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Breast

Management of Contralateral Breast and Axillary Nodes Silicone Migration after Implant Rupture

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Background: Silicone implants were developed in 1962 for breast augmentation and became essential in reconstruction after mastectomy. Silicone "bleeding" has been described from both ruptured and intact implants and can induce disseminated granulomatosis due to the component's high fat solubility. If not adequately treated, they can lead to disastrous cosmetic and functional consequences. Because they may mimic malignancy, prompt and reliable diagnosis should be made as early as possible.

Methods: We present a clinical case description of multiple intraparenchymal and ipsi/contralateral intraganglionic siliconomas in a woman who had undergone breast reconstruction, and a literature review of the pathophysiology of siliconomas and their diagnosis and management.

Results: Silicone migration to the contralateral breast and lymph node is rare and has seldom been described. The mechanism is still debated. Excluding malignancy is a priority, and systematic management must be respected to avoid misdiagnosis or unnecessary investigations.

Conclusions: A multidisciplinary approach is essential for siliconoma management. Silicone-related lymphadenopathies do not require follow-up or special treatment unless they interfere with the diagnosis of tumor recurrence. Careful observation is sufficient for asymptomatic siliconomas; however, symptomatic ones should be treated depending on skin involvement and the patient's eligibility for intervention. *(Plast Reconstr Surg Glob Open 2022;10:e4290; doi: 10.1097/GOX.0000000000004290; Published online 25 May 2022.)*

INTRODUCTION

Silicone implants were developed in 1962 for breast augmentation and became essential in breast reconstruction after mastectomy.[1,2] Silicone granuloma or siliconoma was first described as a direct result of liquid silicone injections, but these were banned by the Food and Drug Administration (FDA) in 1991 due to numerous complications as well as the aesthetic and functional repercussions, often disastrous.[3–6] For this reason, silicone breast implants have since been preferred for breast reconstruction and augmentation.

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However, localized and systemic side-effects following silicone implants have also been reported. Silicone "bleeding" has been described from both ruptured and intact implants[7] and can induce local granulomas, resulting in typical macrophage invasion, giant cell formation, and eventual scarring or disseminated granulomatosis due to the component's high fat solubility.[2] They present as indurated, palpable granulomas found in cutaneous tissues, lymph nodes, and the breast. In rare cases, they may extend to the lungs,[8,9] lower limbs,[10] liver, and spleen.[11] Systemic complications related to silicone from ruptured prostheses are even rarer and are usually described following free silicone injections. Associated symptoms such as edema, erythema, fatigue, or pain seldom persist after implant removal.[12,13] If not adequately treated, they can lead to disastrous cosmetic and functional consequences. Moreover, they can easily mimic and be confused with cancer. For this reason, a rapid and reliable diagnostic has to be reached promptly after the discovery of these masses. Through this case presentation and the analysis of the literature, the authors want to propose an adequate and effective attitude toward these problematics.

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CASE PRESENTATION

A 45-year-old woman, diagnosed in 2003 with ductal carcinoma in situ of the right breast, underwent a right mastectomy and axillary lymph node dissection. The resection was complete, and the patient subsequently underwent chemotherapy. Two years later, in October 2005, the patient received a tissue expander before the definitive reconstruction with a prosthesis (Mentor Siltex Round High Profile, new generation prothesis) and symmetrization of the left breast in April 2006. The patient has never had free silicone injections or other cosmetic implants in the past.

She was referred to our center in early 2020 due to painful capsulitis. She described only breast pain without breast deformity or other systemic symptoms such as asthenia, headaches, or others. A magnetic resonance imaging scan performed a few months earlier by her attending physician showed a rupture of the prosthesis and siliconoma nodules. No further investigation was carried out. It should be noted that the radiological assessment of the last few years had not revealed any siliconoma or signs of rupture. In May 2020, we performed a capsulectomy and replaced the breast prosthesis. Subsequently, we became aware of the presence of these nodules at the MRI and asked for a second radiologist analysis. They reported four nodules (5, 6, 9, and 16 mm) in the left axillary fold at different depths. There was also a 13-mm nodule on the right breast above the prosthesis (Fig. 1). Following a multidisciplinary discussion, a positron emission tomography-computed tomography scan (PET-CT) using radiolabeled tracer 2-deoxy-2-fluoro-D-glucose was requested and showed hypermetabolic nodules at the right pectoral internal level (Standardized Uptake Value: SUVmax 6.8) associated with right internal mammary chain adenopathies (SUVmax 4.8), and two left superolateral breast quadrant nodules (SUVmax 6.1) (Figs. 2, 3). The nodules were described as well-delineated echogenic lesions with a "snowstorm" aspect on ultrasound (Fig. 4). Biopsies of three nodules on both sides showed lymphoid tissue with an exogenous foreign body granulomatous reaction (ie, siliconomas and excluded malignant recurrency).

As the patient was asymptomatic, follow-up MRI imaging was agreed upon. At the control imaging at 6 months, the nodules were stable and showed no change in size.

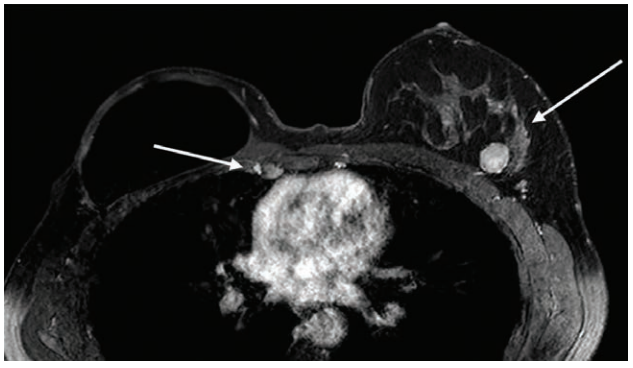

Fig. 1. Contrast enhanced breast MRI: contralateral nodule to the prosthesis in depth of parenchyma and adenopathy of the right internal mammary chain (white arrows).

Takeaways

Question: How to differentiate a siliconoma from a tumor recurrence in a patient with breast prosthesis reconstruction?

Findings: Analysis of the pathogenesis of the siliconoma and current tools for its identification.

Meaning: Radiological diagnostic tools can differentiate siliconomas from tumor recurrences. They do not require any follow-up or treatment unless they are symptomatic.

DISCUSSION

Siliconomas are generally found within the mammary parenchyma, but silicone can also migrate into regional lymph nodes and into more distant sites such as the pleura, ribs, proximal upper extremity muscles, and even within the abdomen.[10,14,15] Silicone-related lymphadenopathies are rare occurrences and consist of a deposition of silicone in one or more lymph nodes on the drainage path of the breast.[16] An inflammatory reaction ensues, which may or may not be symptomatic over time. It may simply present as a palpable lump, which goes unnoticed until later detected as incidentalomas. They are most commonly found in the axillary regions but can also be found in the mediastinal, cervical, and internal mammary regions.[14] Contralateral silicone-related adenopathies are even rarer, and only a few cases have been documented in the literature.[12] The primary difficulty is to differentiate them from infectious or neoplastic adenopathies.

Pathology and Dissemination Route

Silicone is known to be an inert synthetic polymer. Its inertia is limited when contained within its prosthetic shell.[17] However, as described by Hausner et al,[18] once the silicone passes through the shell of the prosthesis either when ruptured or by continuous perspiration, the silicone

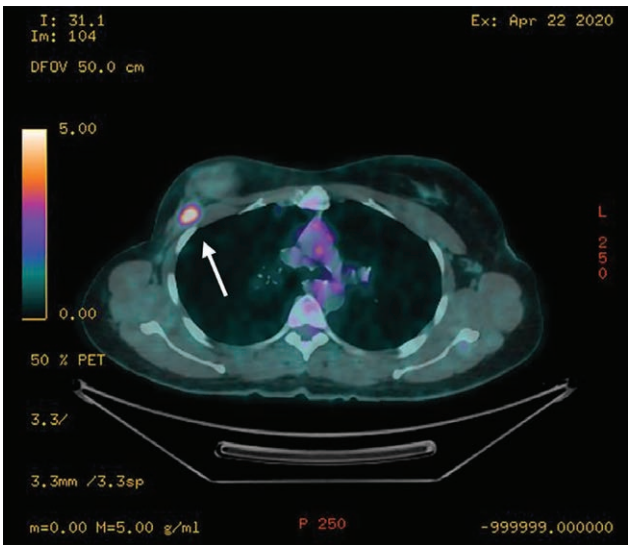

Fig. 2. PET-CT: hypermetabolic tissue nodule at the right pectoral muscle level (white arrow).

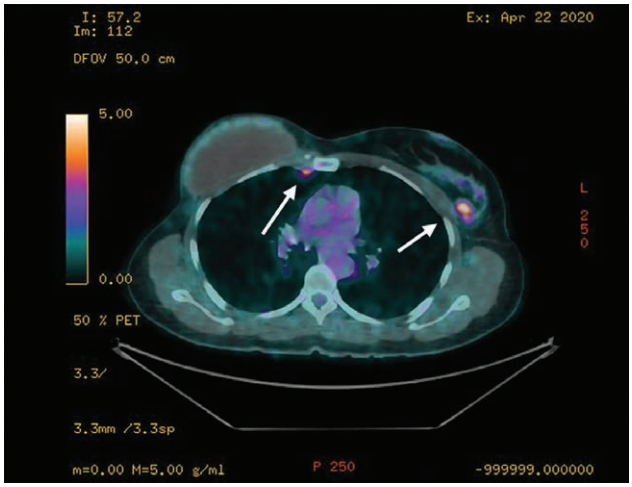

Fig. 3. PET-CT: hypermetabolic tissue nodules (white arrows) in the right internal mammary chain and in the left breast.

loses its inertia. Therefore, it enters the reticuloendothelial system and migrates to different sites, where it causes inflammatory reactions in the form of granulomas or, as more recently reported, generalized, and poorly differentiated autoimmune inflammatory reactions, called ASIA (autoimmune/inflammatory syndrome induced by adjuvants).[19] For older implants like second generation, the leakage rate has been estimated to be approximately 100 mg per year.[20] It is well known that silicone can disseminate either through the lymphatic or hematogenous routes. The migration of silicone through the lymphatic vessels is slow and can take up to 6–10 years to reach the lymph nodes.[21] It explains the latency period between the implantation of prostheses and the onset of symptoms or incidental image findings. Remote localizations can be explained by the nonadherent characteristic of silicone, which facilitates its migration from one site to another. The migration to the axillary and the internal mammary chains is explained by the drainage of the breast. There are three drainage routes of the mammary gland: the axillary ganglia, which represents the main drainage route

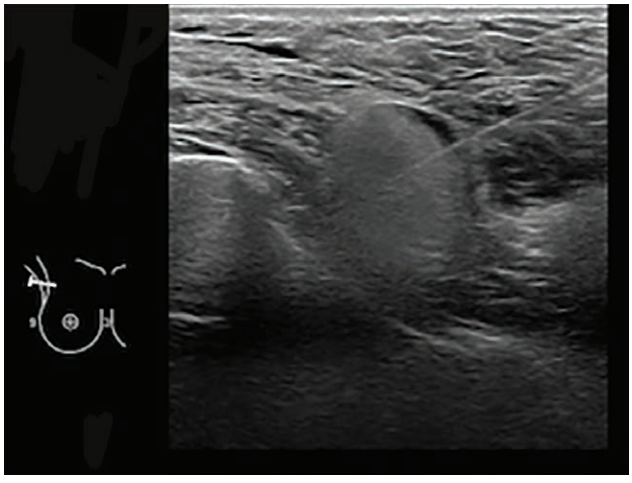

Fig. 4. Ultrasound and needle-biopsy of an axilary siliconoma.

according to Poirier,[22] the internal mammary chain, and the supraclavicular region. Drainage blockage may result in retrograde flow to the liver. The main factor influencing the epidemiology of siliconoma and silicone-related adenopathy is the characteristics of the prostheses over the years. The second-generation prostheses, designed with very fine capsules and a more liquid gel, had a rupture rate of around 60% and were responsible for a large number of siliconomas. The third-generation implants, the highly cohesive silicone gel implants available 20 years ago on the market, were designed with higher viscosity gels with larger silicone particles and a multilayered capsule to prevent the "bleeding."[12,16,23,24] The last two generations of prostheses have been subjected to stricter regulations under the supervision of the FDA and American Society for Testing Methodology regarding silicone cohesiveness and shell thickness.[25] Even with recent improvements, rupture rates remain significant, with an estimated rupture rate of 3.8% at 6 years[23] and 23.7% at 10 years[26] for Mentor implants. Our case is one of the rare cases of contralateral siliconoma formation in a patient with a new generation prostheses. In our department, probably because of the regular follow-up introduced for cancer patients, MRI for suspected cases of capsulitis and the resources available, an average of one case of silicone-related lymphadenopathy per month is observed. Therefore, the rate of siliconoma is supposedly underestimated due to limited access to care. No study has been done yet to evaluate their incidence, relation to rupture of healthy implants, or to the type or generation of implants used.

Diagnostic and Imaging Modalities

Despite increasingly efficient diagnostic tools, siliconoma diagnosis remains a challenge.

A precise diagnosis is essential because the results are crucial for the next steps of the treatment. Imaging plays a key role in the identification, tracking, and monitoring of this disease. Acute and chronic inflammation, benign focal masses of the breast, liponecrosis, and postoperative changes can cause increased uptake of markers on a PET-CT and can easily lead to misinterpretation.[27,28] In many cases, these false-positive lesions can be differentiated from cancer recurrence by comparison with typical appearances on other imaging modalities. In the early 1990s, Harris et al[14] first described the increased echogenicity of free silicone within the parenchyma as a "snowstorm" (Fig. 5). The extracapsular silicone image varies on ultrasound,[28] but the "snowstorm" is considered the most sensitive and specific sign.[29] To highlight a silicone lymphadenopathy, ultrasound is more sensitive than MRI signal in a silicone-specific sequence.[15,29] On the mammography, silicone granulomas may have different aspects, such as dense calcified nodules around the implant[28] (Fig. 6). Axillary silicone-related lymphadenopathies can be seen in this modality. MRI is ideally performed in a silicone-sensitive sequence, which allows the highly sensitive identification of silicone within the implant but also, in the context of a rupture, extracapsular silicone.[14,30] In the FDA recommendations for saline,

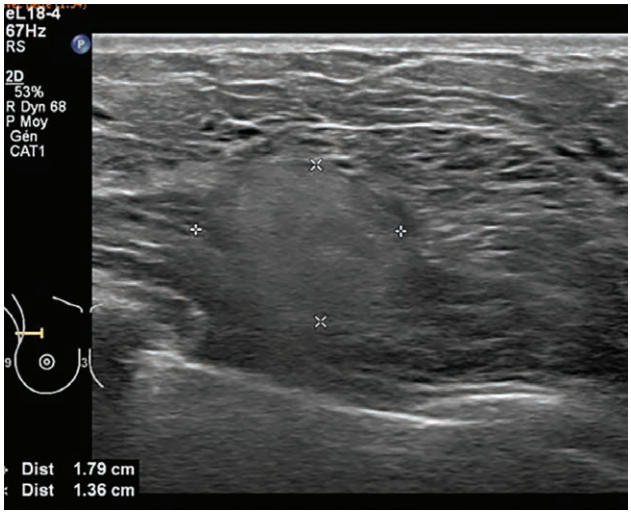

Fig. 5. Typical "snowstorm" pattern in a right axillary silicone-related adenopathy.

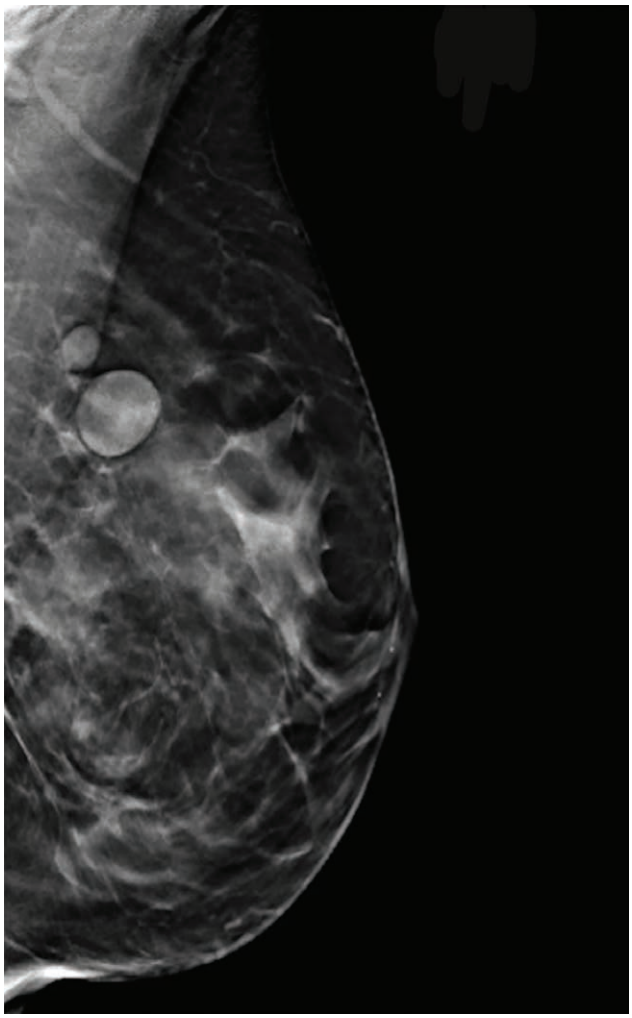

Fig. 6. Left mammogram (left mediolateral oblique view): round well-defined opacities evoking adenopathies.

silicone gel, and alternative breast implants issued in 2006 and revised in 2019,[31] a first ultrasound or MRI is indicated at 5–6 years after the initial implant surgery, and then every 2–3 years thereafter. The American College of Radiology recommends ultrasound first for evaluation of implant integrity, followed by MRI only if the ultrasound is equivocal,[32] limiting further important costs often not covered by insurance.

An excisional biopsy is often necessary in combination with other modalities for definitive diagnosis. For palpable or subcutaneous siliconomas or silicone axillary lymphadenopathies, a fine needle aspiration under ultrasound control is sufficient. In case of migration of silicone into the mediastinal lymph nodes, the endobronchial ultrasound-transbronchial needle aspiration and/or mediastinoscopy are well-established techniques to evaluate them and acquire many samples. For internal mammary nodes, computed tomography-guided biopsy is recommended.[33]

Management and Treatment

The management of siliconomas and silicone-related lymphadenopathy and their treatment have been the subject of much debate. Often, unless a surgical indication is clear, suppressive therapy is tried either with long-term antibiotics or with corticosteroids.[8,34]

If they are not symptomatic or do not interfere with the diagnosis of tumor recurrence, they do not require resection and may be only observed. Although the optimal treatment for the management of these granulomatous lesions is surgical excision, this can lead to debilitating surgeries due to multistage silicone infiltration, often requiring reconstruction with autologous flaps. Management must be done on a case-by-case basis and depends on the oncological status of the patient. As a general rule, authors agree that the management depends on the symptoms and especially on whether or not the skin is affected by this inflammatory reaction. At the University Hospital in Lausanne (CHUV), there is no specific follow-up for silicone-related adenopathies. Even in the oncological setting, current radiological tools are specific enough to distinguish between tumor involvement and silicone accumulation. In general, biopsies are performed on a case-by-case basis. If they reveal silicone, no further follow-up is done. The same is true for siliconomas found in the mammary gland, where, unless there is enlargement or complications, no follow-up or biopsy is performed. If they are asymptomatic, monitoring alone is recommended. In case of enlargement or significant inflammatory reaction, surgery is indicated if siliconomas are well delimited or in an easily accessible area. If it is difficult to access or if the patient is not eligible for surgery, corticosteroid treatment 0.5–1 mg per kg for 3 months may be considered as a first-line treatment to decrease the inflammatory flare-up and to alleviate associated pain. We prefer not to use long-term antibiotic treatments to avoid inducing resistance. Algorithms for siliconoma management are summarized in Figures 7 and 8.

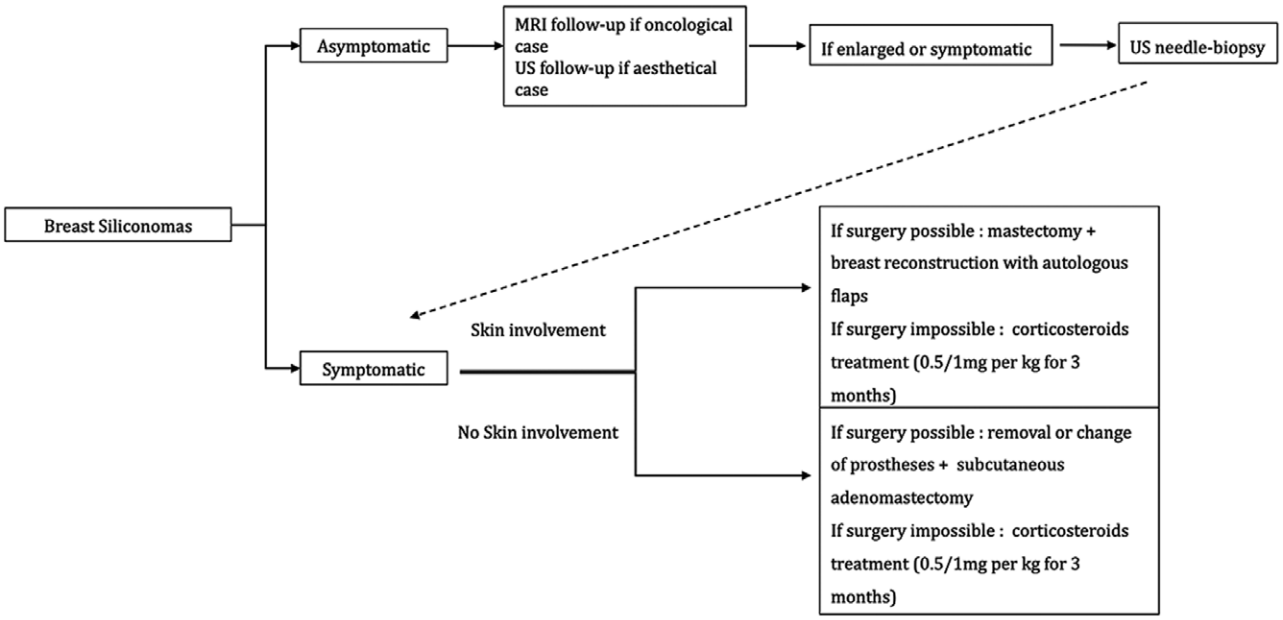

Fig. 7. Algorithm for management of breast siliconomas.

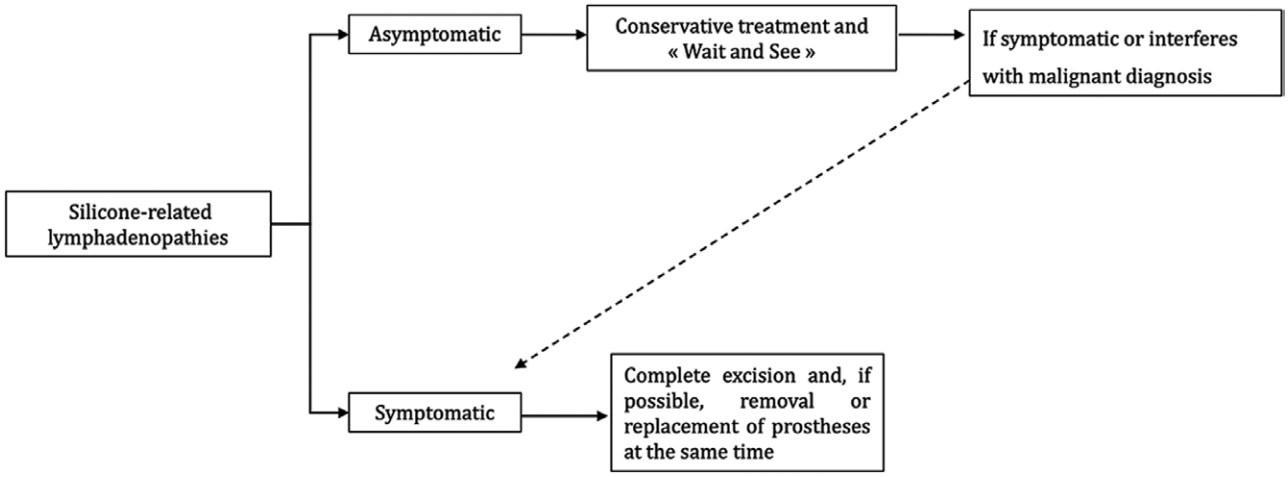

Fig. 8. Algorithm for management of silicone-related lymphadenopathies.

CONCLUSIONS

A multidisciplinary approach is essential for siliconoma management. Silicone dissemination from protheses is rarely responsible for systematic reactions but can be the cause of devastating surgeries. Currently, there is no explanation as to why some women develop them and others do not and why in some cases, they go unnoticed and in others they cause such severe skin damage. Silicone-related lymphadenopathies do not require follow-up or special treatment unless it interferes with the diagnosis of tumor recurrence. Asymptomatic breast siliconoma can be monitored; however, symptomatic siliconomas should be treated according to skin involvement and the patient's eligibility for intervention.

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REFERENCES

1. Noone RB. A review of the possible health implications of silicone breast implants. *Cancer.* 1997;79:1747–1756.
2. Carson B, Cox S, Ismael H. Giant siliconoma mimicking locally advanced breast cancer: a case report and review of literature. *Int J Surg Case Rep* 2018;48:54–60.
3. Wosnitzer B, Mirtcheva R. Silicone granulomas following free silicone gluteal augmentation. *Radiol Case Rep.* 2011;6:491.

4. Bravo BS, de Balassiano LK, de Bastos JT, et al. Siliconoma: report of two cases. *Aesthetic Plast Surg* 2016;40:288–292.
5. Jeng CJ, Ko ML, Wang TH, et al. Vulvar siliconoma migrating from injected silicone breast augmentation. *BJOG*. 2005;112:1659–1660.
6. Chen TA, Mercado CL, Topping KL, et al. Disseminated silicone granulomatosis in the face and orbit. *Am J Ophthalmol Case Rep* 2018;10:32–34.
7. Lykissa ED, Kala SV, Hurley JB, et al. Release of low molecular weight silicones and platinum from silicone breast implants. *Anal Chem*. 1997;69:4912–4916.
8. Muñiz González F, Hermoso Alarza F, Cano Aguirre MDP. Lung siliconoma, a rare complication of breast prosthesis rupture. *Arch Bronconeumol (Engl Ed)* 2018;54:580–581.
9. Dragu A, Theegarten D, Bach AD, et al. Intrapulmonary and cutaneous siliconomas after silent silicone breast implant failure. *Breast J* 2009;15:496–599.
10. Oh JH, Song SY, Lew DH, et al. Distant migration of multiple siliconomas in lower extremities following breast implant rupture: case report. *Plast Reconstr Surg Glob Open* 2016;4:e1011.
11. Hudacko R, Anand K, Gordon R, et al. Hepatic silicone granulomas secondary to ruptured breast implants: a report of two cases. *Case Reports Hepatol* 2019;2019:7348168.
12. Kaufman GJ, Sakr RA, Inguenault C, et al. Silicone migration to the contralateral axillary lymph nodes and breast after highly cohesive silicone gel implant failure: a case report. *Cases J*. 2009;2:6420.
13. Samkari A, Farsi A, Abushal M. A rare case report of siliconoma in contralateral axillary lymph node after silicone implant rupture. *IJSR*. 2018;8.
14. Harris KM, Ganott MA, Shesta KC, et al. Silicone implant rupture: detection with US. *Radiology*. 1993;187:761–768.
15. Fleury EFC. Silicone induced granuloma of breast implant capsule (SIGBIC) diagnosis: breast magnetic resonance (BMR) sensitivity to detect silicone bleeding. *PLoS One*. 2020;15:e0235050.
16. Zambacos GJ, Molnar C, Mandrekas AD. Silicone lymphadenopathy after breast augmentation: case reports, review of the literature, and current thoughts. *Aesthetic Plastic Surgery* 2013;37:278–289.
17. Teuber SS, Reilly DA, Howell L, et al. Severe migratory granulomatous reactions to silicone gel in 3 patients. *J Rheumatol*. 1999;26:699–704.
18. Hausner RJ, Schoen FJ, Mendez-Fernandez MA, et al. Migration of silicone gel to axillary lymph nodes after prosthetic mammoplasty. *Arch Pathol Lab Med*. 1981;105:371–372.
19. Nesher G, Soriano A, Shlomai G, et al. Severe ASIA syndrome associated with lymph node, thoracic, and pulmonary silicone infiltration following breast implant rupture: experience with four cases. *Lupus*. 2015;24:463–468.
20. Schenone G, Bernardello E, Lema B. "Silicone in the axilla and axillary siliconomas assessment and treatment algorithm." In *Injection-Induced Breast Siliconomas*: 205-223.
21. Paplanus SH, Payne CM. Axillary lymphadenopathy 17 years after digital silicone implants: study with x-ray microanalysis. *J Hand Surg Am*. 1988;13:399–400.
22. Delamere G, Poirier P, Cuneo B. The lymphatics. In: Charpy PP eds. *A Treatise of Human Anatomy*. Archibald Constable; 1903.
23. Hillard C, Fowler JD, Barta R, et al. Silicone breast implant rupture: a review. *Gland Surg*. 2017;6:163–168.
24. El-Charnoubi WA, Foged Henriksen T, Joergen Elberg J. Cutaneous silicone granuloma mimicking breast cancer after ruptured breast implant. *Case Rep Dermatol Med*. 2011;2011:129138.
25. Maxwell GP, Gabriel A. Breast implant design. *Gland Surg*. 2017;6:148–153.
26. Caplin DA, Calobrace MB, Wixtrom RN, et al. MemoryGel breast implants: final safety and efficacy results after 10 years of follow-up. *Plast Reconstr Surg*. 2021;147:556–566.
27. Ho L, Wassef H, Seto J. FDG PET/CT imaging in granulomatous changes secondary to breast silicone injection. *Clin Radiol*. 2010;65:659–661.
28. Adejolu M, Huo L, Rohren E, et al. False-positive lesions mimicking breast cancer on FDG PET and PET/CT. *AJR Am J Roentgenol*. 2012;198:W304–14.
29. Klang E, Yosepovich A, Krosser A, et al. Detection of pathologically proven silicone lymphadenopathy: ultrasonography versus magnetic resonance imaging. *J Ultrasound Med*. 2018;37:969–975.
30. Ma J, Choi H, Stafford RJ, et al. Silicone-specific imaging using an inversion-recovery-prepared fast three-point Dixon technique. *J Magn Reson Imaging*. 2004;19:298–302.
31. U.S Food and Drug Adminstration. Saline, silicone gel, and alternative breast implants – guidance for industry and food and drug administration staff, 45. September 2020. Available at https://www.fda.gov/regulatory-information/search-fda-guidance-documents/saline-silicone-gel-and-alternative-breast-implants. Accessed May 2, 2022.
32. Lourenco AP, Moy L, Baron P, et al; Expert Panel on Breast Imaging. ACR Appropriateness criteria breast implant evaluation. *J Am Coll Radiol*. 2018;15:S13–25.
33. Bauer PR, Krajicek BJ, Daniels CE, et al. Silicone breast implant-induced lymphadenopathy: 18 cases. *Respiratory Medicine CME*. 2011;4:126–130.
34. Dornelas M, Correa M, Barra F, et al. Siliconomas. *Revista Brasileira de Cirurgia Plástica* . 2011; 26:16–21.