**Introduction**

First described by Vuitch *et al.* in 1986, pseudoangiomatous stromal hyperplasia (PASH) is a benign mesenchymal breast lesion characterized by the proliferation of myofibroblasts that simulates a vascular lesion (1). It may present as a palpable mass or imaging abnormality, and must be distinguished from other benign and malignant diagnoses including angiosarcoma, phyllodes tumor, and fibroadenoma (2,3). While PASH is uncommon overall with fewer than 1,500 cases documented in the literature, it can also be found incidentally at biopsy for other breast lesions with a reported incidence of 23% (3,4) (*Table 1*). PASH presents most frequently in pre- and peri-menopausal women, though cases have been documented at ages ranging from 14 to 86, as well as in post-menopausal women taking hormone-replacement therapy and in men, usually associated with gynecomastia (9,11). It is thought that hormonal factors contribute to the development of...
Table 1 Summary of retrospective studies for patients with pseudosarcomatous stromal hyperplasia (PASH)

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample size</th>
<th>Age, mean/median, range</th>
<th>Patient population</th>
<th>Clinical presentation</th>
<th>Imaging findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacht et al., 1986 (1)</td>
<td>9</td>
<td>Mean 40; 22-52 years</td>
<td>9 (100%) women</td>
<td>Most often discrete,</td>
<td>Mammogram N/A</td>
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<tr>
<td>Powell et al., 1995, (6)</td>
<td>40</td>
<td>Mean 37; 14-67 years</td>
<td>9 (100%) women</td>
<td>painless, breast mass;</td>
<td>N/A</td>
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<tr>
<td>Harogaden et al., 2008, (8)</td>
<td>149</td>
<td>N/A</td>
<td>4 (10%) post-menopausal; 2 (5%) on HRT</td>
<td>firm, rubbery</td>
<td>Screening N=59:</td>
</tr>
<tr>
<td>Colliers et al., 2010, (7)</td>
<td>73</td>
<td>Mean 51.1; 24-82 years</td>
<td>2 (5%) on HRT</td>
<td>tender, palpable mass;</td>
<td>majority circumscribed mass or</td>
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<tr>
<td>Jones et al., 2010, (3)</td>
<td>57</td>
<td>Mean 48; 9-76 years</td>
<td>1 (2.5%) pre-menarchal</td>
<td>non-tender, palpable unilateral mass</td>
<td>other imaging results</td>
</tr>
<tr>
<td>Degnim et al., 2010, (8)</td>
<td>579</td>
<td>Mean/median N/A; 18-85* years</td>
<td>N/A</td>
<td>ill-defined areas of thickening</td>
<td>N/A</td>
</tr>
<tr>
<td>Greak et al., 2010, (2)</td>
<td>24</td>
<td>Mean/median N/A; 18-86</td>
<td>N/A</td>
<td>non-palpable mass</td>
<td>N/A</td>
</tr>
<tr>
<td>Bowman et al., 2012, (9)</td>
<td>579</td>
<td>Mean 18; 8-85* years</td>
<td>579 (100%) women</td>
<td>non-palpable mass</td>
<td>N/A</td>
</tr>
<tr>
<td>Yoon et al., 2020, (10)</td>
<td>61</td>
<td>Median 41; 14-61 years</td>
<td>579 (100%) women</td>
<td>N/A</td>
<td>N/A</td>
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| Table 1 (continued) |

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<thead>
<tr>
<th>Study</th>
<th>Vuitch et al., 1986 (1)</th>
<th>Powell et al., 1995, (5)</th>
<th>Hargaden et al., 2008, (6)</th>
<th>Celliers et al., 2010, (7)</th>
<th>Jones et al., 2010, (3)</th>
<th>Degnim et al., 2010, (8)</th>
<th>Gresik et al., 2010, (2)</th>
<th>Bowman et al., 2012, (9)</th>
<th>Yoon et al., 2020, (10)</th>
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<tbody>
<tr>
<td>Size (cm)</td>
<td>Mean/median N/A; 2-7 cm (gross examination)</td>
<td>Mean 6 cm; 1.2-12 cm (gross examination)</td>
<td>N/A</td>
<td>Mean 1.8 cm; 0.3-7.0 cm**</td>
<td>N/A</td>
<td>N/A</td>
<td>Mean/median N/A; 0.6-7 cm**</td>
<td>Median 2.3 cm; 0.6-14 cm (on US)</td>
<td>N/A</td>
</tr>
<tr>
<td>Management</td>
<td>· 8 (89%) excisional biopsy</td>
<td>· 38 (95%) excisional biopsy</td>
<td>· 16 (11%) observation</td>
<td>· 12 (17.4%) excision</td>
<td>· 38 (79%) excision</td>
<td>· 579 (100%) excisional biopsy</td>
<td>· 27 (34%) observation</td>
<td>· 14 (58%) surgical excision</td>
<td>· 20 (30.3%) observation</td>
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<td>· 1 (11%) excisional biopsy followed by bilateral mastectomies</td>
<td>· 1 (2.5%) incisional biopsy</td>
<td>· 133 (89%) excision</td>
<td>· 1 (1.4%) reduction mammoplasty (PASH incidental)</td>
<td>· 10 (21%) excision</td>
<td>· 45 (56%) excisional biopsy</td>
<td>· 10 (42%) core needle biopsy and observation</td>
<td>· 11 (16.7%) vacuum-assisted excision</td>
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<td></td>
<td>· 1 (2.5%) bilateral mastectomy</td>
<td>· 60 (61.2%) core needle biopsy, additional treatment N/A</td>
<td>· Data N/A for 9 patients</td>
<td>· 8 (10%) mastectomy</td>
<td>· 5 pts (20% of the total cohort) in the surgical excision group converted to surgery after an initial period of observation</td>
<td>· 29 (43.9%) excision</td>
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<td>Length of Follow-up</td>
<td>Range and mean/median N/A; maximum of 2.5 years</td>
<td>Mean 4.5 years; range 0.6–11 years</td>
<td>Mean/median, range N/A; minimum 4 years</td>
<td>Mean/median N/A; 1–8 years</td>
<td>Mean 4 years; range 0.5–11 years</td>
<td>Mean 19.8 years; range N/A</td>
<td>Median 3.71 years; range, 0.5–9.5 years</td>
<td>Mean/median N/A; range, 0.5–9.5 years</td>
<td>6.9 (1.1%) mastectomy</td>
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<td>· 7 (7%) no recurrence or other notable outcome</td>
<td>· 6 (15%) recurrences at 1 mon-1 year after dx</td>
<td>· 48 (100%) no subsequent cancer</td>
<td>· 73 (100%) no subsequent cancer</td>
<td>· 48 (100% with follow-up) no upgraded lesions or malignancies</td>
<td>· 34 (5.9%) with PASH developed subsequent breast cancers vs. 789 (9.5%) in those without PASH</td>
<td>· Note: PASH was found along with DCIS, LCIS, or invasive cancer in 20/80 (25%), though separate from the malignant lesion, i.e., PASH was incidental</td>
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<td>· 2 (22%) recurrences at 11 and 14 months, underwent repeat excision or mastectomy</td>
<td>· 2/6 (33%) multiple recurrences</td>
<td>· 3 (2%) recurrence; Treatment N/A</td>
<td>· 1 (1.4%) recurrence; treated with excision, 12 months later another recurrence at same site and excised, asymptomatic 6 months later</td>
<td>Observation group</td>
<td>Breast cancer risk lower in PASH patients vs. those with other benign lesions (SIR 1.0 vs. 1.5, P=0.001)</td>
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<td>8 (57%) stable</td>
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<td>· 1/6 (17%) extensive contralateral PASH treated with HRT then bilateral mastectomy</td>
<td>· 38/48 (79%)</td>
<td>Observation group</td>
<td>Observation group</td>
<td>· 7/27 (26%) progression within 32 months</td>
<td>· 2 (14%) progressed (1.9–2.9 cm in 4 years and 1.4–3.8 cm in 8 years)</td>
<td>· 11 (17%) progression overall at median 26 months: 3 (15%) in observation group, 3 (27%) in vacuum-assisted excision group, 5 (17%) in surgical excision group</td>
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Table 1 (continued)

<table>
<thead>
<tr>
<th>Study</th>
<th>Vuitch et al., 1986 (1)</th>
<th>Powell et al., 1995, (18)</th>
<th>Hargaden et al., 2008, (13)</th>
<th>Celliers et al., 2010, (10)</th>
<th>Jones et al., 2010, (3)</th>
<th>Degnim et al., 2010, (9)</th>
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<td>Excision group</td>
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<td>N=10/48 (21%)</td>
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<td>28 (74%) stable</td>
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<td>2/5 had DCIS on surgical pathology</td>
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<td>4 (10%) decreased/ resolved; 6 (16%) progression (further treatment type N/A)</td>
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<td>2 continued observation without further progression</td>
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<td>4 (10%) recurrence (10 excision patients had no follow-up available)</td>
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*, in total cohort of 9,087 pts; age range not specified in the PASH cohort; **, does not specify source of size data. HRT, hormone replacement therapy; DCIS, ductal carcinoma in situ; LCIS, lobular carcinoma in situ.

PASH based on the population affected and its resemblance to breast intralobular stroma during the luteal phase of menstruation (1,12).

**Etiology**

PASH is derived from myofibroblasts with variable expression of myoid and fibroblastic features; there may also be glandular hyperplasia. Myofibroblasts are often CD34 immunoreactive, and the presence of CD34 with vimentin, desmin, smooth muscle actin (SMA) support CD34 as a myofibroblastic differentiation marker (13). Myofibroblasts are normally activated by cytokines and growth factors related to inflammation and wound healing. The myofibroblasts in PASH have more secretory activity and contractile filaments, and it is suggested that stromal fibroblast activation results in collagen release and subsequent stromal hyperplasia (8).

Evidence supporting a potential hormonal etiology for PASH include its preponderance in premenopausal women, and those taking oral contraceptives and hormonal-replacement therapy (HRT) (2-4,7,10,14). One series of 149 patients with PASH reported smaller lesions were more often found in post-menopausal women via screening studies compared with the larger palpable masses that brought pre-menopausal women to clinical attention (6). In the same study, there were more post-menopausal women taking HRT in the palpable mass vs. screening group (19% vs. 8%), suggesting hormonal influence in creating PASH changes large enough to palpate (6). A case report of a 39-year-old woman with cyclical breast pain and progressive bilateral breast enlargement diagnosed with PASH noted improvement in her symptoms when treated with tamoxifen, further suggesting a hormonal relationship (15). PASH has also been diagnosed in men, nearly always in association with gynecomastia (2,16-18). In the largest series of male PASH cases reported by Badve et al., 43 of the 44 patients had gynecomastia, which is known to result from an increase in the ratio of estrogen to androgen activity (16). Further, several histopathology studies have demonstrated estrogen receptor (ER) and progesterone receptor (PR) positive stains within the spindle cells and spaces of the breast stroma, although PR positivity is more frequent (5,9,19).
Clinical presentation

PASH has a wide spectrum of potential presentations. While most common in pre-menopausal women, it can also affect men, post-menopausal women, and pre-menarchal girls. In men, it is associated with gynecomastia; one case was also reported in a transgender man receiving exogenous hormones (9). Documented ages for women range from 12–86 years (9,20) with mean/median in most series between age 30 and 50 years (1,2,4,5,7,10,14,21,22). Clinically, patients either present with a palpable breast mass, or PASH is discovered as an imaging finding. The lesion can grow slowly or rapidly and is often a painless, firm, mobile mass when palpable (11). In a series of 73 patients, the mean age of those who presented with a palpable mass was 45 years, while that of patients detected on imaging was 53 years (7). In the available literature, 38–60% of PASH cases came to clinical attention due to a palpable mass, with the remainder detected at screening (2,3,6,14).

Less common clinical presentations of PASH can mimic other benign and malignant breast diagnoses. One case report described a 17-year-old girl with a rapidly growing, diffusely tender and firm mass concerning for a phyllodes tumor or giant juvenile fibroadenoma (23), and another identified a 35-year-old woman with gradual breast enlargement accompanied by peau-de-orange skin changes worrisome for inflammatory breast cancer (4). While PASH is most often unilateral and focal, bilateral cases do occur (10,12,24) and PASH may present as diffuse breast enlargement or in a multinodular pattern (25). One case described a menarchal 12-year-old girl with a 4-month history of bilateral breast enlargement and significant reactive hyperemia of the overlying skin on physical exam (20). PASH was confirmed in both breasts and initially treated with subcutaneous right mastectomy and left breast reduction, though due to progressive disease, she completed bilateral mastectomy 8 months after the initial presentation.

Imaging

On mammography, PASH commonly presents as a dense, well-circumscribed, round-oval mass without calcifications (24) (Figure 1). It is less frequently detected as a focal asymmetry and is rarely spiculated, but may have indistinct margins (3,25,26) (clinical case #3). While atypical, two studies report PASH associated with calcifications (10,11). Interestingly, in a series of 55 PASH cases, 22% were mammographically occult (3).

Sonographic features of PASH are more variable (24). The most common presentation is a solid, well-circumscribed, homogenous, oval, hypoechoic mass (25) (Figure 2). Other findings include heterogeneous or echogenic areas with hypoechoic central portions, cystic...
components, and irregular borders (12,21,22) (clinical case #1). The majority of lesions lack posterior acoustic shadowing and demonstrate normal vascularity on color Doppler ultrasound (14,27).

MRI characteristics are non-specific and less well documented. PASH has been described as isointense to breast parenchyma on T1- and T2-weighted images with reticular and cystic areas appearing hyperintense (10,23,25,26). Mass enhancement demonstrates a type 1 curve, suggesting a benign etiology; non-mass enhancement is less common. PASH has been called an imaging mimicker as it can present similarly to fibroadenomas on MRI, mammography and ultrasound, though the slit-like foci on MRI corresponding to the spaces seen on pathology can differentiate PASH when seen (25).

PASH has been detected as an incidental finding on CT and infrequently evaluated with PET. As with MRI, PASH may appear similar to fibroadenomas on PET or present as focal areas of FDG uptake, but findings overall are not specific and suggest a benign process (3,25).

**Gross presentation and histopathology**

On gross presentation, PASH is often a smooth, solid, oval, rubbery mass that is non-encapsulated but well-circumscribed (5,24). Sectioning reveals a homogeneous tan or gray-white fibrous interior and lack of extensive hemorrhage and necrosis, though cysts up to 1 cm and nodules may be seen (13). The mean size on gross examination is 4–5 cm, with a range of 1.2–15 cm, though the largest documented case was 20 cm (5,13,23).

On microscopy, PASH was first described by Vuitch et al. as having intermixed stromal and epithelial components with the epithelial cells ranging from normal to hyperplastic. The name pseudoangiomatous was derived because it mimics vasoformative proliferation, which is characteristic of angiosarcoma. The most prominent feature of the stroma is a complex pattern of interanastomosing empty “slit-like” spaces lined with spindle-shaped myofibroblastic cells (Figure 3). The stroma also contains endothelial cells lining small blood vessels and dense collagen (13). Unlike angiosarcoma, PASH lacks erythrocytes, nuclear atypia, mitoses, and pleomorphism. PASH can be classified as simple or fascicular/proliferative; simple is described as above, while the fascicular/proliferative type is characterized

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**Figure 2** Corresponding left breast ultrasound for PASH lesion in a 48-year-old female demonstrates an oval parallel hypoechoic mass with slightly indistinct margins on anti-radial views. There was no internal flow and it was soft on elastography images. PASH, pseudoangiomatous stromal hyperplasia.

**Figure 3** (A,B) H&E 40× and 100×. Pseudoangiomatous stromal hyperplasia (PASH) from an ultrasound guided core needle biopsy specimen for a mass lesion. Histologic sections show a benign myofibroblastic proliferation within a densely collagenized stroma (arrow, A). There are complex interanastomosing spaces within the stroma that imitate the appearance of vessels hence the term “pseudoangiomatous.” These spaces are lined by spindle-shaped myofibroblasts that cause PASH (arrow, B). The ducts and lobules within this area of PASH are involved by usual ductal hyperplasia.
by an accumulation of myofibroblasts into distinct bundles in the background of conventional PASH (13,14). While the proliferative areas can obscure underlying PASH, the classic pattern is still present and this is a differentiating factor from myofibroblastoma (5). Of the 26 patients with PASH one series, 18 (69%) of biopsies were classified as simple and 8 (31%) were fascicular/proliferative (14). Histologic markers that identify PASH include CD34, vimentin, desmin, and SMA; calponin is variably reactive (13). Stains for ER and PR are also generally positive, though PR more consistently so. PASH lesions are negative for endothelial markers (CD 31 and factor VIII) and cytokeratin (28,29).

**Differential diagnosis**

PASH must be differentiated from low-grade angiosarcoma. As the treatment and prognosis of these two lesions is vastly different, histopathology must be carefully examined to ensure the proper diagnosis. Low-grade angiosarcoma is characterized by true vascular spaces, while PASH has pseudoangiomatous slit-like clefts; PASH lacks the erythrocytes, nuclear atypia, mitoses, pleomorphism, destruction of epithelial structures, and endothelial markers found in low-grade angiosarcoma (1). Furthermore, PASH usually is a round, discrete and rubbery mass without the hemorrhagic areas present in angiosarcomas.

Other lesions that are important to differentiate from PASH include fibroadenoma, mammary hamartoma, myofibroblastoma, and additional spindle-cell lesions such as desmoid tumors (also known as fibromatosis), phyllodes (also known as spindle cell sarcoma or cystosarcoma), and leiomyosarcoma (24,30). The clinical presentation of a palpable breast mass in a pre-menopausal woman and the non-specific imaging findings associated with PASH make it especially important to diagnose histologically, and thereby rule out other rare but more serious conditions.

Mammary hamartoma and PASH can present similarly at clinical evaluation and on gross examination as a well-circumscribed breast mass. At histologic comparison, mammary hamartoma may contain glandular breast tissue, fibrous connective tissue, or adipose tissue, while PASH has characteristic dense collagenous breast stroma punctuated by slit like spaces (19). Furthermore, the stroma of PASH stains positive for PR and often ER, while hormone receptor staining is absent in mammary hamartoma. PASH can be distinguished from phyllodes tumors due to absence of the pathognomonic “leaf like” papillary projections of phyllodes, and the lack of true stromal overgrowth, pleomorphism and mitoses seen in malignant phyllodes lesions (22). Myofibroblastoma, another uncommon benign breast lesion, is predominantly seen in older adult men and post-menopausal women, whereas PASH is most common in premenopausal women (26). Both stain positive for vimentin, CD34, and SMA, but PASH expresses PR, while myofibroblastoma expresses androgen receptors (24). Histologically, myofibroblastomas are composed of fascicles and whorls of myofibroblasts intermixed with bands of hyalinized collagen (31). While the fascicular/proliferative subtype of PASH can exhibit a similar pattern, the underlying stromal hyperplasia with slit-like spaces can still be detected to differentiate it from myofibroblastoma. Leiomyosarcoma, a rare breast sarcoma variant, may have areas of hyalinized stromal fibrosis and stain positive for vimentin, desmin, and SMA similar to PASH; characteristics of smooth muscle tumors, nuclear pleomorphism and mitoses separate it from PASH at microscopy evaluation (13).

**Diagnostic approach**

Since physical examination and imaging findings for PASH are non-specific and mimic other benign and malignant breast lesions, biopsy is necessary for definitive diagnosis. Core needle biopsy is preferred over fine needle aspiration (FNA) or excisional biopsy. PASH was indistinguishable from fibroadenoma on cytology in 70% of cases in one series (7) and others have suggested that PASH may be underdiagnosed due to lack of consensus on minimum volume of PASH necessary for diagnosis (8). Upon histologic diagnosis of PASH, clinical and imaging concordance must be determined. As noted in a series of 80 patients with PASH, 35% underwent core needle biopsy but were not properly diagnosed with PASH until surgical excision, highlighting the utility of excisional biopsy in discordant cases (2).

**Treatment and management**

Traditional management of PASH has consisted of surgical excision or even mastectomy in rare cases with very large symptomatic masses (20,32). Current evidence-based guidelines recommend that when core needle biopsy is concordant with imaging and clinical findings, the patient may undergo excision or clinical observation (30). Excision is recommended if there are suspicious imaging findings, interval growth of the mass, or accompanying symptoms. Other authors additionally suggest excision for larger lesions
(≥2 or 3 cm), and for women with a strong family history of breast cancer and/or an increased risk of developing breast cancer (9,10,25). Complete excision of the lesion should be performed, though there are no definitive guidelines for margin management. If observation is elected, clinical exam and radiologic follow-up should occur at 6-month intervals or based on clinical presentation (2). Since many women are younger than age 40 at diagnosis of PASH, ultrasound and/or MRI can be considered for imaging surveillance in place of mammography.

Though rarely used, anti-estrogen therapy is a potential alternative non-surgical intervention to consider for symptomatic PASH. In a case report utilizing this strategy, a 39-year-old woman with painful, enlarging and persistent PASH in both breasts noted symptom relief when treated with tamoxifen (15). In an earlier published series, one patient with PASH experienced recurrence of an incompletely excised mass and was managed temporarily with hormonal therapy, though the type was not specified (5). The side effect profile of tamoxifen, particularly in pre-menopausal women, likely limits its use to symptom management in patients for whom surgery is contraindicated, and may explain the sparse literature in this area.

**Clinical outcomes and risk profile**

PASH itself is a benign lesion not associated with an increased risk of breast cancer. While prognosis is generally excellent, progression, recurrence, and concurrent diagnosis of high risk and/or malignant disease have been described. Progression, defined as an increase in size after initial diagnosis, is a possible outcome when PASH is not excised. In a retrospective analysis of 66 PASH cases, progression occurred in 16.6% at median 26 months (range, 6–36 months) and was associated with additional lesions found on CNB, larger lesion size, and symptoms (10). Others have noted progression rates of 0–71% based on serial imaging and/or physical exam (14,21,27), including one study that noted increased lesion size warranting additional biopsy in 15.8% (6/38) of patients at mean follow up of 4 years (range, 6 months to 11 years) (3). The relatively slow growth rate suggests that observation with close clinical follow up is a reasonable strategy after a balanced discussion of surgical risk and benefit in appropriate patients.

Local recurrence has been reported in 15–22% of cases treated with surgical excision (5,21). In their seminal study of 9 patients with PASH, Vuitch et al. described two patients (22.2%) with local recurrences at 11 and 14 months following excision; one patient had two recurrences at the same site treated with repeat local excision (1). Powell et al found that of 38 patients with PASH undergoing surgical management, 6 (15.8%) experienced recurrence at intervals from one month to one year, of which 5 were ipsilateral and two were multiple (5). Four patients were treated with repeat excision, one did not have further therapy (not specified if this was by patient choice), and one developed bilateral PASH with multiple nodules and was managed temporarily with hormonal therapy before ultimately completing bilateral mastectomies. Accordingly, recurrence could be attributed to incomplete excision, the presence of multiple lesions that were not all excised, or de novo growth of PASH (33).

PASH is often accompanied by other benign and high risk lesions. These include fibroadenoma, fibrocystic change, hamartoma, apocrine metaplasia, intraductal papilloma, atypical hyperplasia, and LCIS, which are synchronously found in 14–65% of cases (7,10). PASH has infrequently been found concurrent with malignancy diagnosed on the same core needle biopsy, though always described as distinct and separate from the primary tumor focus. Until 2010, only one case of invasive ductal carcinoma was reported in association with PASH on core needle biopsy (14). In a later series of 80 patients diagnosed with PASH on core needle biopsy, 38 completed excisional biopsies, and 35% (13/38) were subsequently diagnosed with DCIS, LCIS, or infiltrating cancer on surgical pathology (2). The malignant lesions were found separate from the focus of PASH, and the authors note it was not possible to determine the reason for excision, i.e. discordance of imaging, clinical, and pathology findings which would prompt surgical management. In cases with synchronous diagnoses, the more pathologic (i.e., atypical or malignant) lesion determines the patient’s prognosis as PASH itself does not give rise to atypia or malignancy.

Further evidence that PASH is not associated with an increased risk of breast cancer is derived from a comparative study of 9,087 patients who underwent surgical excision of benign breast lesions including PASH (8). Of the 579 (6.4%) patients with PASH at histologic examination, the majority (88%) were under age 55 and most (71%) presented with a palpable mass. At mean follow-up of 18.5 years, subsequent breast cancer developed in 5.9% of patients in the PASH group vs. 8.8% in the non-PASH group. Women with histologic PASH had a lower risk of breast cancer (SIR 1.03, 95% CI, 0.71–1.44) than those without PASH (SIR 1.54, 95% CI, 1.43–1.65) (P=0.01). PASH was not associated...
with a family history of breast cancer and was not more commonly found with proliferative lesions, supporting the divergent pathogenesis of PASH and epithelial lesions that increase breast cancer risk. However, interestingly, 85% of subsequent breast cancers in the PASH group developed in the ipsilateral breast, suggesting a potential relationship between the hormonal environment of PASH and the epithelial-stromal interactions in breast carcinogenesis.

Summary and recommendation

PASH is a benign stromal lesion of the breast characterized by “pseudoangiomatous” capillary-like spaces. It is most common in premenopausal women and may present as a palpable mass or an incidental imaging finding. Core needle biopsy is indicated for diagnosis and must be concordant with imaging and clinical findings. PASH lesions should be surgically excised if enlarging, associated with symptoms, or suspicious imaging findings are present; otherwise, observation with clinical and imaging follow-up is appropriate. A discussion of risks and benefits, as well as patient preferences, should be used to facilitate shared decision making and optimal patient care (Table 2).

### PASH clinical scenarios

**Case 1**

A 27-year-old female gravida 5 para 2 presented to her OB/GYN with a self-palpated left breast mass and associated pain. Family history included a paternal grandmother with breast cancer at age 68; she had a personal history of systemic lupus erythematosus. Ultrasound examination demonstrated in the left breast at the 3:00 position, 3 cm from the nipple an oval parallel mixed echogenicity mass comprised of hypoechoic vascular tissue with anechoic cysts, minimally stiff on elastography, measuring 3.1×0.7×2.5 cm (Figure 4). She was referred to breast surgery and clinical exam showed a 3×2 cm firm mobile mass at the site of her palpable abnormality; no axillary adenopathy was noted. Ultrasound guided core needle biopsy yielded PASH, focal atypical ductal hyperplasia (ADH), apocrine metaplasia and cysts, intraductal papillomatosis, and a benign sclerosing lesion. Pathology was concordant with imaging and clinical exam. Excisional biopsy was recommended due to presence of ADH and clinical symptoms (pain, bothersome palpability). Surgical pathology yielded PASH, florid usual ductal...
hyperplasia, a complex sclerosing lesion with associated microcalcifications, and microcysts. She recovered well post-operatively and continues bi-annual surveillance in a high risk breast cancer program.

Case 2

A 48-year-old pre-menopausal female, gravida 1 para 1, presented with a self-palpated left breast mass. The patient had a strong family history of breast cancer, involving her mother at age 54, a paternal aunt at age 44, and a maternal aunt at unknown age. There was also a history of pancreatic and uterine cancers on the maternal side. Clinical exam demonstrated a 2 cm mass in the left breast lower outer quadrant without axillary lymphadenopathy. Diagnostic mammography showed an oval density in the area of palpable abnormality in the left breast without suspicious calcifications (Figure 1). On targeted ultrasound, at 5 o'clock 1 cm from the nipple, there was an oval parallel hypoechoic mass with slightly indistinct margins and without internal flow, soft on elastography images (Figure 2). Ultrasound examination of the left axilla demonstrated 3 unremarkable lymph nodes. Ultrasound-guided vacuum assisted core biopsy yielded PASH, columnar cell change, and usual ductal hyperplasia. The pathology results were concordant with the imaging and clinical exam findings. Surgical excision and clinical observation were discussed. Due to the small size and lack of associated symptoms, observation was elected. There was no interval change in size, imaging characteristics, or symptoms at one year of follow-up (Figure 5). The patient was referred to genetics for consultation regarding her family history of breast and other malignancies.

Case 3

A 44-year-old pre-menopausal female, gravida 2 para 1, presented with a screen-detected right breast mass. Her family history included breast cancer in a post-menopausal maternal great aunt. Right diagnostic mammogram demonstrated a well-circumscribed oval mass in the superolateral aspect at mid to posterior depth (Figure 6). Right breast ultrasound showed an oval well-circumscribed mass with mixed echogenicity in the 11:00 position 6 cm from the nipple, measuring 2.3×1.1×2.3 cm with minimal internal vascularity and soft elastography characteristics; categorized BI-RADS Category 4 (Figure 7). Clinical exam demonstrated a 3 cm firm, irregular mass in the upper outer quadrant of the right breast without skin or nipple changes. No axillary, infraclavicular, or supraclavicular lymphadenopathy was appreciated on physical exam or ultrasound. Ultrasound guided core needle biopsy yielded PASH and usual ductal hyperplasia. This was concordant with the imaging and clinical exam findings. The patient declined surgical consultation and presented 18 months later due to increased size of the mass. Repeat mammogram and ultrasound showed the size to measure 3.1×1.5×3.3 cm (Figures 8 and 9); clinical exam was significant for a 4 cm mass in the upper outer quadrant. Surgical excision was recommended and completed (Figure 10). Pathology
Figure 6 (A,B) Case 3: mammography images at initial presentation in a 44-year-old female; a well-circumscribed oval mass in the superolateral aspect of the right breast at mid to posterior depth is circled on CC and MLO views. CC, cranial-caudal; MLO, mediolateral oblique.

Figure 7 Case 3: ultrasound images at initial presentation for a 44-year-old female patient demonstrating an oval well-circumscribed mass with mixed echogenicity; anti-radial and radial views.
Figure 8 (A,B) Case 3: mammography images for a 44-year-old patient at 18 months after PASH diagnosis via core needle biopsy. Right breast CC and MLO views show an increase in the size of the circled mass with associated biopsy clip. CC, cranial-caudal; MLO, mediolateral oblique.

Figure 9 Case 3: Ultrasound image for a 44-year-old patient at 18 months after PASH diagnosis via core needle biopsy; radial view. PASH, pseudoangiomatous stromal hyperplasia.

demonstrated PASH, fibroadenomatous change, and sclerosing adenosis. Her postoperative course was uneventful and no recurrence has been noted at 2 years of follow up.

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Figure 10 Case 3: surgical specimen after excisional biopsy in a 44-year-old patient demonstrating mass, biopsy clip, and magnetic seed localizing marker. Pathology yielded PASH, fibroadenomatous change, and sclerosing adenosis.

Footnote

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