

# Venous Malformation in the Breast: Imaging Features to Avoid Unnecessary Biopsies or Surgery

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## ABSTRACT

Venous malformations are now categorised under the broad heading of slow flow vascular malformations. They comprise abnormally dilated venous channels that fail to involute. These may be superficial or deep in location. We describe two cases of venous malformation in breast. Both the patients presented with focal pain in one breast. On mammography, they appeared as equal density well circumscribed soft tissue masses. No sonographic correlate was found on initial ultrasound examination. Subsequent ultrasonography performed by an experienced radiologist with minimal probe pressure revealed dilated veins. On the basis of imaging findings, the diagnosis of venous malformation was established.

## CASE REPORT

### CASE REPORT

#### Introduction

Vascular disorders of breast are quite infrequent and represent a wide spectrum including malformations and benign or malignant neoplastic conditions. These may appear as focal lobular masses on mammogram mimicking neoplasm which may generate anxiety in the patients and result in unnecessary additional investigations and biopsy, if not diagnosed correctly. Routine breast ultrasound requires application of gentle but firm pressure to decrease reflective and refractive attenuation and to facilitate better penetration of the breast tissue. This may result in obliteration of the slow flow vascular channels and failure to identify the lesion raising the possibility that a small isoechoic solid mass is being missed. It is therefore necessary to perform ultrasound with minimal or light pressure in this setting to diagnose a vascular pathology. We present a case

series of two female patients who presented with focal pain in the breast and were diagnosed to have venous malformation on mammography and ultrasonography.

#### Case report 1

A 45-year-old multiparous woman presented to our institution with the complaints of pain in upper outer quadrant of left breast associated with itching on the overlying skin for one year. She did not complain of any nipple discharge, lump in the breast, fever or weight loss. No history of any comorbidity, previous surgery or trauma was elucidated. On physical examination a vague nodular mildly tender lump of size approximately ~1cm was palpated in the upper outer quadrant of left breast. Overlying skin and nipple-areola region were normal. Right breast was normal on examination. Patient

was subsequently referred for mammography for further evaluation.

Mammography revealed an oval equal density circumscribed mass measuring ~1 x 0.8cm in upper outer quadrant of the left breast (Fig. 1A-D). There was no associated intralesional calcification or architectural distortion. An ultrasound performed at the same sitting to further characterize the lesion failed to reveal any abnormality after multiple careful attempts to locate the mass. A repeat ultrasound performed by an experienced radiologist, subsequently, with minimal probe pressure revealed a parallelly oriented, anechoic circumscribed tubular channel in the upper outer quadrant measuring ~10 x 6mm, showing mild posterior acoustic enhancement and few moving internal echoes within (Fig. 1E). There were no calcifications or architectural distortion. It showed venous flow on colour doppler examination (Fig. 1F). It was compressible on probe compression due to which it was obscured in the initial ultrasound examination done with routine probe pressure. Based on the imaging findings, the diagnosis of venous malformation was made.

### Case report 2

A 42-year-old woman was referred to the Radiology department for routine screening mammography. She had undergone hysterectomy and was receiving hormone replacement therapy for one year. She gave a non-specific history of mild vague occasional pain in left breast. No history of nipple discharge, trauma, fever or previous surgery at local site was evident. Local examination revealed a tender 2 x 2cm vague soft lump in upper inner quadrant of left breast. No wound or scar was noted on the skin surface. Mammography of left breast showed two round and oval equal density masses with circumscribed margins in the upper inner quadrant of left breast extending to the retro-areolar region (Fig. 2A-B). No pathological calcification or architectural distortion was noted. Mammography of the right breast was normal. Again, no mass was detected on the initial correlative ultrasound examination. The patient was recalled and ultrasound performed by experienced radiologist with minimal pressure showed few prominent anechoic linear tubular channels in the upper inner quadrant and retro-areolar region, which demonstrated posterior acoustic enhancement and moving internal echoes corresponding to slow venous flow. It showed multifocal patchy colour uptake (Fig. 2C-D) and venous flow on colour doppler with low PRF (pulse repetition frequency) setting suggesting venous malformation.

## DISCUSSION

Vascular lesions of breast comprise a gamut of arterial and venous disorders as well as benign and malignant vascular tumours. Vascular disorders are classified based on the symmetry of the pathology (Flowchart Fig. 3). Benign vascular masses consist of hemangiomas, and angioliipomas. Primary and secondary angiosarcoma and hemangiopericytoma fall under the malignant category (1).

### Etiology & Demographics:

Venous malformation represents non-neoplastic developmental disorder of vasculature presenting as multiple venous dilatations which may occur at varying places such as cutaneous tissue, muscles and visceral organ, however breast is an uncommon location for this pathology (1,2).

Venous malformations may occur at any age. These have been reported to be found in 1.2% of mastectomy specimen. Previous studies have reported association of cavernous hemangioma in patients taking hormone replacement therapy (HRT) and its possible role in increasing the size of the lesion (3). A similar association of occurrence of venous malformation was noted in one of our patients taking HRT.

### Clinical & Imaging findings:

Venous malformations in the breast are usually asymptomatic or may present as painless palpable lump. Pain may be the presenting complaint if thrombosis or hemorrhage has occurred in the lesion with subsequent compression on surrounding breast parenchyma. Clinically, these are palpable as single or multifocal discrete lobular masses with or without focal firm to hard nodules representing thrombus or phleboliths. Focal bluish discoloration of the overlying skin may be present (4).

Mammography is the first investigation performed in case of suspected lesion in breast in patients over 40 years of age. Ultrasonography and doppler serve as crucial adjunct imaging modalities in further lesion characterization. Multimodality imaging approach along with thorough knowledge of the imaging appearances of these lesions are essential to arrive at correct diagnosis and plan further management (1,5).

On mammogram, venous malformations appear as well-defined round, globular or serpiginous soft tissue masses. A rare but significant characteristic hint towards the diagnosis is presence of phleboliths seen as benign round calcifications with or without central radiolucent ring (2). This was not seen in any of our cases and in such a situation distinction from other benign and probably benign masses is difficult.

Ultrasonography aids in better defining the lesion. It is crucial to perform ultrasound with minimal pressure if the lesion is not visualized with routine pressure ultrasound to avoid false negative results and further irrelevant investigations. Sonographic appearance of venous malformation may be variable ranging from focal dilatation of single or multiple venous channels to an irregular fluid filled anechoic or hypoechoic cystic lesion showing internal septations. In both of our cases anechoic tubular channels were seen with moving internal echoes. Presence of echogenic foci exhibiting posterior acoustic shadowing represents phleboliths which may be seen but are not common in breast lesions. This was not seen in any of our cases. On colour doppler examination, the cystic areas show mild to moderate colour uptake with venous waveform on spectral doppler. Absence of colour uptake on doppler may reflect slow flow or thrombosis, the latter may mimic superficial thrombophlebitis. The lesion demonstrates engorgement and increased doppler colour flow following Valsalva maneuver and on releasing probe compression (4,6).

In case of uncertain diagnosis and large lesion, MRI (magnetic resonance imaging) may be done to confirm the diagnosis and illustrate the accurate extent of the lesion and relation with surrounding structures. On MRI, venous malformation appears iso-hypointense on T1 weighted image, markedly hyperintense on T2 weighted images and short tau inversion recovery sequence. On dynamic contrast enhanced MRI (DCE-MRI), gradual delayed heterogenous filling of the lesion is typical with near complete enhancement of the lesion, barring areas of thrombus and lymphatic component, if any. Phleboliths appear as well-defined round T1 and T2 hypointense foci, while thrombus shows T1 hyperintense and T2 hypointense signal. The lesion may also demonstrate fluid-fluid levels owing to the stagnant slow blood flow in venous channels or cystic cavities (4).

#### Differential Diagnosis:

Breast carcinoma is the most important differential to be considered and ruled out in post-menopausal women presenting with breast lump. Owing to the superficial location of venous malformation in breast, possible differentials for superficially located lesions in breast include hematoma, fat necrosis, superficial thrombophlebitis (Mondor's disease) and epidermal inclusion cyst. Other differential diagnosis to be considered are breast cyst and intramammary lymph node (3,7).

1. *Breast carcinoma*- A high density lesion with lobulated or undulated margins on mammography, with no corresponding pathology on ultrasonography may raise suspicion of missed malignancy. Also, the presence of phleboliths in venous malformation may mimic calcifications found in intraductal breast carcinoma, hence the need to differentiate it from malignancy. Breast carcinoma on ultrasound appears as hypoechoic solid mass lesion with angular or spiculated or microlobulated margins, shows posterior acoustic shadowing owing to its high cellularity and demonstrates significant internal vascularity. The lesion may or may not show calcifications within. On DCE-MRI, these lesions show typical rapid contrast uptake and washout pattern (type III curve) (7).
2. *Hematoma*- Breast hematoma occur following trauma to breast or iatrogenic injury or in patients with bleeding disorders and on antithrombotic drugs. Imaging appearance varies depending on size and age of hematoma. On mammography, acute and subacute hematomas (<1 month) may appear as subtle ill-defined area of focal increased density if small in size or may show well circumscribed high-density mass. On ultrasound, smaller lesions appear as focal hyper-echogenicity in fat associated with small cystic lesions, while the larger lesions demonstrate well defined cysts with septations, dependent echogenic debris or clot within and no internal vascularity on colour doppler which helps it to distinguish it from venous malformations. Chronic presentation of breast hematoma is mostly secondary to fat necrosis(8).
3. *Fat necrosis*- On mammography, oil cyst present as well defined low density mass with or without smooth curvilinear wall calcification which differ from vascular malformations appearing as iso-dense masses

with or without calcifications. However, oil cysts being situated in subcutaneous plane and superficial breast parenchyma may sometimes mimic vascular lesion on ultrasound. These appear as a round or oval well circumscribed cystic masses with homogenous mobile internal echoes and sometimes, fat fluid level within. Presence of intracystic mobile echogenic band changing position with patient's position is diagnostic for oil cyst. Contrary to venous malformation, these cysts are non-compressible and do not show vascularity on colour doppler examination. Fat necrosis may also present as hyperechogenicity in subcutaneous plane with small cysts within or complex solid cystic masses or solid appearing mass lesions. (9).

4. *Superficial thrombophlebitis* - Also known as Mondor's disease, superficial thrombophlebitis of the breast is characterized by thrombosis of superficial veins of breast and anterior chest wall secondary to either trauma or coagulopathy. Mammography shows dilated linear tubular densities in the breast which may be misinterpreted as dilated duct and warrant biopsy. Ultrasound reveals superficially located long, dilated, beaded, non-compressible, tubular hypoechoic structure showing intraluminal echoes representing thrombus and no internal vascularity on colour doppler. There may be associated edema in subcutaneous plane and surrounding breast parenchyma(10).
5. *Epidermal inclusion cyst*- Epidermal inclusion cysts arise from the infundibulum (uppermost portion) of the hair follicle and thus frequently located in skin and subcutaneous tissue. These appear as well circumscribed iso or high-density lesion on mammography. Calcification may also be seen. Ultrasound reveals a superficially located well circumscribed cystic to heterogeneously hypoechoic lesion depending on the composition of the lesion with no internal vascularity. A peculiar internal whorled or onion-ring appearance has also been reported owing to the lamellated keratinous material in the cyst. (11).
6. *Breast cyst*- Breast cysts appear as well circumscribed, round or oval equal to high density lesions on mammography. On ultrasound, simple cyst appears as a well-circumscribed anechoic lesion with thin echogenic wall, posterior acoustic enhancement, thin edge shadows and no internal vascularity on colour doppler. Complicated cysts show internal echoes or fluid-fluid level or dependent debris. No internal vascularity is demonstrated. (12).
7. *Intramammary lymph node*- Intramammary lymph nodes are most commonly (70%) located in upper outer quadrant of breast and appear as subcentimetric well-circumscribed, oval or reniform shaped isodense lesions with central or peripheral lucency representing fatty hilum. Ultrasonography reveals reniform shaped well-circumscribed hypoechoic solid lesion with fatty hyperechoic centre through which blood vessel may be seen entering the node on colour doppler. (13,14).

#### **Treatment and prognosis**

Meticulous search for a sonographic lesion corresponding to circumscribed iso-dense mass on mammography and reaching at correct diagnosis is of paramount importance to

avoid invasive investigation like stereotactic biopsy when no corresponding ultrasound lesion is found or ultrasound guided biopsy, if the sonographic correlate is found but shows no or mild patchy colour flow as may happen in slow-flow venous malformation.

Although venous malformation is a benign pathology and carries extremely low chance of progression to angiosarcoma, classifying them as BI-RADS 3 category (probably benign) ensures 6 monthly follow-up to gauge any interval change in size and morphology of the lesion. Another 6-monthly and there-after yearly follow up for 2-3 years is suggested, if the lesions remains stable. The fundamental aim of treatment is symptom mitigation and not necessarily removal the lesion. Based on the symptoms and size and extent of the lesion various treatment options are available including reassurance and observation, medical management and surgical excision. A multidisciplinary approach is followed in each case (2). The prognosis of the vascular malformation is favourable. Our patients were only mildly symptomatic, hence they were kept under short term follow-up of 6 months.

### CONCLUSION

Venous malformation is an uncommon pathology, rarely found in the breast and thus lacks extensive literature. It is of utmost importance to perform the ultrasound with light or minimal pressure in such cases to avoid diagnostic error and reduce patient's angst. It is crucial for radiologists to acquaint themselves with the imaging features of venous malformation and take this differential into consideration in cases of isodense masses on mammography. This is especially the case when fairly well-visualized lesion on mammography reveals no sonographic correlate which raises the possibility of an isoechoic lesion being missed and may even erroneously oblige stereotactic biopsy. Thus, the importance of reaching a correct diagnosis cannot be overemphasized.

### TEACHING POINT

Venous malformation is a rare benign vascular disorder in the breast and its mammographic appearance may mimic a malignant etiology. Ultrasound assists in typifying the lesion and should be performed with minimal pressure to avoid missing the diagnosis and to prevent further futile investigations and biopsy.

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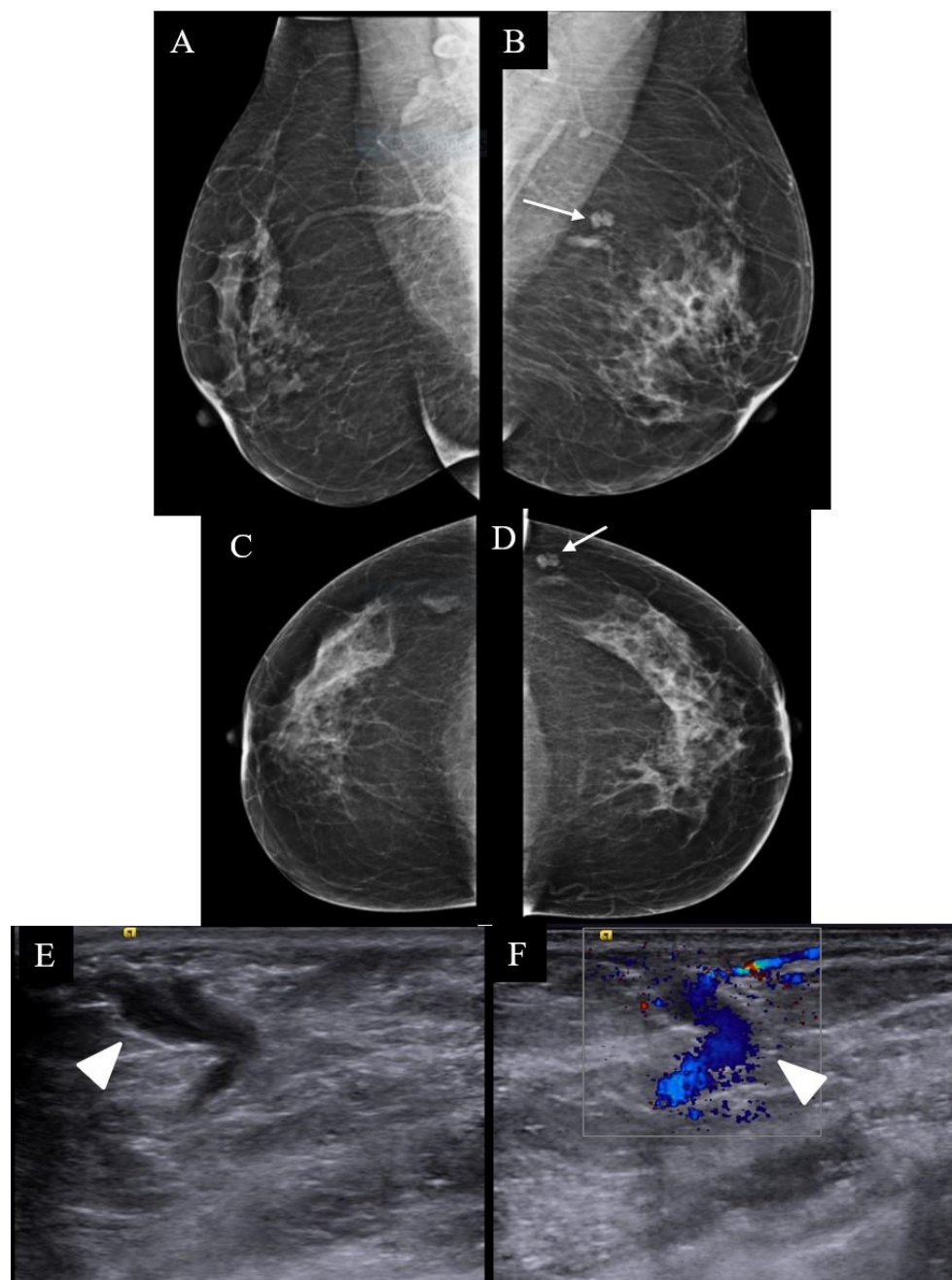
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## FIGURES



**Figure 1:** 45-year-old woman with venous malformation in left breast.

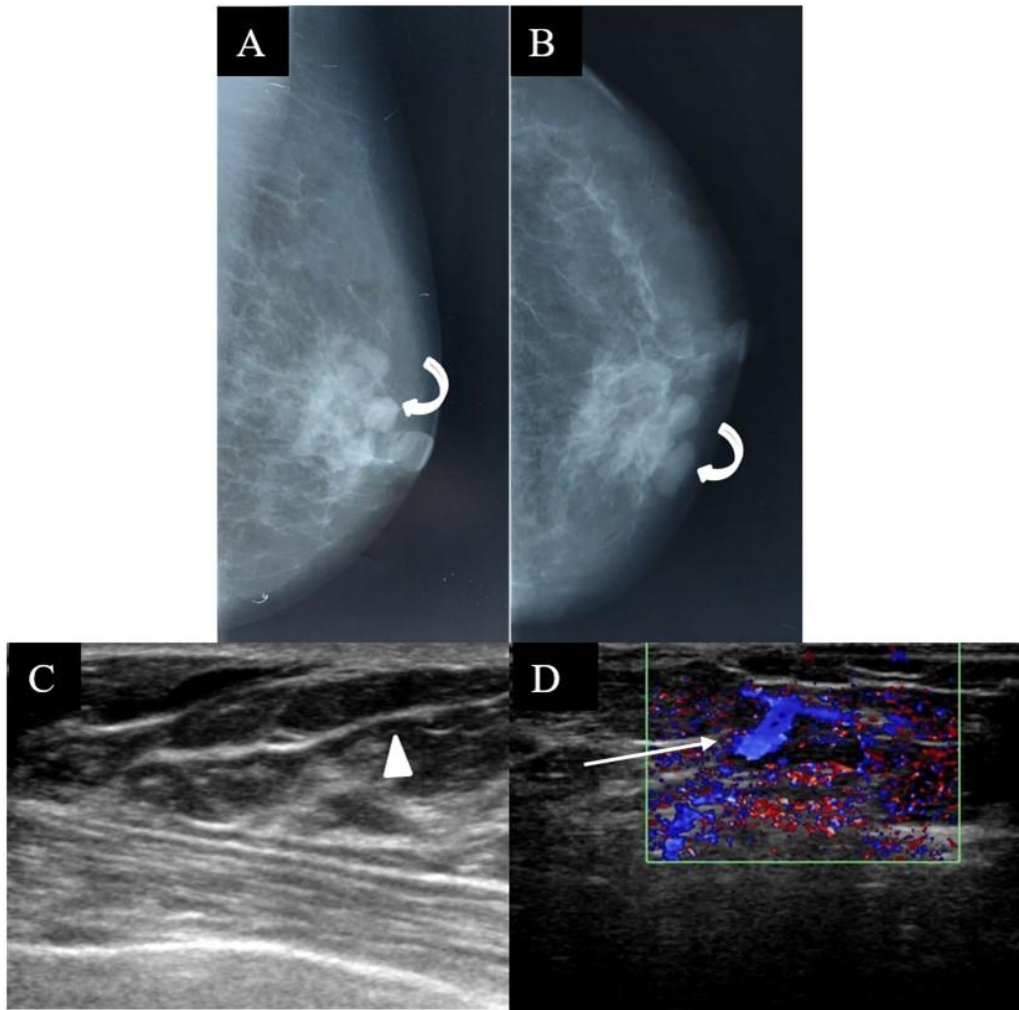
Fig 1 (A-D):

Technique- Digital mammogram (35kVp, 73mAs), Mediolateral oblique (A-B) and craniocaudal (C-D) views of bilateral breasts  
 Findings- An oval equal density circumscribed mass (arrow in B & D) is noted in upper outer quadrant of the left breast with no associated intralesional calcification or architectural distortion. Right breast shows normal fibroglandular parenchyma with no space occupying lesion.

Fig 1 (E-F):

Technique- Transverse grey scale ultrasound (E) and transverse ultrasound doppler (with low PRF setting) of left breast (F) using Linear Array transducer (4-9MHz)

Findings- A parallelly oriented anechoic circumscribed tubular channel (arrowhead) is seen with posterior acoustic enhancement and few internal echoes within showing colour uptake on doppler examination suggesting venous flow.



**Figure 2:** 42-year-old woman with venous malformation in left breast

Fig 2 (A-B):

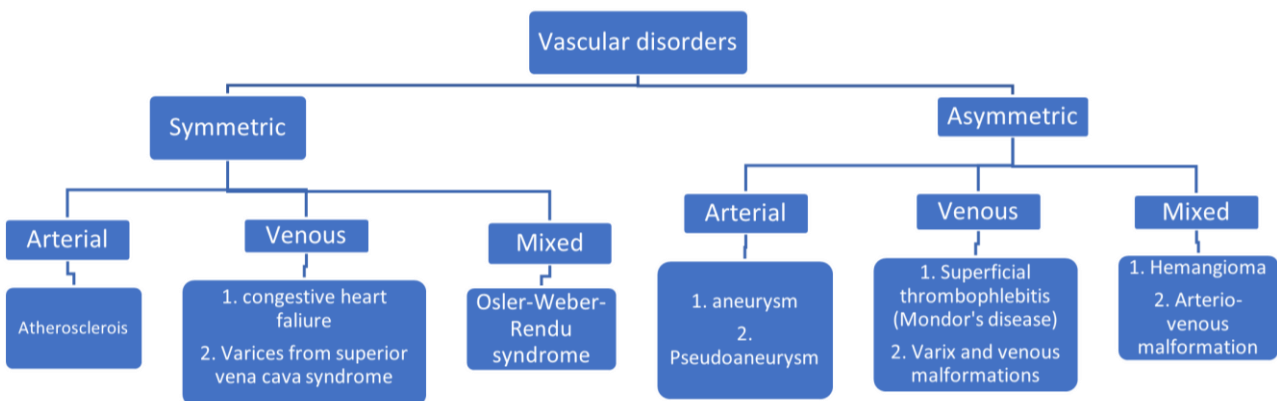
Technique- Conventional mammogram (100kVp, 30mAs), Mediolateral oblique (A) and craniocaudal (B) views of left breast

Findings- Two round and oval equal density masses (curved arrows) with circumscribed margins is seen in the upper inner quadrant and retroareolar region of left breast with no calcification or architectural distortion.

Fig 2 (C-D):

Technique- Transverse grey scale ultrasound image (C) and transverse ultrasound doppler (with low PRF setting) image of left breast (D) using Linear Array transducer (5-12MHz)

Findings-Few prominent anechoic linear tubular channels (arrow head) noted in the upper inner quadrant and retroareolar region which show mild posterior acoustic enhancement and internal echoes and demonstrate colour uptake on colour doppler examination (arrow in D)



**Figure 3:** Flowchart Classification of vascular disorders

<b>Etiology</b>	Non neoplastic developmental disorder of vasculature
<b>Incidence</b>	Found in 1.2% of mastectomy specimen
<b>Gender ratio</b>	NA
<b>Age predilection</b>	May occur in any age group
<b>Risk factors</b>	Hormone replacement therapy
<b>Treatment</b>	BI-RADS 3- 6 monthly follow-up; Multidisciplinary approach (observation, medical management, surgical excision depending upon symptoms, size and extent of lesion)
<b>Prognosis</b>	Usually favourable
<b>Imaging findings</b>	Well-defined round, globular or serpiginous soft tissue mass on mammography with or without phleboliths. Light pressure ultrasound- multiple dilated vascular channels with venous flow on colour doppler

	<b>Mammogram</b>	<b>Ultrasound</b>
<b>Venous malformation</b>	Well-defined round, globular or serpiginous low-equal density soft tissue mass with or without phleboliths	Multiple serpiginous venous channels or an irregular fluid filled anechoic or hypoechoic cystic lesion showing internal septations, mild to moderate colour uptake on colour doppler. Pressure may obscure the lesion.
<b>Breast carcinoma</b>	High density lobulated or spiculated mass lesion with or without suspicious calcifications	Hypoechoic solid mass lesion with angular or spiculated or microlobulated margins, shows posterior acoustic shadowing and significant internal vascularity
<b>Hematoma</b>	<i>Acute and subacute hematomas (&lt;1 month)</i> - subtle ill-defined area of focal increased density if small in size or a well circumscribed high density mass lesion with or without air-fluid level in larger hematomas <i>Chronic</i> - similar to fat necrosis	<i>Acute and subacute</i> - smaller lesions appear as focal hyperechogenicity in fat associated with small cystic lesions, larger lesions demonstrate well defined cystic lesions with septations, dependent echogenic debris or clot within and no internal vascularity on colour doppler. <i>Chronic</i> - similar to fat necrosis
<b>Fat necrosis</b>	Oil cyst- Well-defined low-density mass with or without smooth curvilinear wall calcification	oil cysts mimic vascular lesion on ultrasound, appear as a round or oval well circumscribed cystic masses with homogenous mobile internal echoes and sometimes, fat fluid level within, non-compressible and do not show vascularity on colour doppler; may also present as hyperechogenicity in subcutaneous plane with small cysts within or complex solid cystic masses or solid appearing mass lesions
<b>Superficial thrombophlebitis (Mondor's disease)</b>	dilated linear tubular densities in the breast which may be misinterpreted as dilated duct and warrant biopsy.	superficially located long, dilated, beaded, non-compressible, tubular hypoechoic structure showing intraluminal echoes representing thrombus and no internal vascularity on colour doppler; may be associated edema in subcutaneous plane and surrounding breast parenchyma
<b>Epidermal inclusion cyst</b>	Well circumscribed iso or high-density lesion with or without calcification.	Superficially located well circumscribed cystic to heterogeneously hypoechoic lesion depending on the composition of the lesion with no internal vascularity; internal whorled or onion-ring appearance reported
<b>Breast cyst</b>	Well circumscribed, round or oval equal-high density lesions. On ultrasound, demonstrated.	Simple cyst-well-circumscribed anechoic lesion with thin echogenic wall, posterior acoustic enhancement, thin edge shadows and no internal vascularity. Complicated cysts show internal echoes or fluid-fluid level or dependent debris.
<b>Intramammary lymph node</b>	Subcentimetric well-circumscribed, oval or reniform shaped isodense lesion with central or peripheral lucency representing fatty hilum.	Reniform shaped well-circumscribed hypoechoic solid lesion with fatty hyperechoic centre through which traversing blood vessel may be seen.

**Table 2:** Differential diagnosis table for breast venous malformations.

## ABBREVIATIONS

DCE-MRI = dynamic contrast enhanced magnetic resonance imaging  
HRT = hormone replacement therapy  
MRI = magnetic resonance imaging  
PRF = pulse repetition frequency  
STIR = short tau inversion recovery sequence  
WI = weighted image

## KEYWORDS

venous malformation; breast; mammography; light pressure ultrasonography; vascular disorders

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