CDR Contemporary Diagnostic Radiology
Volume 42 • Number 25
December 15, 2019
A BIWEEKLY REVIEW OF CLINICAL RADIOLOGIC PRACTICE

What the Radiologist Needs to Know About Breast Trauma

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After participating in this educational activity, the radiologist should be better able to describe the usual presentation and imaging features of traumatic breast injuries and to explain follow-up management protocols.

Category: Breast Imaging
Modality: Multiple

Key Words: Breast Trauma, Imaging of Breast Trauma, Treatment of Breast Trauma

The breast is injured in a variety of circumstances, including direct trauma, such as from a motor vehicle accident, or iatrogenic, secondary to biopsy or intervention. The severity of reported breast injuries ranges from small hematomas to breast avulsion; the latter injury requires emergent mastectomy to stop active hemorrhage.[1] *The correlation of multimodality breast imaging with clinical presentation is important for differentiating benign posttraumatic abnormalities from malignant processes, thereby preventing unnecessary workup and intervention.*

The objective of this article is to review the various mechanisms of breast injury and associated complications by a multimodality review of breast imaging findings, including mammography, ultrasonography, and MRI. We also discuss the appropriate workup for traumatic injury to the breast.

Thermal Injuries

Deep thermal burns to the anterior chest of prepubertal girls are rare but can result in unsightly scarring, breast asymmetry, breast hypo- or hyperplasia, nipple displacement, and nipple distortion.[1,2] At the time of thermal injury, conservative treatment often is advised. However, if surgery is required, care should be taken to avoid the breast bud, which is located in the subcutaneous tissue in the areolar region.[1,2] If the breast bud is injured during puberty, associated scar tissue may result in significant breast constriction.[1,2] Patients often suffer from breast disfiguration and an apparent lack of breast development due to firm postburn scar tissue restricting the anterior chest wall.[1,2] On mammography, one may see an asymmetrically smaller breast, skin thickening, and/or scarring[1] (Figure 1).

If the breast bud is injured by a thermal burn during puberty, an asymmetric, smaller breast may develop.

Blunt Injuries

Most blunt injuries to the breast are secondary to motor vehicle trauma, leading to a characteristic pattern of findings termed "seat belt syndrome."[1,3] Seat-felt syndrome includes soft tissue injuries to the anterior chest wall, including the breasts; clavicle, sternum, rib, and spine fractures; mesenteric tears; and hollow organ perforation.[1,3] Blunt injury to the breast is most often secondary to crush or compression. Severity and type of breast injury depends on the presence of air bags in the vehicle; impact velocity; age and body habitus of the injured person; and the relationship of the passenger position and seat belt.[3] In a motor vehicle accident involving a left-hand drive vehicle, a front seat passenger usually sustains injuries in the upper inner and lower inner quadrants of the right breast, and a driver usually sustains injures in the upper inner quadrant or central portion of the left breast

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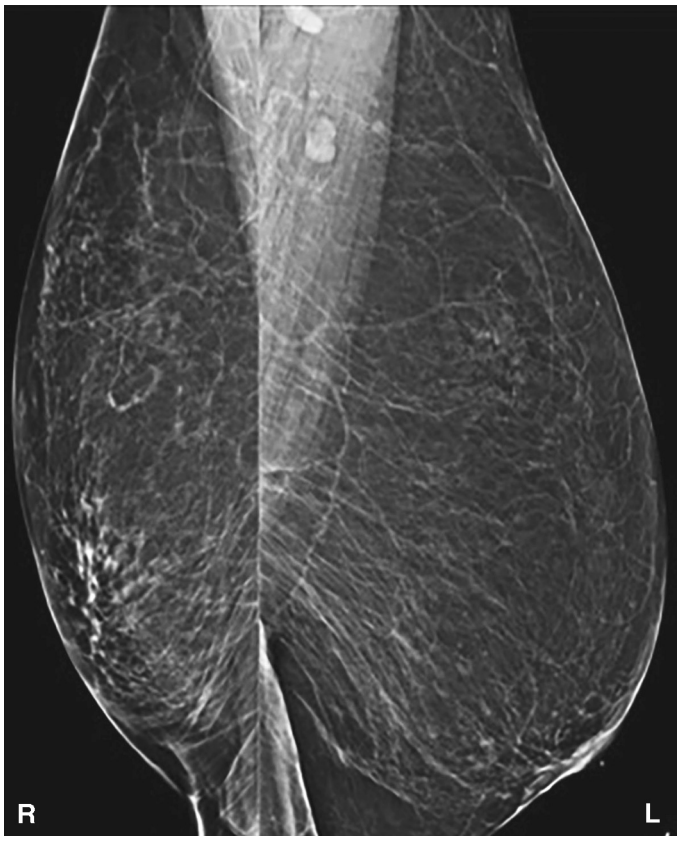

Figure 1. Mediolateral oblique (MLO) views show noticeable asymmetry between the left and right breasts consistent with right breast hypoplasia secondary to reported history of thermal injury to the right breast during puberty. MLO, mediolateral oblique.

and/or the lower inner quadrant of the right breast corresponding to the respective seat belt position[3,4] (Figure 2).

Patients may present with a palpable breast lump due to hematoma, a skin indentation along the seat belt line, bruising, and pain.[3-5] Symptoms may persist for many months after injury and a prominent scar of the overlying skin and fat necrosis in the breast parenchyma may develop in the chronic stages.[3] Blistering and ulceration of the skin as a result of friction of the seat belt against the breast skin also have been reported.[3]

Additional causes of blunt injury to the breast may result from a fall or sports injuries. In the setting of anticoagulation, these injuries may result in significant hematoma formation (Figure 3). The mammographic and sonographic findings

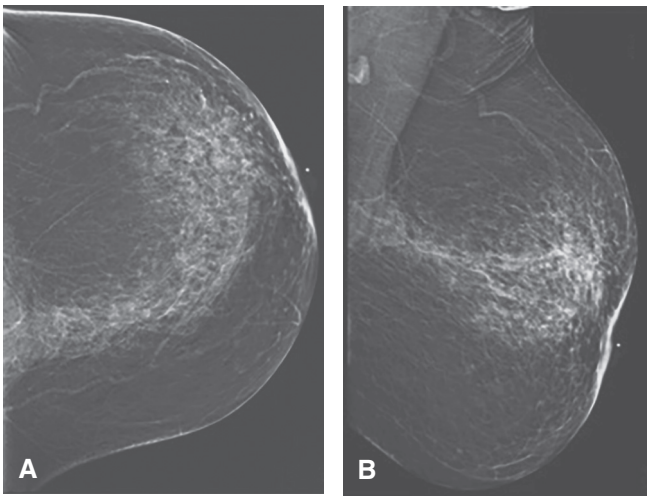

Figure 2. Craniocaudal (CC) (*A*) and MLO (*B*) views of the left breast show a broad area of increased density, with trabecular thickening in the left upper inner quadrant and interspersed fat density consistent with seat belt injury in this restrained driver after a motor vehicle accident.

will appear similar to that of other blunt breast injuries such as seat belt trauma.

Mammographically, blunt breast injuries will present as a linear or band-like parenchymal density, hematoma, skin thickening, and eventually progression to fat necrosis.[3] Sonographic findings are less specific than mammography and can include hypoechoic or anechoic fluid collections containing low-level debris, which are common sonographic features related to hematoma formation.[1,3] The MR findings parallel those of mammography and include hyperintensity on fluid-sensitive sequences and band-like enhancement, corresponding to the position of the seat belt.[3] In the later stages of healing, rim-enhancing nodules with central fat signal intensity consistent with oil cysts and fat necrosis may be observed.[3]

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Additional imaging may be performed to evaluate for intrathoracic injury. CT findings in the breast can include

The continuing education activity in *Contemporary Diagnostic Radiology* is intended for radiologists.

Contemporary Diagnostic Radiology (ISSN 0149-9009) is published bi-weekly by Wolters Kluwer Health, Inc. at 14700 Citicorp Drive, Bldg 3, Hagerstown, MD 21742. **Customer Service: Phone (800) 638-3030; Fax (301) 223-2400; E-mail: customerservice@lww.com.** Visit our website at LWW.com. Publisher, Randi Davis.

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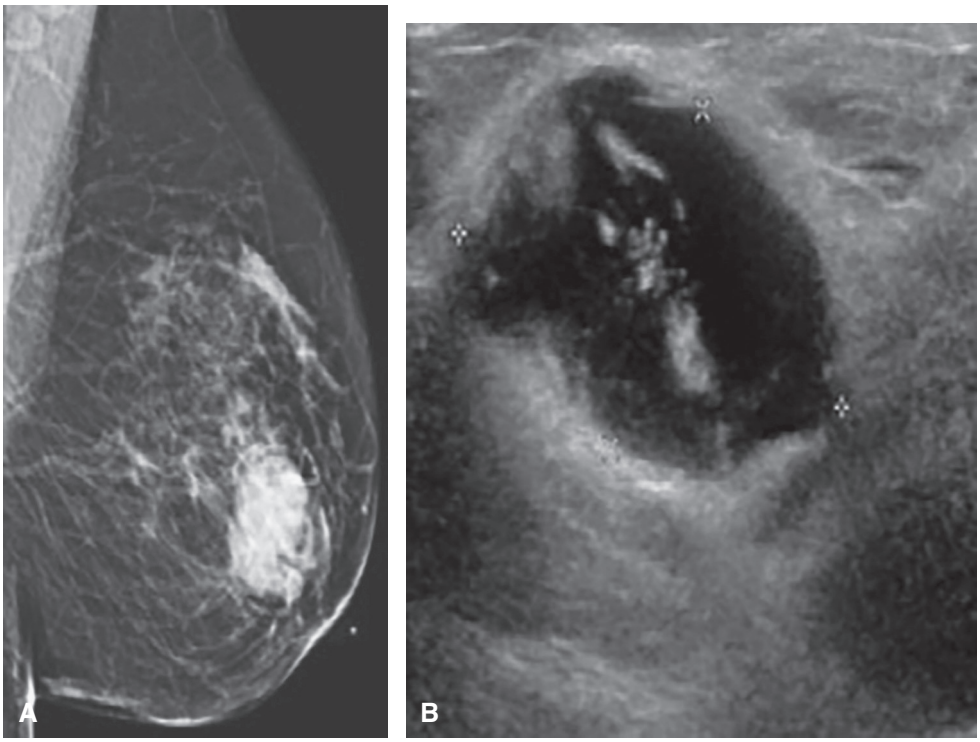

Figure 3. Breast hematoma *A*: A 63-year-old woman on warfarin for atrial fibrillation sustained trauma to left breast 3 weeks previously. This MLO view shows a relatively circumscribed, high-density mass in the left inner central breast, corresponding to a palpable lump, indicated by a triangle marker. *B*: Grayscale ultrasound image shows an oval, complex, primarily fluid-filled breast mass with absent internal vascularity (color Doppler not shown) consistent with a hematoma.

asymmetrically increased breast density with skin thickening, an associated mass if a hematoma is present, and irregular regions of increased density, which may represent contrast extravasation suggesting active bleeding.[5]

Treatment typically is conservative and involves manual pressure at the site of the hematoma.[4] When manual pressure fails, more invasive methods can be employed, including intravascular embolization and/or surgical ligation.[4]

Penetrating Injuries

Penetrating injuries of the breast can include stab wounds, gunshot wounds, and a variety of other projectile injuries. Penetrating injuries to the breasts often are detected initially on chest CT to assess for secondary complications such as lung hematomas, pulmonary lacerations and contusions, pneumothoraces, and/or foreign bodies[5] (Figure 4).

Penetrating injuries to the breasts often are detected initially on chest CT ordered to assess for secondary complications in the lungs.

Mammographic findings, although nonspecific, can include focal asymmetry with possible architectural distortion.[5] Mammography occasionally can be used to better localize a foreign body[5] (Figure 5). On ultrasound, a hematoma appears as an irregular, heterogeneous mass, with both cystic and solid components, with or without posterior acoustic enhancement or shadowing, and possible architectural distortion.[5] The treatment usually is supportive; however, follow-up ultrasound may be performed to document complete resolution if there is persistent clinical concern.[5] It is recommended that a mammogram be performed 3 to 6 months after the injury to establish a new baseline.[5]

Iatrogenic Injuries

Postbiopsy Hematomas

The overall incidence of postbiopsy breast hematoma is very low, reported to be less than 1% on multiple studies.[3] Hematomas after ultrasound-guided or stereotactic biopsies are generally small, measuring less than 12 mm, and typically are not clinically significant.[3,5] Manual compression is applied to the biopsy site for 5 to 10 minutes to achieve hemostasis. Persistent bleeding with an associated large area of bruising in the biopsied breast skin, particularly 1 to 2 days after the biopsy, is considered "excessive."[3-5] Skin bruising can be extensive, extending to the contralateral breast, up the chest wall, around to the back, and down the flank.[3] The incidence of bruising complications is higher in patients who are taking anticoagulants versus those who are not (34% vs 26.5%); however, the incidence of postbiopsy hematoma is not as affected by the patient's coagulation status.[3,6] In one recent study, the probability of developing a hematoma was 22% for patients taking antithrombotics compared with 13% for patients not taking antithrombotics, but no clinically significant bleeding complications have been reported.[3,6,7] The use of lidocaine with epinephrine during biopsy; localized compression after biopsy; and, in some cases, a pressure dressing, can decrease the complication rate.[3]

Mammographically, a hematoma presents as a new, poorly defined or circumscribed mass near the biopsy site[3] (Figure 6). A gas-fluid level also may be observed adjacent to the biopsy site if a vacuum-assisted breast biopsy device was used.[3] Hemorrhage within the breast is identified as a new focal asymmetry in and around the biopsy site.[3] Sonographically, hemorrhage appears as an area of hypoechogenicity tracking along the course of the needle/biopsy device.[3] A hematoma may appear as a hypoechoic fluid collection or as a complex, heterogeneous cystic and

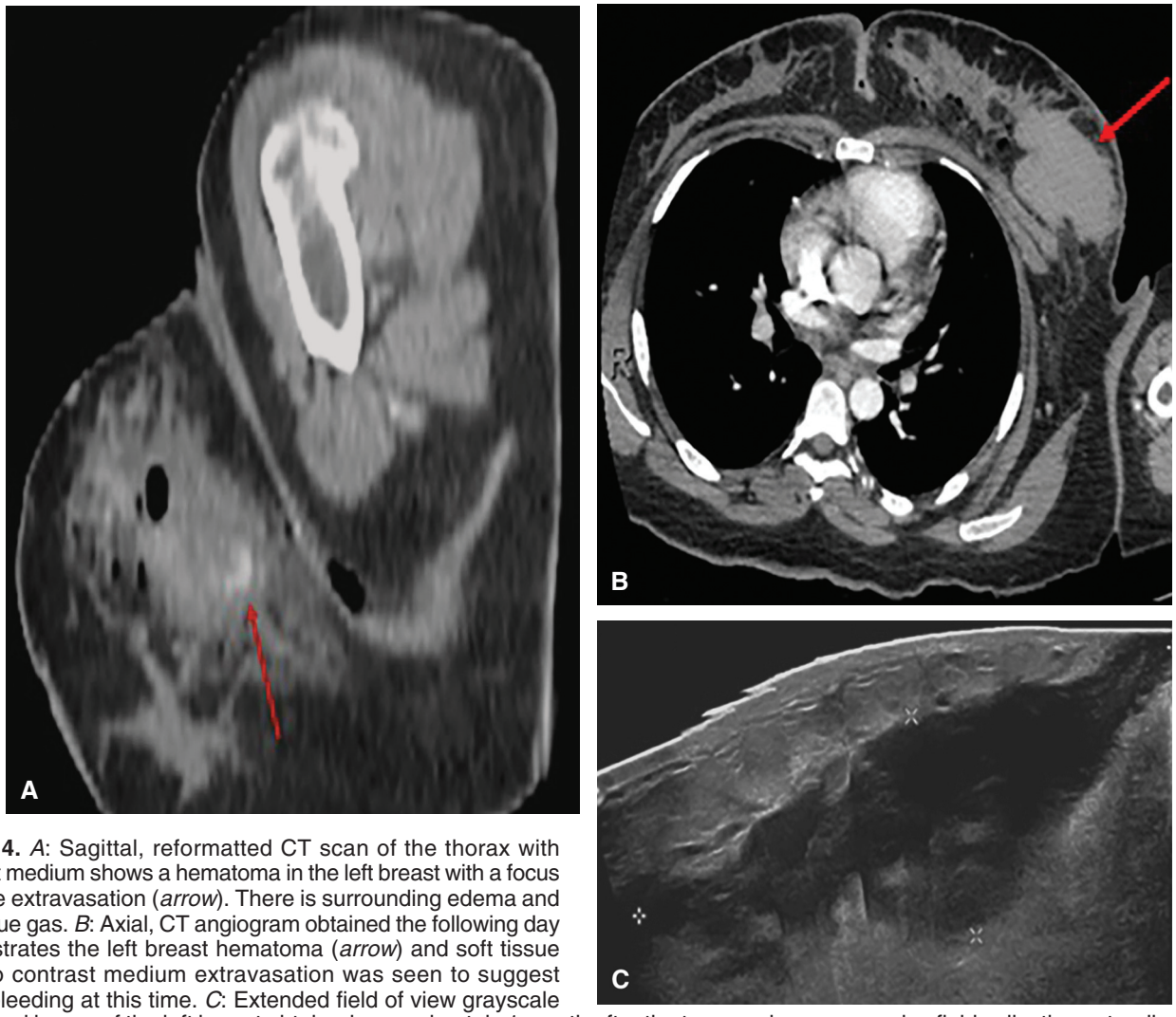

Figure 4. *A*: Sagittal, reformatted CT scan of the thorax with contrast medium shows a hematoma in the left breast with a focus of active extravasation (*arrow*). There is surrounding edema and soft tissue gas. *B*: Axial, CT angiogram obtained the following day demonstrates the left breast hematoma (*arrow*) and soft tissue gas. No contrast medium extravasation was seen to suggest active bleeding at this time. *C*: Extended field of view grayscale ultrasound image of the left breast obtained approximately 1 month after the trauma shows a complex fluid collection extending to the skin. There was no internal vascularity. The patient reported increased pain and swelling of the left breast with purulent drainage from the wound site in the left upper outer quadrant. Findings are consistent with an infected breast hematoma.

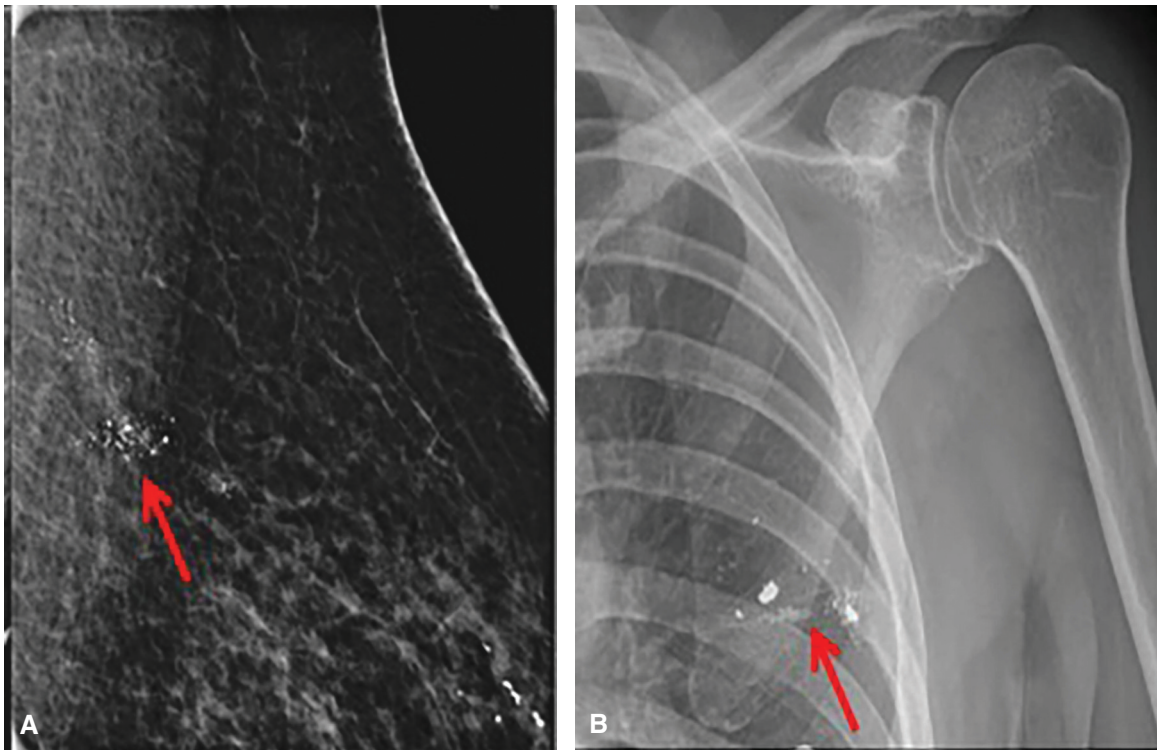

Figure 5. *A*: MLO magnification mammographic view shows numerous high-density foci in the left upper inner quadrant posteriorly due to bullet fragments (*arrow*), mimicking microcalcifications. *B*: Left shoulder radiograph shows metallic foreign bodies (*arrow*) in the left breast and chest wall in this same patient with a history of gunshot injury to the left breast.

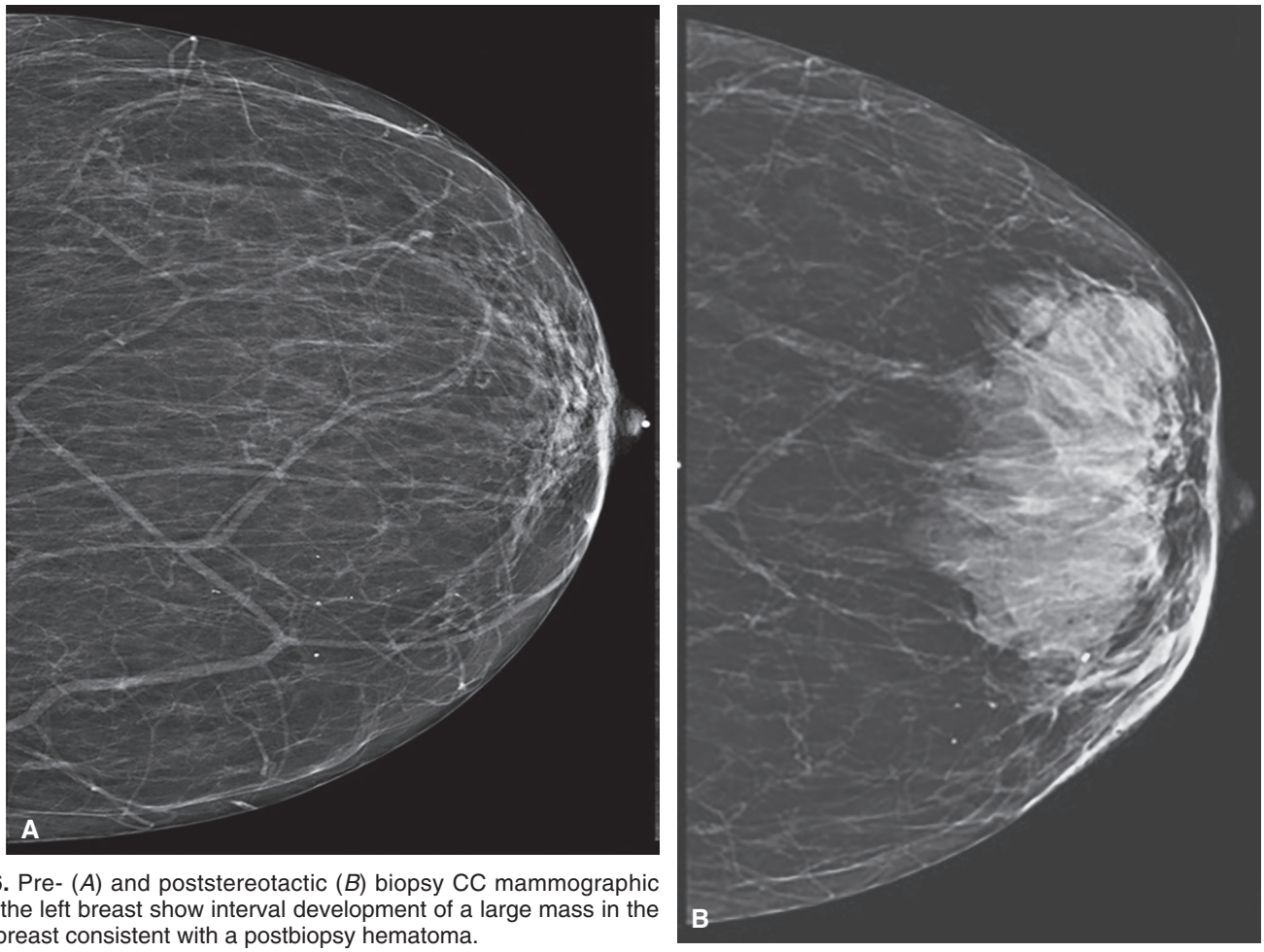

Figure 6. Pre- (*A*) and poststereotactic (*B*) biopsy CC mammographic views of the left breast show interval development of a large mass in the anterior breast consistent with a postbiopsy hematoma.

solid mass.[3] In rare instances, angiography can be helpful in detecting an active bleed by showing extraluminal extravasation of contrast material.[3] On MRI, a hematoma is hyperintense on T1-weighted imaging, hypointense on T2-weighted imaging, and shows no enhancement[8] (Figure 7).

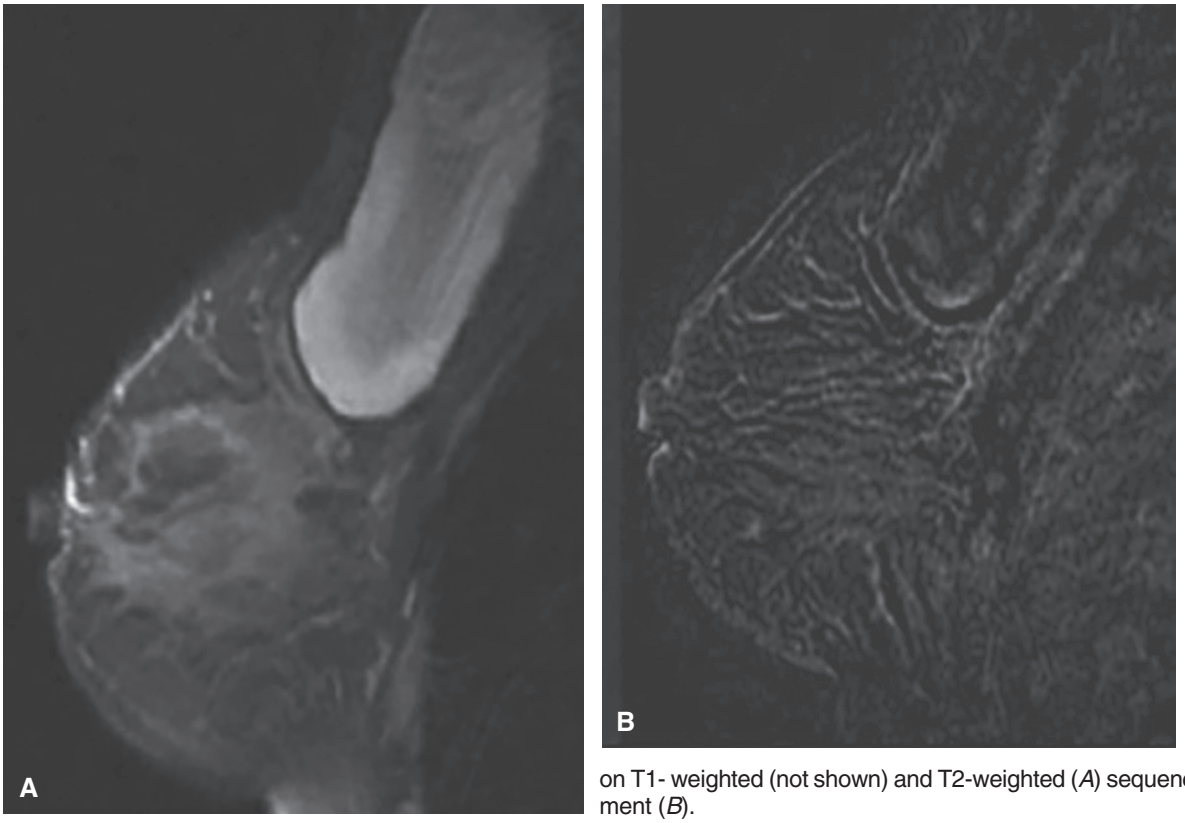

Figure 7. Preoperative breast MR images were obtained to evaluate the extent of disease in a 61-year-old woman who had undergone ultrasound-guided biopsy of two suspicious lesions in the right breast. Pathologic analysis confirmed multifocal, invasive mammary carcinoma. Imaging revealed a large, circumscribed mass with mixed intensity on T1- weighted (not shown) and T2-weighted (*A*) sequences and no enhancement (*B*).

On MRI, the typical appearance of a breast hematoma is hyperintense on T1-weighted imaging and hypointense on T2-weighted imaging, without enhancement.

Pseudoaneurysms

Pseudoaneurysms of the breast are rare but well-described complications after breast biopsy. A pseudoaneurysm is a hematoma that communicates with the arterial lumen, contains flowing blood, and lacks the three layers of the normal arterial wall.[3] In reported cases of pseudoaneurysm formation postbreast biopsy, excessive bleeding or formation of a large hematoma often is noted at the time of biopsy.[3] Clinically, a palpable pulsatile mass is present, generally ranging from 1 to 3 cm in size with overlying bruising of the skin.[3]

Mammography can show a circumscribed mass adjacent to a blood vessel.[3] A lack of internal fat density can help differentiate the pseudoaneurysm from an intramammary lymph node.[3] On ultrasound, pseudoaneurysms present as anechoic lesions with an echogenic rim and a neck connecting the pseudoaneurysm to the adjacent artery.[3] Clotting occurs at the periphery of the hematoma, which appears hyperechoic at sonographic evaluation, whereas the center of the pseudoaneurysm remains anechoic with flowing blood.[3] Color Doppler imaging will show the swirling or "yin-yang" pattern of blood flow in the pseudoaneurysm[3] (Figure 8). Spectral Doppler imaging will show a "to and fro" waveform.[3]

On ultrasound, a breast pseudoaneurysm presents as an anechoic lesion with an echogenic rim and a neck connecting it to the adjacent artery.

Treatment options include ultrasound-guided compression at the neck of the pseudoaneurysm for 30 to 60 minutes, which often results in rapid thrombosis.[3] If this is not successful, ultrasound-guided percutaneous thrombin injection can be effective regardless of anticoagulation status. Other options in refractory cases include embolization, percutaneous alcohol injection, and surgical intervention with ligation of the bleeding vessel.[3] Once the pseudoaneurysm has thrombosed, follow-up ultrasound imaging is performed in 2 to 7 days to ensure continued thrombosis.[3] Compared with pseudoaneurysms located in other areas, lower treatment success rates are reported in the breast; however, higher success rates are reported when the breast pseudoaneurysm is treated early.[3]

Review of Fat Necrosis

Fat necrosis is most commonly the result of trauma to the breast (21%–70%), radiotherapy, anticoagulation, cyst aspiration, biopsy, lumpectomy, reduction mammoplasty, implant removal, breast reconstruction with tissue transfer, duct ectasia, or breast infection.[9] Clinically, patients present with a painless, firm, indiscrete, immobile mass with occasional overlying skin thickening and retraction.[5,9] However, in almost 50% of cases, patients do not report any injury to the breast, and the fat necrosis is occult clinically.[9] Radiographic appearance and clinical presentation can be variable and may even mimic breast malignancy.

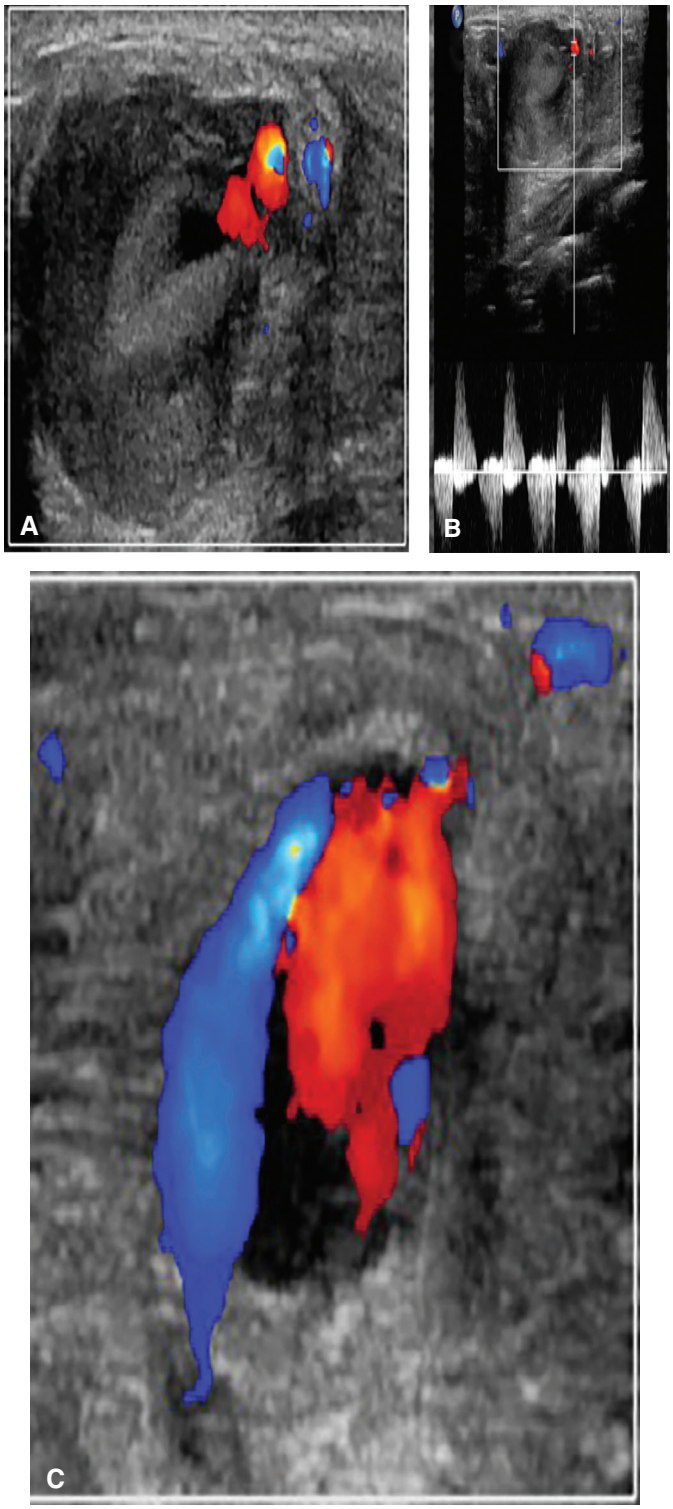

Figure 8. Pseudoaneurysm. Color (*A*) and spectral (*B*) Doppler ultrasound images obtained after ultrasound-guided biopsy in a patient with excessive bleeding show a circumscribed, heterogeneous mass with arterial flow at its neck consistent with a pseudoaneurysm. Color Doppler ultrasound image (*C*) in a different patient after ultrasound-guided biopsy shows the characteristic "yin-yang" pattern of a pseudoaneurysm.

On mammography, fat necrosis classically is described as lipid cysts with a lucent center surrounded by a smooth rim that may become calcified[5,9] (Figure 9). Focal asymmetries, oil cysts, spiculated masses, and calcifications of various sizes and morphologies also can be seen in fat necrosis; however, the typical benign-appearing calcifications

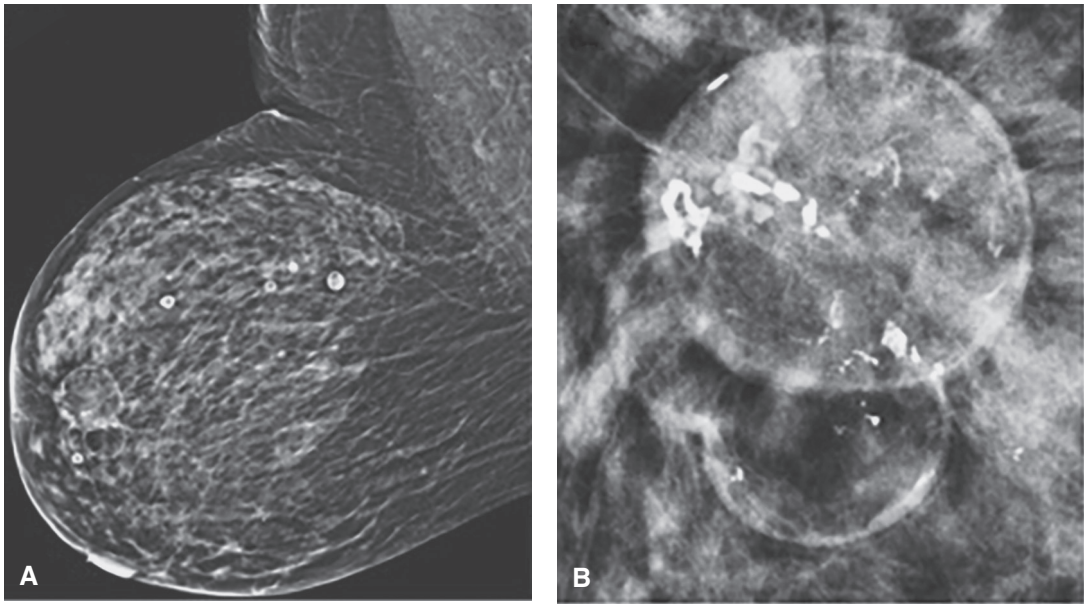

Figure 9. Breast fat necrosis. MLO (*A*) and zoomed-in CC (*B*) mammographic views show circumscribed, round, fat-containing masses with coarse and rim calcifications consistent with breast fat necrosis.

related to fat necrosis are smooth and round.[5,9] If the mammographic appearance is not characteristic for fat necrosis (eg, pleomorphic microcalcifications), further evaluation with MRI may be indicated to exclude malignancy.[5] The classic MR appearance of fat necrosis is a lipid cyst, round or oval mass with hypointense T1-weighted signal on fat saturation images.[9] Fat necrosis usually is isointense to fat elsewhere in the breast and shows low signal intensity on a T1-weighted sequence, which may be due to its hemorrhagic and inflammatory content.[9] Fat necrosis may show focal or diffuse, homogeneous or heterogeneous enhancement after the administration of IV contrast material, and the amount of enhancement is correlated with the intensity of the inflammatory process.[9] Sonographically, fat necrosis often appears solid but also can demonstrate complex, cystic and solid components, and posterior acoustic enhancement or shadowing. Distortion of surrounding breast architecture can occur.[5] Often, imaging findings evolve over time and depict the histologic evolution of fat necrosis.[9]

On mammography, breast fat necrosis classically is described as lipid cysts with a lucent center surrounded by a smooth rim that may become calcified.

Conclusion

Traumatic breast injuries are uncommon but require prompt identification and management when they occur. Most iatrogenic complications, including pseudoaneurysms and postbiopsy hematomas, are the result of interventional procedures. However, the radiologist must be aware of other traumatic breast injuries, including seat belt syndrome, penetrating trauma, and thermal injuries. Knowledge of the usual presentations, management, and appropriate follow-up protocols of traumatic breast injuries is essential to prevent unwarranted stress for the patient and unnecessary follow-up.

References

1. Gatta G, Pinto A, Romano S, et al. Clinical, mammographic and ultrasonographic features of blunt breast trauma. *Eur J Radiol*. 2006;59(3):327-330.
2. Hunter JE, Gilbert PM, Dheansa BS. Correction of postburn superior pole breast deformity and macromastia—a novel approach. *Burns*. 2009;5:746-749.
3. Mahoney MC, Ingram AD. Breast emergencies: types, imaging features, and management. *AJR Am J Roentgenol*. 2014;202:W390-399.
4. Ingram AD, Mahoney MC. An overview of breast emergencies and guide to management by interventional radiologists. *Techn Vasc Interv Radiol*. 2014;17:55-63.
5. Khadem N, Reddy S, Lee S, et al. ED breast cases and other breast emergencies. *Emerg Radiol*. 2016;23:67-77.
6. Somerville P, Seifert PJ, Destounis SV, et al. Anticoagulation and bleeding risk after core needle biopsy. *AJR Am J Roentgenol*. 2008;191:1194-1197.
7. Chetlen AL, Kasales C, Mack J, et al. Hematoma formation during breast core needle biopsy in women taking antithrombotic therapy. *AJR Am J Roentgenol*. 2013;201:215-222.
8. Dhillon GS, Bell N, Ginat DT, et al. Breast MR imaging: what the radiologist needs to know. *J Clin Imaging Sci*. 2011;1:48.
9. Kerridge WD, Kryvenko ON, Thompson A, et al. Fat necrosis of the breast: a pictorial review of the mammographic, ultrasound, CT, and MRI findings with histopathologic correlation. *Radiol Res Pract*. 2015;2015:613139.

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1. Once a postbiopsy breast pseudoaneurysm has thrombosed, when should follow-up ultrasound imaging be performed to ensure continued thrombosis?
- **A.** 1 day later
- **B.** 2 to 7 days later
- **C.** 10 to14 days later
- **D.** 3 to 4 weeks later
- **E.** 3 to 6 months later

2. Which one of the following mammographic findings can be observed *early* at the breast biopsy site if a vacuum-assisted breast biopsy device is used?
- **A.** Spiculated mass
- **B.** Gas-fluid level
- **C.** Architectural distortion
- **D.** Fine linear calcifications
- **E.** Focal asymmetry

3. All of the following are potential clinical findings of seat belt injury of the breast in an adult, *except*
- **A.** palpable breast hematoma
- **B.** skin indentation along the seat belt line
- **C.** asymmetric small breast
- **D.** skin blistering
- **E.** skin ulceration

4. All of the following are mammographic findings of blunt injury to the breast, *except*
- **A.** linear parenchymal density
- **B.** band-like parenchymal density
- **C.** hematoma
- **D.** skin thinning
- **E.** fat necrosis

5. On MRI, the typical appearance of a breast hematoma is
- **A.** hyperintense on T1-weighted imaging, hypointense on T2-weighted imaging, without enhancement
- **B.** hypointense on T1-weighted imaging, hypointense on T2-weighted imaging, without enhancement
- **C.** hyperintense on T1-weighted imaging, hypointense on T2-weighted imaging, and shows enhancement
- **D.** hyperintense on T1-weighted imaging, hyperintense on T2-weighted imaging, without enhancement
- **E.** hyperintense on T1-weighted imaging, hyperintense on T2-weighted imaging, and shows enhancement

6. After breast biopsy, persistent bleeding and skin bruising in the biopsied breast can extend into the
- **A.** contralateral breast
- **B.** chest wall
- **C.** back
- **D.** flank
- **E.** all of the above

7. *Most* blunt injuries to the breast are caused by
- **A.** motor vehicle trauma from a seat belt
- **B.** sports injury
- **C.** fall
- **D.** biopsy
- **E.** lumpectomy

8. All of the following are treatments for blunt injury of the breast with a hematoma, *except*
- **A.** manual pressure at the site of hematoma
- **B.** immediate surgical excision of hematoma
- **C.** intravascular embolization when manual pressure fails
- **D.** surgical ligation of feeding vessel when manual pressure fails

9. Which one of the following is a mammographic finding of previous thermal injury to the breast during puberty?
- **A.** Asymmetric smaller breast
- **B.** Spiculated mass
- **C.** Large hematoma
- **D.** Diffuse microcalcifications
- **E.** Circumscribed mass

10. Which one of the following areas of the breast of the driver of a left-hand drive vehicle is *least* likely to sustain a seat belt injury after a severe motor vehicle accident?
- **A.** Upper inner quadrant of the left breast
- **B.** Central left breast
- **C.** Lower inner quadrant of the right breast
- **D.** Upper outer quadrant of the right breast