

# DIAGNOSIS AND ENDOVASCULAR TREATMENT OF AN ARTERIOVENOUS FISTULA IN THE BREAST

## MEMEDE ARTERİYOVENÖZ FİSTÜL OLGUSUNUN TANI VE ENDOVASKÜLER TEDAVİSİ

Rana Günöz CÖMERT<sup>1</sup> , Mehmet Semih ÇAKIR<sup>2</sup> , Ravza YILMAZ<sup>1</sup> , Selman EMİROĞLU<sup>3</sup> , Bülent ACUNAŞ<sup>2</sup> 

<sup>1</sup>Istanbul University, Istanbul Faculty of Medicine, Department of Radiology, Division of Breast Imaging, Istanbul, Türkiye

<sup>2</sup>Istanbul University, Istanbul Faculty of Medicine, Department of Radiology, Division of Interventional Radiology, Istanbul, Türkiye

<sup>3</sup>Istanbul University, Istanbul Faculty of Medicine, Department of General Surgery, Division of Oncoplastic Breast Surgery, Istanbul, Türkiye

**ORCID IDs of the authors:** R.G.C. 0000-0003-3084-8232; M.S.Ç. 0000-0002-7072-5985; R.Y. 0000-0001-8661-6751; S.E. 0000-0001-9333-6926; B.A. 0000-0003-4695-6043

**Cite this article as:** Cömert RG, Çakır MS, Yılmaz R, Emiroğlu S, Acunaş B. Diagnosis and endovascular treatment of an arteriovenous fistula in the breast. J Ist Faculty Med 2024;87(1):95-100. doi: 10.26650/IUITFD.1320684

### ABSTRACT

Arteriovenous fistulas (AVF) are abnormal connections between the arteries and veins in the absence of normal capillaries. The etiology of AVFs includes surgical planning for hemodialysis, congenital/syndrome related conditions, malignancy and trauma, and iatrogenic complications. Breast AVFs are rare, and most of those reported in the literature are biopsy-related acquired cases. A 91-year-old female patient was diagnosed with AVF in the right breast via radiological imaging findings and underwent endovascular treatment. The AVF could not be associated with any acquired etiology. Doppler ultrasonography and MDCTA-MRA are guides for the diagnosis of AVF. Digital angiography is both the gold standard in diagnosis and can be used for endovascular treatment in suitable cases.

**Keywords:** Breast, arteriovenous fistula, Doppler ultrasound, magnetic resonance angiography, digital angiography, endovascular treatment

### ÖZET

Arteriyovenöz fistüller (AVF), arterler ve venler arasında normal kapiller vasküler sistemin olmadığı anormal bağlantılardır. AVF'lerin etiyolojisinde hemodiyaliz için cerrahi planlama, konjenital/sendrom ilişkili durumlar, malignite ve travma ve iatrojenik komplikasyonlar bulunmaktadır. Meme AVF'leri nadirdir ve literatürde bildirilenlerin çoğu biyopsi ile ilişkili edinsel vakalardır. Doksan bir yaşında kadın hastaya radyolojik görüntüleme bulguları ile sağ memede AVF tanısı konuldu ve endovasküler tedavi uygulandı. Olgumuzun anamnezinde AVF etiyolojisi bulunamamıştır. Doppler ultrasonografi ve MDCTA-MRA AVF tanısında yol göstericidir. Dijital anjiyografi altın standarttır ve uygun olgularda endovasküler tedavi olanağı sağlamaktadır.

**Anahtar Kelimeler:** Meme, arteriyovenöz fistül, Doppler ultrason, manyetik rezonans anjiyografi, dijital anjiyografi, endovasküler tedavi

**Corresponding author/İletişim kurulacak yazar:** Rana Günöz CÖMERT – rana.comert@istanbul.edu.tr; rgcomert@gmail.com

**Submitted/Başvuru:** 04.07.2023 • **Revision Requested/Revizyon Talebi:** 12.07.2023 •

**Last Revision Received/Son Revizyon:** 12.07.2023 • **Accepted/Kabul:** 13.11.2023 • **Published Online/Online Yayın:** 15.01.2024



Content of this journal is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

## INTRODUCTION

Arteriovenous fistulas (AVF) are abnormal connections between an artery and a vein in the absence of capillaries. The blood flow in AVFs creates a hyperdynamic shunt from the artery to the vein. The etiology of AVFs includes surgical planning of hemodialysis, congenital/syndrome-related conditions, pathological processes such as malignancy or trauma, or iatrogenic complications (1). Radiological findings include the presence of a low-resistance arterial feeder and arterialized high-flow velocity vein using Doppler ultrasonography (USG). Multidetector computed tomographic angiography (MDCTA) and magnetic resonance angiography (MRA) show early filling of the draining vein at the early arterial phase, and digital angiography shows arterial feeders and draining veins.

## CASE PRESENTATION

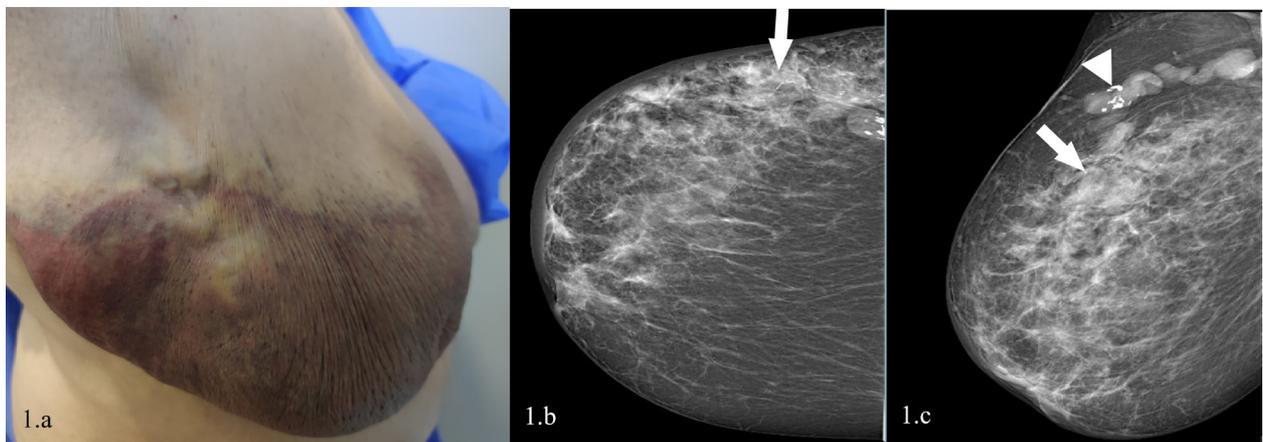
A 91-year-old female patient was admitted with complaints of bruising, stiffness, and pain in the right breast. The patient presented with essential hypertension, congestive heart failure, and chronic obstructive pulmonary disease. The patient was taking an antihypertensive and a daily 100 mg/day acetylsalicylic acid treatment. Physical examination indicated the presence of extensive ecchymosis of the skin in the right breast with a warm-pulsatile palpable lesion in the outer quadrant. The hemogram, biochemistry, and coagulation examination results and expected normal ranges were as following: WBC:  $8.56 \times 10^3$  cells/ $\mu\text{l}$  (4.1-11.2), Hb: 11.2 g/dL (11.7-15.5), Platelets:  $167 \times 10^3$ / $\mu\text{l}$  (160-390), Neu:  $5.24 \times 10^3$ / $\mu\text{l}$  (1.3-7); Glucose: 112 mg/dL (70-100), Creatinine: 0.69 mg/dL (0.7-1.4), CRP: 13.06 mg/L (0-5), INR: 0.82 (0.85-1.2), PT time: 10 s (10-15), Prothrombin activity: 136.6% (70-130), and APTT: 25.1 s (21-36).

Mammography images indicated the presence of a tortuous dilated vascular structure in the upper outer quad-

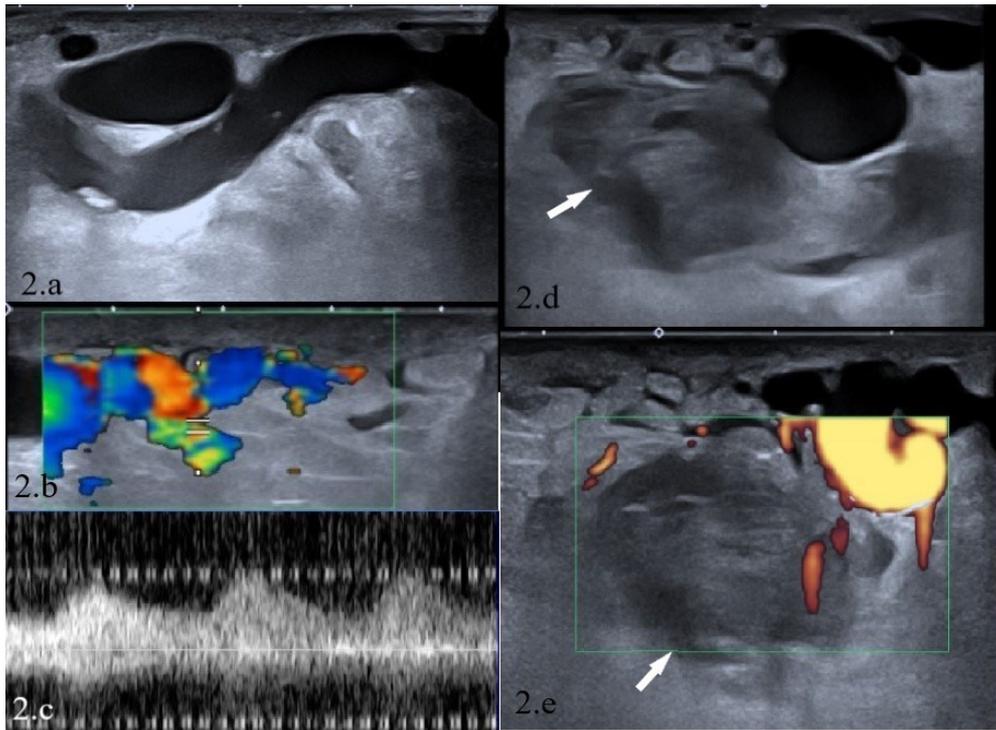
rant of the right breast as a tubular opacity with atherosclerotic calcification on its wall. A 3-cm opacity covered by parenchyma was observed adjacent to the dilated vascular structure, which was more evident on the mediolateral oblique view (MLO) mammogram. In addition, diffuse thickening and increased trabeculation were observed in the right breast skin (Figure 1). USG examination indicated the presence of extensive dilated superficial vascular collaterals, cutaneous-subcutaneous fatty tissue edema, and increased echo signal along the upper and outer quadrants of the right breast. A hypo-isoechoic lesion  $17 \times 18 \times 38$  mm in size was observed at the 9 o'clock position in the right breast. The location was consistent with the opacity observed in the mammogram. Doppler examination indicated the presence of a low-resistance arterial feeder and arterialized high-flow velocity vein adjacent to the hypoechoic lesion with turbulent flow in its lumen, suggesting the presence of a partially thrombosed pseudoaneurysm-associated AVF (Figure 2).

To further investigate the origin of the vascular pathology, the time-resolved 3D MRA technique with IV contrast for the right axilla and breast, along with arterial and venous phase MRA, was first applied to the patient. This was followed by the acquisition of conventional MR images by placing the breast coil in the prone position. MRA images showed the presence of focal aneurysmatic dilations from the proximal segment of the right thoracic lateral artery originating from the axillary artery and multiple collaterals in the outer quadrant of the right breast compatible with the presence of an AVF in the retro-mammillary area (Figure 3). In addition, venous return starting in the early arterial phase was observed.

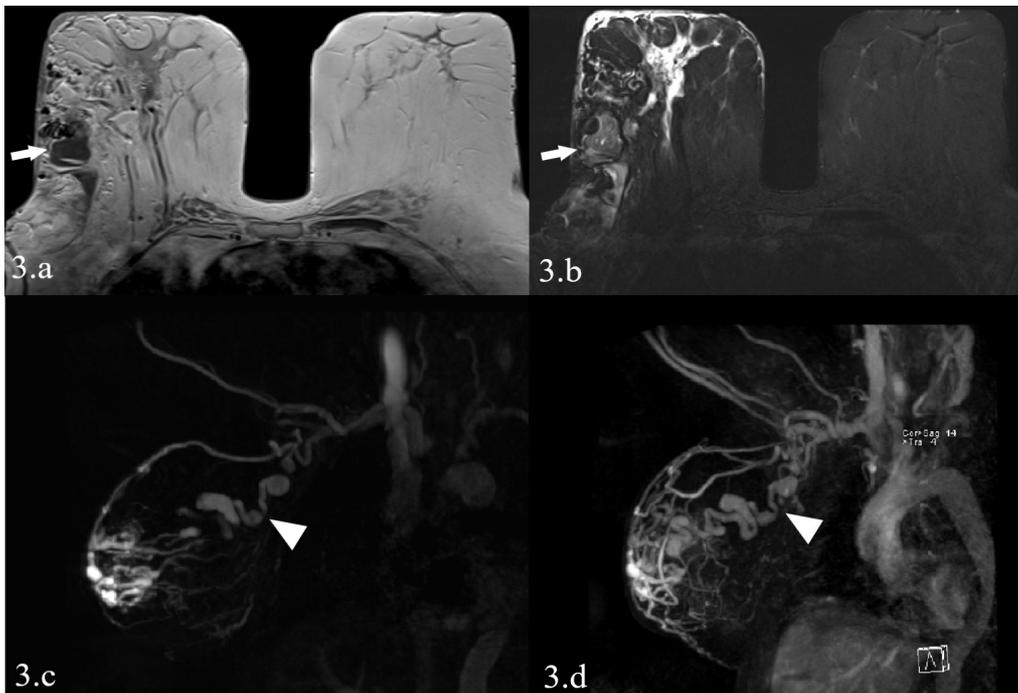
At the interventional radiology unit, the patient underwent a modified Allen test, after which a 4F vascular sheath was placed by sonography-assisted radial artery



**Figure 1:** (a) Extensive ecchymosis of the skin in the right breast, (b) CC and (c) MLO mammography images indicating the presence of tortuous dilated vascular structure (black arrowhead), opacity (pseudoaneurysm location) covered by parenchyma adjacent to the dilated vascular structure (black arrow).



**Figure 2:** (a, b) Extensive dilated superficial vascular collaterals, cutaneous-subcutaneous fatty tissue edema, and echo increase; (c, d, e) hypo-isoechoic lesion (white arrow), Doppler examination indicating the presence of a low resistance arterial feeder, and arterialized high-flow velocity vein adjacent to the hypoechoic lesion with turbulent flow in its lumen, suggesting the presence of a partially thrombosed pseudoaneurysm-associated AVF.



**Figure 3:** (a, b) Partially thrombosed pseudoaneurysm with intermediate signal intensity in T1W and T2W images (white arrow); (c, d) Focal aneurysmatic dilations from the proximal segment of the right thoracic lateral artery originating from the axillary artery, and multiple collaterals in the outer quadrant of the right breast (white arrowhead).

access from the right wrist. The right subclavian artery was then catheterized with a 0.035-inch guidewire and a 4F diagnostic vertebral catheter. Digital subtraction angiography (DSA) was carried out by administering the contrast material via a pump. The DSA images indicated that the lateral thoracic branch of the right axillary artery was prominently hypertrophic and tortuous in appearance. The images obtained by selective catheterization of the right lateral thoracic artery indicated a multisegmental aneurysmatic expansion along the lateral thoracic artery followed by early filling of multiple venous drainage veins (Figure 4).

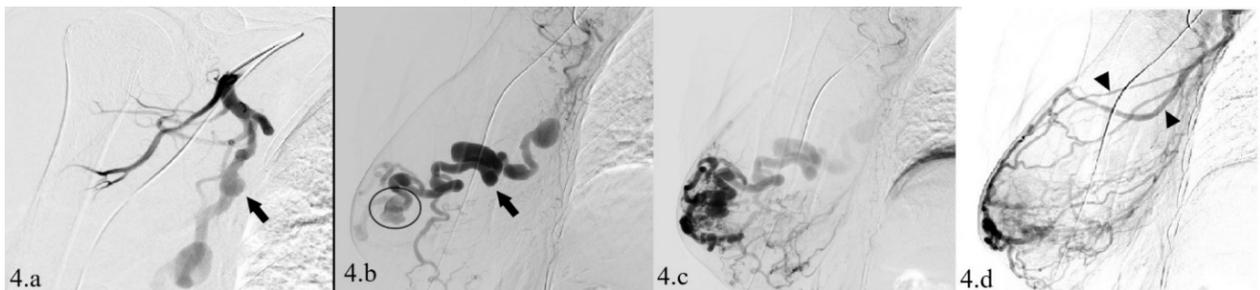
The fistula was reached by passing the aneurysmatic segments with a 2.4F Progreat Micro Catheter System (Terumo, Tokyo). Next, a 10% Histoacryl® (B/Braun, Tuttlingen, Germany) lipiodol mixture was given as a slow injection through the microcatheter, primarily to eliminate any flow in the fistula. Once the fistula flow was eliminated, the microcatheter was withdrawn, and the pathological segments of the afferent artery were embolized with a glue/lipiodol mixture, including all aneurysmatic segments. The selective internal mammary artery images taken at the end of the procedure confirmed that the pathological vascularization had been eliminated (Figure 5). The endovascular treatment procedure was terminated suc-

cessfully, and the patient was discharged after a one-day hospital stay and prescribed co-amoxiclav, paracetamol, proton pump inhibitor (pantoprazole), and nonsteroidal anti-inflammatory (lornoxiam) drugs. The patient was scheduled for a follow-up examination 7 days later.

A follow-up examination of the patient indicated that the ecchymosis in the breast had largely regressed and become limited to the outer quadrant; the patient's complaints had also been alleviated. A control ultrasonography indicated that the pseudoaneurysm in the right breast outer quadrant had been completely thrombosed. A dirty acoustic shadowing was observed in the lumen due to the embolization of the injected contrast material with other collateral vascular structures; moreover, no flow was observed in the Doppler examination (Figure 6). In addition, the skin edema and inflammatory echo increase in fatty tissue had also been resolved.

## DISCUSSION

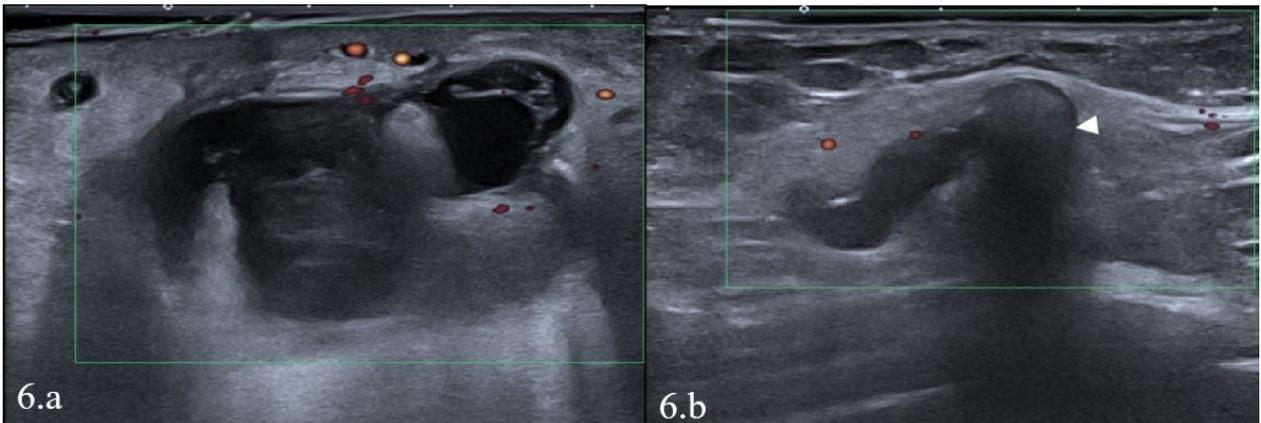
Congenital AVFs are associated with deviations in the development and differentiation of arteries and veins during the embryological period (2). Acquired AVFs are encountered more frequently than congenital causes. Acquired AVFs usually have a dominant arterial feeder and a dominant draining vein, while congenital AVFs



**Figure 4:** Digital subtraction angiography, right breast, AVF. (a, b) Aneurysmatic dilated lateral thoracic artery with a tortuous course in the early arterial phase (black arrow) and fistula location (marked with a black circle); (c) retro-mamillary venous drainage veins; (d) mixed venous drainage into the lateral thoracic vein and internal mammary vein (black arrowhead).



**Figure 5:** (a, b) Stagnation by embolizing injection; (c) No reflow was observed in the fistula-related collaterals of the right breast in the post-embolization angiography images taken via selective internal mammarian artery catheterization.



**Figure 6:** Control ultrasonography 1 week post-intervention. The pseudoaneurysm was completely thrombosed. A dirty acoustic shadowing was observed in the lumen due to the embolization of the injected contrast material with other collateral vascular structures; moreover, no flow was observed in the Doppler examination.

have multiple arterial feeders and draining veins forming a complex connection (2). Digital angiography in the current case showed the presence of the lateral thoracic artery as the major single arterial feeder, while the lateral thoracic and internal mammary veins were observed as the major draining veins.

Published data on the etiology of AVF in the breast suggest that, apart from congenital causes, AVFs can result from malignant masses, Tru-cut/fine needle aspiration biopsies, trauma, surgical interventions, and superior vena cava thrombosis/stenosis-related causes (2-6). A detailed anamnesis to understand the etiology of AVF in the current case suggested that the patient had no previous history of intervention, such as vascular intervention or tissue biopsy of the breast. To the best of our knowledge, no reported cases of spontaneous breast AVF are found in the literature; thus, we were unable to identify an explanatory etiology in the current case. The presence of a history of unremembered trauma is a feasible speculation.

The presence of a ying-yang sign (back-and-forth flow pattern) in the pseudo aneurysm lumen, a low resistance arterial feeder, and arterialized high-flow velocity vein in the Doppler USG are indicative of the presence of a pseudoaneurysm-associated arteriovenous fistula (PA-AVF) (3). MRA and/or MDCTA contribute to the detection of early filling of the draining vein in the early arterial phase and clarifies the anatomy of the arterial feeder and venous drainage. In addition to these techniques, digital angiography is considered the gold standard for determining the relationship between AVF-related arterial and venous structures and also provides the opportunity to map percutaneous endovascular embolization treatments.

The absence of any capillary vascular system able to provide passage in AVFs can lead to complications such as venous hypertension, pseudoaneurysm, hematoma, and

symptoms of heart failure due to high-velocity blood flow from the artery to the vein (2). Options for the treatment of AVF-associated pseudoaneurysms include ultrasound-guided compression, thrombin injection, alcohol injection, endovascular treatment, and surgical ligation treatment (3, 6, 7). The lesion size of PA-AVF is important in determining the treatment approach: Pseudoaneurysms <2 cm can be followed by thrombin injection and observation, while endovascular or surgical intervention is generally preferred for lesions >2 cm (3).

One published case report presented an AVF that was closed on angiography but required surgical ligation and excision in the follow-up (6). In the current case, the AVF was closed during embolization. More importantly, the follow-up ultrasonography carried out a week later showed that the pseudoaneurysm had been completely thrombosed, with no flow observed in the associated arterial and venous collaterals.

## CONCLUSION

AVFs of the breast are rare, and most of the cases reported in the literature are biopsy-related acquired cases. In the case reported in the current study, no associated etiology could be identified. Doppler USG, MDCTA, and MRA can guide the diagnosis of AVF. Digital angiography is the gold standard in diagnosis and can also be used for endovascular treatment in appropriate cases.

**Informed Consent:** Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

**Author Contributions:** Conception/Design of Study-R.G.C., M.S.Ç., R.Y., S.E., B.U.; Drafting Manuscript-R.G.C., M.S.Ç., R.Y., S.E., B.A.; Critical Revision of

Manuscript- M.S.Ç., B.A.; Final Approval and Accountability- R.G.C., M.S.Ç., R.Y., S.E., B.A.

**Conflict of Interest:** The authors have no conflict of interest to declare.

**Financial Disclosure:** The authors declared that this study has received no financial support.

## REFERENCES

1. Baleato González S, Vilanova Busquets JC, García Figueiras R, Villalba Martín C, Seoane Pose C, Martínez De Alegría A et al. Imaging arteriovenous fistulas. *AJR*. 2009;193(5):1425-33. [\[CrossRef\]](#)
2. Rhodes-Wilson M. Arteriovenous Fistula of the Breast. *JDMS* 2004;20(1):57-61. [\[CrossRef\]](#)
3. Li Y, Wu Z, Yan F, Peng Y, Ma L, Zeng G, et al. Pseudoaneurysm associated with arteriovenous fistula involving a superficial breast arteriole after vacuum-assisted removal of a benign mass: A case report. *Medicine (Baltimore)* 2018;97(36):e12250. [\[CrossRef\]](#)
4. Joseph KA, Ditkoff BA, Komenaka I, Mercado CL, Millman SL, Lantis J, et al. Acquired Arteriovenous Fistula of the Breast *Breast J* 2004;10(2):156-8. [\[CrossRef\]](#)
5. Gregg A, Leddy R, Lewis M, Irshad A. Acquired arteriovenous fistula of the breast following ultrasound-guided biopsy of invasive ductal carcinoma. *J Clin Imaging Sci* 2013;3:38. [\[CrossRef\]](#)
6. Yanagisawa W, Sedaghat N, Gordon-Thomson D. Endovascular management of iatrogenic arteriovenous fistula of the breast. *Breast J* 2021;27(1):52-5. [\[CrossRef\]](#)
7. Eli E, Ansari H, Williams J, Carter M, Friedman P. Successful treatment of a two-centimeter breast pseudoaneurysm with thrombin injection. *Breast J* 2012;18(3):292-3. [\[CrossRef\]](#)