralesional steroids, antibiotics for possible *Borrelia* coverage, and combination antibiotics and topicals have all shown some efficacy in this population with limited side effects.[63] If radiation treatment is required, beginning at the lowest possible dose should be a priority to avoid significant side effects, and referral to lymphoma clinics may be required for these patients.[63,64]

Other Treatment Options and Novel Therapies

When classic therapies for PCMZL fail, unique therapeutic approaches have been used with various efficacies. Here, we briefly describe a few of these approaches and their success.

Use of intralesional or subcutaneous interferon-alpha has been reported in disseminated PCMZL, with one study citing a complete response rate in 8 patients receiving interferon-alpha injections 3 times per week. Unfortunately, the rate of relapse was high.[65,66] Targeted therapies interfering with the MYD88 cellular signaling complex through IL-1 receptor-associated-kinase-1/4 inhibitors, such as Ibrutinib, may also be a novel treatment option in rare cases.[67] Of note, patients with amyloidoma may have higher resistance to traditional therapies for PCMZL due to high levels of amyloid deposits. Bortezomib has been shown to have efficacy in this population subset.[68] One case that had no treatment success with Rituximab showed clinical improvement with prednisolone, chloroquine, and thalidomide.[69] Conversely, enzastaurin as monotherapy had no response in PCMZL patients.[70] In a case of PCMZL in a patient with concurrent lung adenocarcinoma, four cycles of pemetrexed and cisplatin after initial surgery and alectinib appear to have improved cutaneous lesions.[35]

Chemotherapy can also be used to treat the extracutaneous progression of PCMZL.[23,66] The disseminated disease was successfully treated with CHOP, R-CVP, or R-PLD alone, regardless of stage or subtype.[71,72]

Blinatumomab, a monoclonal antibody that targets CD19/CD3, is being explored as a potential PCMZL therapy, but this may not be as effective in advanced PCMZL due to high plasma cell levels which do not express CD19.[48]

Other studies also investigated the use of electrochemotherapy (ECT) with either bleomycin, cisplatin, or calcium electroporation to treat PCMZL. In a case series of 3 patients with multifocal lesions, ECT combined with antibiotics for 18 months was effective in treating PCMZL.[73]

Table 2a. *Traditional therapies for PCMZL.*

Treatment	Treatment Type	Use	Outcome
Topical Imiquimod	PCBCL, primary cutaneous lymphomas; consideration for pediatric patients	Applied on all affected areas for 6 hours, 3 times weekly	31% complete response rate for patients with PCBCL
Intralesional Steroids	Epidermotropic PCMZL, classic PCMZL; consideration for pediatric patients	Applied to single or multiple lesions within a region Refractory or symptomatic lesions in disseminated disease	Partial remission, high rate of local recurrence
Antibiotic Indication	PCMZL, PCMZL patients with positive or negative B. burgdorferi serology and PCMZL	110 mg of doxycycline twice daily Cefuroxime 500 mg twice daily Doxycycline 100 mg twice daily	Penicillin: significant partial reduction Doxycycline: partial resolution Cefuroxime: partial resolution
Radiotherapy	Non-symptomatic PCMZL; consideration for pediatric patients	High response rate in single-lesion, multi-lesion, and widespread involvement	Complete remission with excellent survival and minimal toxicity Higher relapse rates (specifically in head and neck)
Surgical Management, Combined Surgical + Radiotherapy	Early-stage PCMZL and in isolated lesions	Small, solitary lesions	Complete remission More successful treatment when combined
Rituximab	Symptomatic and disseminated lesions of PCMZL; difficult-to-manage and relapsed PCMZL	Not an ideal first-line agent Difficult-to-treat areas (face and scalp)	High complete remission rates

Table 2b. *Novel therapies for PCMZL*.

Treatment	Treatment Type	Use	Outcome
Chemotherapy	PCMZL	Extracutaneous progression of PCMZL	Successful for disseminated disease
Electrochemotherapy (ECT) with either bleomycin or cisplatin, or calcium electroporation	PCMZL	Patients with multifocal lesions	Effective in treating PCMZL and is a good alternative to traditional chemotherapy

CONCLUSIONS

In conclusion, PCMZL has a wide range of clinical presentations that require histologic, immunophenotypic, and molecular genetic testing to confirm the diagnosis and differentiate it from other cutaneous diseases. Once confirmed, various treatment options can be used to treat PCMZL, depending on the severity of presentation and the potential side effects related to treatment. In most cases, conservative treatment should be recommended, especially when considering the excellent prognosis of PCMZL.

Funding sources: None.

Conflicts of Interest: None declared.

REFERENCES

1. Dumont M, Battistella M, Ram-Wolff C, et al. Diagnosis and treatment of primary cutaneous B-cell lymphomas: State of the art and perspectives. *Cancers (Basel)*. 2020;12(6):1497. https://doi.org/10.3390/cancers12061497
2. Gibson SE & Swerdlow SH. How I diagnose primary cutaneous marginal zone lymphoma. *Am J Clin Pathol*. 2020;154(4):428-449. https://doi.org/10.1093/ajcp/aqaa116
3. Brandenburg A, Humme D, Terhorst D, et al. Long-term outcome of intravenous therapy with rituximab in patients with primary cutaneous B-cell lymphomas. *Br J Dermatol*. 2013;169(5):1126-1132. https://doi.org/10.1111/bjd.12484
4. Fava P, Roccuzzo G, Alberti-Violetti S, et al. Cutaneous B-cell lymphomas: Update on diagnosis, risk-stratification, and management. *Presse Med*. 2022;51(1):104109. https://doi.org/10.1016/j.lpm.2022.104109
5. Goyal A, LeBlanc RE, Carter JB. Cutaneous B-cell lymphoma. *Hematol Oncol Clin North Am*. 2019;33(1):149-161. https://doi.org/10.1016/j.hoc.2018.08.006
6. Agnihotri T, Adotama P, Kalowitz-Bieber A, et al. A case of primary cutaneous marginal zone lymphoma presenting with rosacea-like eruption. *JAAD Case Rep*. 2020;6(9):902-904. https://doi.org/10.1016/j.jdcr.2020.07.018
7. Colmant C, Demers MA, Hatami A, et al. Pediatric cutaneous hematologic disorders: Cutaneous lymphoma and leukemia cutis-experience of a tertiary-care pediatric institution and review of the literature. *J Cutan Med Surg*. 2022;26(4):349-360. https://doi.org/10.1177/12034754221077694
8. Kempf W, Kazakov DV, Buechner SA, et al. Primary cutaneous marginal zone lymphoma in children: A report of 3 cases and review of the literature. *Am J Dermatopathol*. 2014;36(8):661-666. https://doi.org/10.1097/DAD.0000000000000062
9. Stagner AM, Jakobiec FA, Freitag SK. Primary cutaneous extranodal marginal zone B-cell lymphoma of the eyelid skin: Diagnostic clues and distinction from other ocular adnexal diseases. *Surv Ophthalmol*. 2016;61(3):333-338. https://doi.org/10.1016/j.survophthal.2015.10.007
10. Wilcox RA. Cutaneous B-cell lymphomas: 2019 update on diagnosis, risk stratification, and management. *Am J Hematol*. 2018;93(11):1427-1430. https://doi.org/10.1002/ajh.25224

11. Grandi V, Alberti Violetti S, La Selva R, et al. Primary cutaneous B-cell lymphoma: Narrative review of the literature. *G Ital Dermatol Venereol*. 2019;154(4):466-479. https://doi.org/10.23736/S0392-0488.17.05670-X
12. Krenitsky A, Klager S, Hatch L, et al. Update in diagnosis and management of primary cutaneous B-cell lymphomas. *Am J Clin Dermatol*. 2022;23(5):689-706. https://doi.org/10.1007/s40257-022-00704-0
13. Bakr F, Wain EM, Barlow R, et al. Primary cutaneous CD4+ small/medium T-cell lymphoproliferative disorder or primary cutaneous marginal zone B-cell lymphoma? Two distinct entities with overlapping histopathological features. *Am J Dermatopathol*. 2021;43(12):e204-e212. https://doi.org/10.1097/DAD.0000000000002003
14. Chen ST, Barnes J, Duncan L. Primary cutaneous B-cell lymphomas: Clinical and histopathologic features, differential diagnosis, and treatment. *Semin Cutan Med Surg*. 2018;37(1):49-55. https://doi.org/10.12788/j.sder.2018.014
15. Gauci ML, Quero L, Ram-Wolff C, et al. Outcomes of radiation therapy of indolent cutaneous B-cell lymphomas and literature review. *J Eur Acad Dermatol Venereol*. 2018;32(10):1668-1673. https://doi.org/10.1111/jdv.14972
16. Puccio J, Huang Y, Reneau J, et al. Presenting features of indolent primary cutaneous B-cell lymphomas: Distinguishing clinical and histopathologic features. *Clin Dermatol*. 2024;42(1):93-95. https://doi.org/10.1016/j.clindermatol.2023.12.001
17. Barzilai A, Amitay-Laish I, Didkovsky E, et al. New insights into macular type of primary cutaneous B-cell lymphoma: Extension of the clinical and histopathological patterns. *Dermatology*. 2022;238(6):1018-1025. https://doi.org/10.1159/000525439
18. Goodlad JR, Cerroni L, Swerdlow SH. Recent advances in cutaneous lymphoma-implications for current and future classifications. *Virchows Arch*. 2023;482(1):281-298. https://doi.org/10.1007/s00428-022-03421-5
19. Artemaki PI, Letsos PA, Zoupa IC, et al. The multifaceted role and utility of microRNAs in indolent B-cell non-Hodgkin lymphomas. *Biomedicines*. 2021;9(4):333. https://doi.org/10.3390/biomedicines9040333
20. Kempf W, Kazakov DV, Mitteldorf C. Cutaneous lymphomas: An update: Part 2: B-cell lymphomas and related conditions. *Am J Dermatopathol*. 2014;36(3):197-208; quiz 209-210. https://doi.org/10.1097/DAD.0b013e318289b20e
21. Olszewska-Szopa M, Sobas M, Laribi K, et al. Primary cutaneous indolent B-cell lymphomas: A retrospective multicenter analysis and a review of literature. *Acta Oncol*. 2021;60(10):1361-1368. https://doi.org/10.1080/0284186X.2021.1956689
22. Malachowski SJ, Sun J, Chen PL, et al. Diagnosis and management of cutaneous B-cell lymphomas. *Dermatol Clin*. 2019;37(4),:443-454. https://doi.org/10.1016/j.det.2019.05.004
23. Pinter-Brown LC. Diagnosis and management of cutaneous B-cell lymphoma. *Dermatol Clin*. 2015;33(4):835-840. https://doi.org/10.1016/j.det.2015.05.003
24. Ronchi A, Sica A, Vitiello P, et al. Dermatological considerations in the diagnosis and treatment of marginal zone lymphomas. *Clin Cosmet Investig Dermatol*. 2021;14:231-239. https://doi.org/10.2147/CCID.S277667
25. Lee BA, Jacobson M, Seidel G. Epidermotropic marginal zone lymphoma simulating mycosis fungoides. *J Cutan Pathol*. 2013;40(6):569-572. https://doi.org/10.1111/cup.12114
26. Xu Z, Margolskee E, Villasenor-Park J, et al. A healthy 16-year-old boy presenting with multifocal asymptomatic subcutaneous nodules. *Pediatr Dermatol*. 2022;39(1):e8–e10. https://doi.org/10.1111/pde.14854
27. Nicolay JP, Wobser M. Cutaneous B-cell lymphomas: Pathogenesis, diagnostic workup, and therapy. *J Dtsch Dermatol Ges*. 2016;14(12):1207-1224. https://doi.org/10.1111/ddg.13164
28. Skaljic M, Cotton CH, Reilly AF, et al. Complete resolution of primary cutaneous marginal zone B-cell lymphoma on the cheek of a 7-year-old boy with intralesional triamcinolone and tincture of time. *Pediatr Dermatol*. 2020;*37*(1):228-229. https://doi.org/10.1111/pde.14028
29. Zhang Y, LeWitt TM, Louissaint A Jr, et al. Disease-defining molecular features of primary cutaneous B-cell lymphomas: Implications for classification and treatment. *J Invest Dermatol*. 2023;143(2):189-196. https://doi.org/10.1016/j.jid.2022.07.027
30. Çetinözman F, Koens L, Jansen PM, et al. Programmed death-1 expression in cutaneous B-cell lymphoma. *J Cutan Pathol*. 2014;41(1);14-21. https://doi.org/10.1111/cup.12254
31. Leonard N, Lal K, Luffman C, et al. Darier sign in a teenager with primary cutaneous marginal zone lymphoma. *Pediatr Dermatol*. 2021;38(2): 494-496. https://doi.org/10.1111/pde.14488
32. Goyal N, O'Leary D, Carter JB, et al. A practical review of the presentation, diagnosis, and management of cutaneous B-cell lymphomas. *Dermatol Clin*. 2023;41(1):187-208. https://doi.org/10.1016/j.det.2022.07.014

33. Hristov AC, Tejasvi T, Wilcox RA. Cutaneous B-cell lymphomas: 2021 update on diagnosis, risk-stratification, and management. *Am J Hematol*. 2020;95(10):1209-1213. https://doi.org/10.1002/ajh.25970
34. González-Quesada A, Bastida J, Rivero-Vera JC, et al. Image gallery: Metachronic occurrence of primary cutaneous marginal zone B-cell lymphoma and primary cutaneous Rosai-Dorfman disease in the same patient. *Br J Dermatol*. 2017;177(6):e355. https://doi.org/10.1111/bjd.16036
35. Ashish S, Rodriguez RR, Sethi P, et al. (2022). Anaplastic lymphoma kinase (ALK) mutation-targeting treatment with alectinib in lung adenocarcinoma and primary cutaneous marginal zone B-cell lymphoma. *Cureus*. 2022;14(10);e29922. https://doi.org/10.7759/cureus.29922
36. Piccolo V, Mascolo M, Russo T, et al. Dermoscopy of primary cutaneous B-cell lymphoma (PCBCL). *J Am Acad Dermatol*. 2016;75(4):e137-e139. https://doi.org/10.1016/j.jaad.2016.02.1217
37. Lima M. Cutaneous primary B-cell lymphomas: From diagnosis to treatment. *An Bras Dermatol*. 2015;90(5):687-706. https://doi.org/10.1590/abd1806-4841.20153638
38. Guitart J, Deonizio J, Bloom T, et al. High incidence of gastrointestinal tract disorders and autoimmunity in primary cutaneous marginal zone B-cell lymphomas. *JAMA Dermatol*. 2014;150(4):412-418. https://doi.org/10.1001/jamadermatol.2013.9223
39. Lee SY, Kim WH, Choi JH, et al. Early diagnosis and surgical treatment of primary cutaneous marginal zone B-cell lymphomas of the face in an Asian patient. *Arch Craniofac Surg*. 2021;22(5):280-284. https://doi.org/10.7181/acfs.2021.00472
40. Varshney A, Goyal T, Zawar V, et al. Disseminated anetoderma in a patient with nodal Epstein-Barr virus-associated classical Hodgkin lymphoma: Anetodermic form of a concurrent discordant cutaneous marginal zone lymphoma. *Int J Dermatol*. 2016;55(7):739-744. https://doi.org/10.1111/ijd.13262
41. Zanelli M, Palicelli A, Sanguedolce F, et al. Cutaneous involvement in diseases with plasma cell differentiation: Diagnostic approach. *Curr Oncol*. 2022;29(5):3026-3043. https://doi.org/10.3390/curroncol29050246
42. Brenner I, Roth S, Puppe B, et al. Primary cutaneous marginal zone lymphomas with plasmacytic differentiation show frequent IgG4 expression. *Mod Pathol*. 2013;26(12):1568-1576. https://doi.org/10.1038/modpathol.2013.106
43. Swerdlow SH. Cutaneous marginal zone lymphomas. *Semin Diagn Pathol*. 2017;34(1):76–84. https://doi.org/10.1053/j.semdp.2016.11.007
44. Akhtari M, Reddy JP, Pinnix CC, et al. Primary cutaneous B-cell lymphoma (non-leg type) has excellent outcomes even after very low dose radiation as single-modality therapy. *Leuk Lymphoma*. 2016;57(1):34-38. https://doi.org/10.3109/10428194.2015.1040012
45. Vitiello P, Sica A, Ronchi A, et al. Primary cutaneous B-cell lymphomas: An update. *Front Oncol*. 2020;10(651):1-7. https://doi.org/10.3389/fonc.2020.00651
46. Di Napoli A, Rogges E, Noccioli N, et al. Deep sequencing of immunoglobulin genes identifies a very low percentage of monoclonal B cells in primary cutaneous marginal zone lymphomas with CD30-positive Hodgkin/Reed-Sternberg-like cells. *Diagnostics (Basel)*. 2022;12(2):1-12. https://doi.org/10.3390/diagnostics12020290
47. Goyal A, Carter JB, Pashtan I, et al. Very low-dose versus standard dose radiation therapy for indolent primary cutaneous B-cell lymphomas: A retrospective study. *J Am Acad Dermatol*. 2018;78(2):408-410. https://doi.org/10.1016/j.jaad.2017.07.053
48. Lang CCV, Ramelyte E, Dummer R. Innovative therapeutic approaches in primary cutaneous B-cell lymphoma. *Frontiers in Oncology*. 2020;10:1163-1169. https://doi.org/10.3389/fonc.2020.01163
49. Hwang S, Johnson A, Fabbro S, et al. Topical imiquimod monotherapy for indolent primary cutaneous B-cell lymphomas: A single-institution experience. *The British Journal of Dermatology*. 2020;183(2):386-387. https://doi.org/10.1111/bjd.18961
50. Coors EA, Schuler G, Von Den Driesch P. Topical imiquimod as treatment for different kinds of cutaneous lymphoma. *European Journal of Dermatology*. 2006;16(4): 391-393. https://doi.org/10.5070/D3218028432
51. Kollipara R, Hans A, Hall J, et al. A case report of primary cutaneous marginal zone lymphoma treated with intralesional steroids. *Dermatology Online Journal*. 2015;21(8);13030/qt9s15929m.
52. Boudreaux BW, Patel MH, Brumfiel CM, et al. Primary cutaneous epidermotropic marginal zone B-cell lymphoma treated with total skin electron beam therapy. *JAAD Case Rep*. 2021;15:15-18. https://doi.org/10.1016/j.jdcr.2021.06.027
53. Servitje O, Muniesa C, Benavente Y, et al. Primary cutaneous marginal zone B-cell lymphoma: Response to treatment and disease-free survival in a series of 137 patients. *J Am Acad Dermatol*. 2013;69(3): 357-365. https://doi.org/10.1016/j.jaad.2013.04.047

54. Liu H, Shi X, Cao L, et al. Effects of conventional interventions on early-stage primary cutaneous marginal zone lymphoma: A population-based study. *Leuk Res*. 2022;114:106795. https://doi.org/10.1016/j.leukres.2022.106795
55. Oertel M, Elsayad K, Weishaupt C, et al. De-escalated radiotherapy for indolent primary cutaneous B-cell lymphoma. *Strahlenther Onkol*. 2020;196(2):126-131. https://doi.org/10.1007/s00066-019-01541-7
56. Tang J, Chen J, Liu H, et al. Primary cutaneous marginal zone B-cell lymphoma of vulva in a pregnant woman. *Indian J Dermatol Venereol Leprol*. 2019;85(2):211-214. https://doi.org/10.4103/ijdvl.IJDVL_295_18
57. Qin Y, Wang Y. Penicillin in *Borrelia burgdorferi*-negative primary cutaneous marginal zone lymphoma: A case series and literature review. *Acta Derm Venereol*. 2022;102:adv00668. https://doi.org/10.2340/actadv.v102.198
58. Ghatalia P, Porter J, Wroblewski D, et al. Primary cutaneous marginal zone lymphoma associated with juxta-articular fibrotic nodules in a teenager. *J Cutan Pathol*. 2013;40(5):477-484. https://doi.org/10.1111/cup.12102
59. Travaglino A, Varricchio S, Pace M, et al. *Borrelia burgdorferi* in primary cutaneous lymphomas: A systematic review and meta-analysis. *J Dtsch Dermatol Ges*. 2020;18(12):1379-1384. https://doi.org/10.1111/ddg.14289
60. Eberle FC, Holstein J, Scheu A, et al. Intralesional anti-CD20 antibody for low-grade primary cutaneous B-cell lymphoma: Adverse reactions correlate with favorable clinical outcome. *J Dtsch Dermatol Ges*. 2017;15(3):319-323. https://doi.org/10.1111/ddg.13188
61. Choi H, Lee J. Primary cutaneous marginal zone B-cell lymphoma presenting as a small mass on temple area. *J Craniofac Surg*. 2016;27(4):e335-336. https://doi.org/10.1097/SCS.0000000000002481
62. Goto H, Sugita K, Yamamoto O. Nodules on the knee in a child: A quiz. *Acta Derm Venereol*. 2020;100(15):adv00231. https://doi.org/10.2340/00015555-3580
63. Torre-Castro J, Estrach T, Peñate Y, et al. Primary cutaneous lymphomas in children: A prospective study from the Spanish Academy of Dermatology and Venereology (AEDV) Primary Cutaneous Lymphoma Registry. *Pediatr Dermatol*. 2021;38(6): 1506-1509. https://doi.org/10.1111/pde.14811
64. Amitay-Laish I, Tavallaee M, Kim J, et al. Paediatric primary cutaneous marginal zone B-cell lymphoma: Does it differ from its adult counterpart?. *Br J Dermatol*. 2017;176(4):1010-1020. https://doi.org/10.1111/bjd.14932
65. Senff NJ, Noordijk E M, Kim YH, et al. European Organization for Research and Treatment of Cancer and International Society for Cutaneous Lymphoma consensus recommendations for the management of cutaneous B-cell lymphomas. *Blood*. 2008;112(5):1600-1609. https://doi.org/10.1182/blood-2008-04-152850
66. Vermeer MH, Willemze R. Recent advances in primary cutaneous B-cell lymphomas. *Curr Opin Oncol*. 2014;26(2):230-236. https://doi.org/10.1097/CCO.0000000000000060
67. Wobser M, Maurus K, Roth S, et al. Myeloid differentiation primary response 88 mutations in a distinct type of cutaneous marginal-zone lymphoma with a nonclass-switched immunoglobulin M immunophenotype. *Br J Dermatol*. 2017;177(2):564-566. https://doi.org/10.1111/bjd.15183
68. Dangien A, Beylot-Barry M, Battistella M, et al. Clinical presentation, therapeutic approach and outcome of primary cutaneous marginal zone B-cell lymphoma presenting as AL amyloidoma of the skin. *Br J Dermatol*. 2019;181(3):607-609. https://doi.org/10.1111/bjd.17821
69. Trager MH, Ram-Wolff C, Bouaziz JD, et al. Lupus erythematosus tumidus mimicking primary cutaneous marginal zone B-cell lymphoma. *Acta Derm Venereol*. 2020;100(15):adv00229. https://doi.org/10.2340/00015555-3575
70. Forsyth CJ, Gomez-Almaguer D, Camargo JF, et al. A multicenter, open-label, noncomparative screening study of enzastaurin in adult patients with non-Hodgkin lymphomas. *Clin Lymphoma Myeloma Leuk*. 2013;13(4):398-403. https://doi.org/10.1016/j.clml.2013.03.005
71. Fabbri A, Cencini E, Alterini R, et al. Rituximab plus liposomal pegylated doxorubicin in the treatment of primary cutaneous B-cell lymphomas. *Eur J Haematol*. 2014;93(2):129-136. https://doi.org/10.1111/ejh.12315
72. Kim MJ, Hong ME, Maeng CH, et al. Clinical features and treatment outcomes of primary cutaneous B-cell lymphoma: A single-center analysis in South Korea. *Int J Hematol*. 2015;101(3);273-278. https://doi.org/10.1007/s12185-014-1728-2
73. Gatti A, Stinco G, Trevisini S, et al. Electrochemotherapy as a novel treatment for primary cutaneous marginal zone B-cell lymphomas. *Dermatol Ther*. 2014;27(4):244-247. https://doi.org/10.1111/dth.12128

74. Campo E, Jaffe ES, Cook JR, et al. The International Consensus Classification of Mature Lymphoid Neoplasms: A report from the Clinical Advisory Committee. *Blood*. 2022;140(11):1229-1253. https://doi.org/10.1182/blood.2022015851
75. Obiorah IE, Karrs J, Brown L, et al. Overlapping features of primary cutaneous marginal zone lymphoproliferative disorder and primary cutaneous CD4+ small/medium T-cell lymphoproliferative disorder: A diagnostic challenge examined by genomic analysis. *American Journal of Surgical Pathology*. 2023;47(3):344-353. https://doi.org/10.1097/PAS.0000000000001984