Liponecrosis after autologous lipofilling: Which is the best imaging modality for evaluating it?

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Learning objectives

• To evaluate the role of radiologists in the follow-up of patients after breast tumor resection and immediate reconstruction with autologous fat transfer.
• To determine the best imaging modality for evaluating postoperative changes after autologous lipograft.
**Background**

Autologous fat transfer is a century-old method for correcting contours or soft tissue defects. Its applications are numerous and its uses in many medical fields are wide.

Breast reconstruction by means of fat grafting was excluded for years, because of complications related with lipofilling technique and due to the hypothesis that grown factors contained in fat grafts could interact with remaining tumor cells on the resection borders and could suppose an oncologic risk, later studies have not been able to demonstrate this, however.

Despite recent advances, fat graft failure remains a concern because it lead frequently to clinical and/or radiological liponecrotic lesion.

A new immediate breast reconstruction technique with fat grafting was developed by surgeons of the Breast Pathology Functional Unit of our institution, Hospital Universitari I Politècnic La Fe, Valencia, and published recently by Moltó, G. R., González, A. V., & Villaverde, D. M. They concluded that the technique was useful, innovative, had good aesthetic results, with a decreased incidence of aesthetic sequelae, commonly seen in simple lumpectomies without reconstruction, and did not compromised oncological safety.

Otherwise, all the patients showed a variable spectrum of fat necrosis, on follow-up imaging tests.
Findings and procedure details

Description of the study

A prospective study was performed at our institution, Hospital Universitari I Politècnic La Fe, Valencia. Over a four year period, thirty seven patients that had undergone immediate breast lipofilling after breast-conserving surgery were subsequently evaluated with mammography, ultrasound and magnetic resonance imaging (MRI), and it took 12-18 months after the procedure to evaluate graft survival.

Surgical technique

Lumpectomy is performed depending on the oncological requirements, the cavity created inside the breast is meticulously and hermetically closed with absorbable stitches. This traction manoeuvre causes deformities and distortions on the surface of the breast, distant to the tumour bed. Simultaneously, another surgical team proceeds to harvest fat tissue through an atraumatic technique using a cannula similar to Coleman™. After carrying on this phase the following method is made: adipose tissue is removed with a 20 cm2 syringe and decanted for 10-15 min. Then, the liquid fraction is expelled and four serial washings with normal saline in the syringe are carried out. This is done to achieve a completely clean fat fraction only made up of its stromal and cellular fraction, avoiding the excess of growth factors contained in the fat graft. (Fig. 1)

Fat infiltration is performed in the deformed areas created when closing the lumpectomy area, but distanced from it. The incisions are sutured and finally, an elasticised bandage and Mepore® dressings are applied and replaced 3 days later by a high-compression sports bra to attain the highest immobilization of the graft, which is vital to ensure its subsistence.

IMAGING FINDINGS

Fat necrosis is a benign nonsuppurative inflammatory process of adipose tissue that may pose a challenge to clinicians and radiologists. Liponecrosis in the breast is a very common pathologic condition with a wide variety of presentations on mammography, ultrasound and MRI. Its incidence is estimated to be 0.6%, representing 2.75% of all breast lesions.

At our study, the follow-up of all patients showed a variable spectrum of fat necrosis and findings in mammography and ultrasound were conclusive. Only two patients undergone
core needle biopsy because of BI-RADS 4 ultrasound finding and the histological analysis revealed fat necrosis.

Breast-MRI was not superior in evaluating liponecrosis and did not contribute any additional information.

**Mammographics findings:**

Most common findings of fat necrosis in mammograms include oil cysts, coarse calcifications, focal asymmetries, microcalcifications, and spiculated masses. Mammographics features reflect the amount of fibrosis that is normally developed on later stages of Liponecrosis.

- **Oils cyst:** when fibrosis is minimal, an oil cyst or a radiolucent mass appears (Fig. 2). Oil cyst typically develops calcifications initially linear and curvilinear and later central calcifications are visualized.
- **Calcification:** usually smooth and round or curvilinear. However, fat necrosis calcifications may have a more worrisome appearance, including branching, rodlike or angular calcification (Fig. 3)
- **Focal asymmetries, focal dense mass, spiculated mass:** these occur when reparative fibrotic reaction replaces all of the radiolucent necrotic fat.

**Ultrasound findings:**

On sonography, same as on mammography, findings depict the histopathological evolution of fat necrosis and the degree of fibrosis with a wide distribution of sonographic presentation:

- Increased echogenicity of the subcutaneous tissues with or without small cyst (Fig. 4)
- **Masses:** may be anechoic/hypoechoic masses with posterior acoustic enhancement or with posterior acoustic shadowing (fig. 5), solid-appearing masses (figs. 6) and cystic masses with internal echoes (fig. 7) or mural nodules (fig 8).
- **Calcification:** gross or puntiform echogenic calcification with or without acoustic posterior shadowing may be seen (fig. 9)

A specific sonographic indicator of fat necrosis is a mass with echogenic internal bands that shift in orientation with changes in patient position. Hyperechoic masses very rarely represent malignancy; in fact, hyperechoic cancers are reported in less than 0.8% of tumours. The associated ultrasound characteristics (margin, shape and hypervascularity) are important to consider when determining follow-up or when determining whether core needle biopsy is needed.
Ultrasound of fat necrosis should always be interpreted in the context of mammographic findings.

**MRI findings:**

Fat necrosis produces a wide spectrum of findings on MRI and the appearance is the result of the amount of the inflammatory reaction, the amount of liquefied fat, and the degree of fibrosis.

Sometimes MRI findings in liponecrosis may be indistinguishable from those of malignancy and can mimic tumour recurrence after breast conservation therapy.

- **Oil cyst:** is the most common appearance of fat necrosis on MRI, a round or oval mass with fat signal intensity (figs. 10-11) with or without fat-liquid levels of fat-fat levels. (fig. 12). Fat-saturation sequences are useful detecting lipid contents a may help differentiating fat necrosis from post-surgical complications (fluid collection, haematomas, etc.) (fig. 13)
- **Calcifications:** are sometimes seen on MRI as areas of signal voids, when small, usually are not identified.
- **Architectural distortion or masses:** reflects fibrosis degree.
- **Enhancement:** Fat necrosis can enhance after injection of intravenous paramagnetic contrast material. The amount of enhancement correlates with the intensity of the inflammatory process and can be focal or diffuse and homogeneous or heterogeneous. The high signal of fat on MRI interferes with detection of enhancing lesions. Thus, fat suppression is important to identified enhancement. Kinetic analysis may be of little help because fat necrosis exhibits the full spectrum of benign and malignant enhancement patterns (Figs 14)
Fig. 1: Surgical Technique

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Fig. 2: Mammography: Oil cyst

30 years old woman MLO views mammograms (A) shows microcalcifications, stereotactic biopsy confirm malignancy. Mammograms obtained a year after lumpectomy and immediate liposuction (B) shows a radiolucent mass with no calcifications, compatible with oil cyst. Two years later (C) gross central calcifications are seen.

Oils cyst: when fibrosis is minimal, an oil cyst or a radiolucent mass appears (B) when fibrosis occur oil cysts typically develop calcifications (C).
**Fig. 3. Mammography: typical calcification evolution**

*Calcifications are usually smooth and round or curvilinear or may have a more worrisome appearance, including branching, rodlike or angular calcifications.*

32 years old woman annual MLO views mammograms after tumorectomy and lipograft show normal evolution of fat necrosis with oil cysts, architectural distortion and progressive calcifications.

**Fig. 4. Ultrasound: Typical oil cyst**

*The most common ultrasound finding is an increased echogenicity of the subcutaneous tissues with small cyst (oil cyst) which may show echogenic walls due to calcifications.*

47 years old woman MLO view mammogram and ultrasound obtained a year after tumorectomy and lipograft show typical appearance of oil cyst.

**Fig. 3:** Mammography: Typical calcification evolution

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**Fig. 4:** Ultrasound: typical oil cyst

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Fig. 5: Ultrasound: Mass appearance of fat necrosis

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Fig. 6: Ultrasound: Solid mass appearance

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**Fig. 7 Ultrasound: Cystic mass with internal echoes**

Examples of fat necrosis presentation as a cystic mass with echogenic contents

- 58 years old woman ultrasound 12 months after tumorectomy and lipograft shows a cystic mass with echogenic contents (a) representing the radiolucent mass at mammography (b) that shows progressive calcifications at 6 months later mammogram (c).

40 years old woman ultrasound (a) shows a well-circumscribed cystic mass with heterogeneous echogenicity. The first mammogram (b) shows no relevant findings. 8 months later mammogram (c) shows a well-defined nodule with calcifications and adjacent typical oil cysts.

**Fig. 7: Ultrasound: cystic mass appearance**

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**Fig. 8 Ultrasound: Cystic mass with mural nodules**

39 years woman ultrasound shows a cystic mass with mural echogenic nodules (red arrows) with an increased echogenicity of adjacent tissue, at mammography a well-defined containing fat nodule with partial calcified walls is seen (black arrows). MRI-breast show characteristic findings of fat necrosis (arrowheads).

**Fig. 8: Ultrasound: Cystic mass with mural nodules**

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**Fig. 9: Ultrasound: Calcification**

61 years old woman mammogram CC and MLO views 12 years after tumorectomy and immediate lipograft show typical oil cyst. At ultrasound an heterogeneous echogenicity of breast tissue with punctiform echoes without acoustic shadowing representing calcifications, were found.

**Calcification:** Gross or punctiform echogenic calcification with or without acoustic posterior shadowing may beseen.

**Fig. 10: MRI: Typical findings**

Oil cyst is the most common appearance of fat necrosis on MRI, a round or oval mass with fat signal intensity.

Oil cyst typical appearances at mammogram (a) and ultrasound (b), MRI T1-weighted (c) T2-weighted (d) and and fat-saturated contrast-enhanced T1-weighted (e) images shows a round mass with fat signal intensity.
Fig. 11: MRI: typical findings

Fig. 12: MRI: Fat necrosis with internal levels
**Fig. 13** MRI: Surgical complications

Fat-saturation sequences are useful detecting lipid contents a may help differentiating fat necrosis from post-surgical complications.

69 years old woman, a year after lumpectomy and immediate lipograft reconstruction, feels a nodule at surgical bed. Mammogram (a) shows subtle calcifications. At ultrasound an echogenic mass is observed (b). MRI T1-weighted (c) and T2-weighted images show a fluid collection. At fat-sat contrast-enhanced T1-weighted images the mass shows peripheric heterogeneous enhancement (c). Note at fat sat T2-weighted images fluid is not saturated (d). Fine needle aspiration confirm a proteinaceous fluid collection.

**Fig. 14** MRI: Kinetic enhancement curves

Magnetic resonance images T1-weighted (a) and T2-weighted (b) show no significant findings. At dynamic study (c) after gadolinium administration there is a focal progressive enhancement pattern, with a kinetic curve showing a continuous increase in signal intensity throughout time, usually considered benign (TYPE I).

**Fig. 14** MRI: Kinetic enhancement curves

Kinetic analysis may be of little help because fat necrosis exhibits the full spectrum of benign and malignant enhancement patterns.
Fig. 15: MRI: Kinetic enhancement curves

MRI typical findings of fat necrosis, with peripheral enhancement due to variable inflammation and fibrosis. Enhancement kinetic curve shows a plateau pattern with rapid uptake followed by the plateau phase, considered concerning for malignancy (TYPE II).
Conclusion

- Mammography and ultrasound are sufficient after autologous lipograft and MRI is only indicated when recurrence is suspected and needle-biopsy is to be avoided.
- Although esthetic results are excellent, radiological findings of liponecrosis may be confusing. Radiologist should be familiar with these findings, frequently BI-RADS 4 categorized, to avoid unnecessary biopsies.
References