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Multimodality Imaging of the Reconstructed Breast☆

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The purpose of this article is to illustrate the imaging characteristics and pathologic findings associated with various types of breast reconstruction in women who have undergone mastectomy to treat breast cancer. As the use of breast reconstruction becomes more prevalent, it is imperative that radiologists interpreting imaging studies identify normal and abnormal imaging findings associated with differing breast reconstruction techniques, recognize imaging manifestation of expected complications, and reliably distinguish these from malignancy.

Introduction

In the United States, 1 in 8 women will develop breast cancer. In 2015, an estimated 231,840 new cases of invasive breast carcinoma are expected along with 60,290 cases of ductal carcinoma in situ (DCIS).[1] Of the patients with breast cancer, 20%-40% will undergo breast reconstruction.[1] Currently, the most frequent reconstruction techniques include the use of autologous tissue or implants, or a combination of both. Several factors influence the type of reconstruction chosen, including the patient's desires, body habitus, medical condition, and the need for adjuvant therapy.

The radiologist should be knowledgeable about the anatomy of the reconstructed breast and about the common and uncommon imaging findings in breasts reconstructed with implants or with autologous flaps from the abdomen or latissimus dorsi (LD) myocutaneous flaps. Benign findings often seen in the reconstructed breast, including hematomas, infections, epidermal inclusion cysts, and fat necrosis, should be distinguished from malignant findings, such as recurrent primary tumors and sarcomas.

In this review, we illustrate the expected and unexpected imaging and pathologic findings associated with breast reconstruction with autologous tissue flaps and implants in women who have undergone mastectomy to treat breast cancer.

Reconstruction With Autologous Tissue Flaps

An autologous myocutaneous flap reconstruction rebuilds a breast mound using tissue from another part of the body, comprising skin, subcutaneous fat, and muscle. The advantages of this type of reconstruction include a better esthetic appearance with better suppleness and a more-natural-appearing disposition of the breast compared with an implant.[2]

The use of autologous tissue flaps has evolved since the LD flap was introduced in 1906 and the transverse rectus abdominis myocutaneous (TRAM) flap's introduction in 1982.[3,4] The abdominal wall has become a popular option as a donor site for autologous breast reconstruction. TRAM flap techniques have been modified over time to decrease the morbidity associated with breast reconstruction, and several TRAM variants are available,[5] including the pedicled TRAM flap (Fig 1A) and the free deep inferior epigastric perforator (DIEP) flap (Fig 1B). The vessels that nourish the abdominal wall can be ligated or kept intact in a TRAM flap reconstruction (Fig 2).

The pedicled TRAM flap technique transfers the rectus abdominis muscle through a tunnel under the skin to the mastectomy site with its proximal attachments (the superior epigastric vessels) intact, thereby preserving its superior blood supply. This is a shorter and easier procedure than a free TRAM flap reconstruction, without the need for microvascular techniques, but it has a limited blood supply, limiting the size of the flap to the hemiabdomen.[6]

In the free TRAM flap, the flap vessels are ligated and microsurgically reanastomosed commonly with the internal mammary and sometimes with the thoracodorsal vessels. With free flaps, the options range from complete TRAM flaps (skin, fatty tissue, and rectus abdominis muscle) and muscle-sparing TRAM flaps (skin, fatty tissue, and a small portion of the rectus abdominis muscle) to isolated perforator flaps such as DIEP flaps (skin, fatty tissue, and the deep inferior epigastric artery), and superficial inferior epigastric artery or SIEA flaps (skin, fatty tissue, and the superficial inferior epigastric vessels), which have become very popular.

The LD flap is a pedicled flap often used to reconstruct moderate-sized to small breasts in combination with silicone or saline implants. This flap contains skin, fat, the LD muscle, and the

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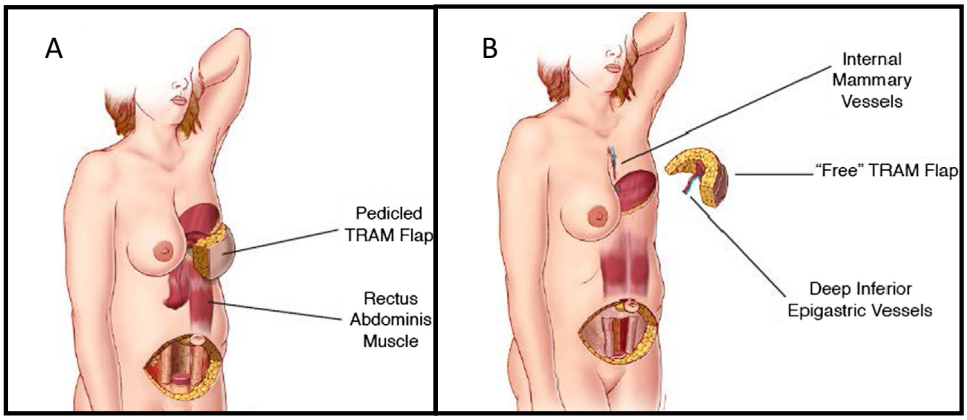

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Fig. 1. Pedicled and free TRAM flaps. (A) The pedicled flap rotates the abdominal tissue to the chest wall with its blood supply. The pedicled flap contains skin, fatty tissue, and muscle. (B) The free flap vessels are ligated and microsurgically anastomosed to the chest vessels. The free flap contains skin, fatty tissue, and vessels. (Adapted with permission from Reshaping You: Options for Breast Reconstruction ©2009. The University of Texas MD Anderson Cancer Center, Patient Education Office.) (Color version of figure is available online.)

thoracodorsal vessels,[6] with the arteries and veins still attached. Therefore, it is a pedicled flap rather than a free flap (Fig 3).

Normal and Benign Imaging Findings After Autologous Breast Reconstruction

As flaps are composed mainly of fatty tissue, reconstructed breasts demonstrate primarily fatty tissue on mammography, ultrasound imaging, computed tomography (CT), and magnetic resonance imaging (MRI) (Fig 4). The muscular component of the flap can be seen on mammography, CT, and MRI as a density with associated vessels in the posterior region of the reconstructed breast, anterior to the pectoral muscle.

Postsurgical Complications

Postsurgical complications following autologous reconstruction include seromas, hematomas, and infections. Seromas are fluid collections commonly seen in the early postoperative period. They are often seen on ultrasound imaging as anechoic (Fig 5) or complex fluid collections that tend to resolve over time.[7] Israeli et al[8] found that LD flaps are more prone to seromas than TRAM flaps, whereas TRAM flaps are associated with more perfusion-related complications, such as skin necrosis and fat necrosis.

Hematomas are also seen in the early postoperative period. The sonographic appearance of hematomas depends on the state of degradation of the blood products. The sonographic appearance of hematomas is varied, including hyperechoic, cystic, and complex cystic masses with internal debris and echogenic walls.[9]

The incidence of infection following reconstruction ranges between 2% and 4%.[10] Ultrasound imaging is usually required to differentiate between mastitis and an abscess. Abscesses on ultrasound imaging are shown as irregular, oval cystic masses with internal debris and surrounding subcutaneous edema (Fig 5). Doppler ultrasound imaging shows the cyst wall to be thick with increased vascularity.[9] Hence, sonography remains an important diagnostic tool in the immediate to subacute postoperative period following myocutaneous flap reconstruction.

Other benign findings, including epidermal inclusion cysts and fat necrosis, may appear after reconstructive surgery. Although there are certain features detailed and illustrated later that may strongly suggest these lesions, needle biopsy may be needed to establish the correct diagnosis.

Epidermal Inclusion Cysts

Epidermal inclusion cysts are formed by a proliferation of squamous cells implanted in the dermis. As epidermal inclusion cysts have been reported to be secondary to trauma such as

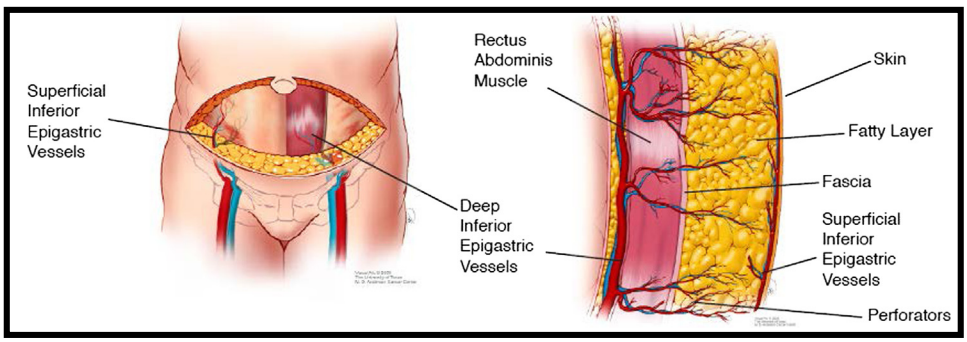

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Fig. 2. Abdominal vascular anatomy. The deep vessels are the superior epigastric vessels and the deep inferior epigastric vessels. These vessels have perforators that supply the overlying fat and the skin. The superficial network is supplied by the superficial superior epigastric vessels and the superficial inferior epigastric vessels. (Adapted with permission from Reshaping You: Options for Breast Reconstruction ©2009. The University of Texas MD Anderson Cancer Center, Patient Education Office.) (Color version of figure is available online.)