Breast assessment in children and adolescents: A pictorial essay

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Authors: F. T. Horigome, R. A. E. K. Matsumoto, P. C. Moraes, N. de Barros; São Paulo/BR
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Learning objectives

The purpose of our educational exhibit is to:

• know the important features of breast development and the differences between girls and boys
• describe the most common breast complaints in children and adolescents
• present frequency and epidemiology of the main breast lesions found in this age group
• organize a diagnostic flowchart and assessment of breast masses
Background

Pathologic breast conditions are rare in pediatric group. Breast lesions have a different spectrum if compared with those found in adults and are age-dependent. Most of the lesions found are benign with only rare cases of malignancy. It is important to investigate some factors that aid in diagnosis such as the length of time that the mass has been present, associated pain or other symptoms, whether the mass affects one breast or both, how rapidly the mass is growing, and, finally, any family history of breast disease.

The development of the breast presents two different phases of growth and differentiation. The first occurs during fetal development and results in the formation of a rudimentary organ composed of simple branched ducts capable of responding to secretory stimuli of maternal origin, whereas the second growth period occurs at puberty, when the ducts elongate, divide and form terminal duct lobular units.

Development breast lesions can be asymmetric or unilateral, and include:

- Premature thelarche characterized by breast development before age 7 to 8 years, if there are no associated findings of precocious puberty;
- Asymmetric development of breast buds, with up to a 2-year difference between breasts in the overall timing;
- Supernumerary nipple or breast tissue, generally found along the course of the mammary ridge, most commonly in the axilla. It is estimated to occur in 1-6% of the population and may be associated with renal anomalies;
- Congenital amastia, when there is absence of mammary glands, usually associated with Poland syndrome;
- Gynecomastia is the excessive development of the breast tissue in neonates or pubertal boys. Neonatal breast hypertrophy is a common transient condition seen in up to 90% of all newborns. Pubertal gynecomastia is generally seen in boys aged 10-13 years, with typical onset 6 months after the appearance of secondary sex characteristics. It is a benign process that should regress within 2 years of onset. Pathologic gynecomastia can be caused by drugs (e.g. anabolic steroids, digitalis, isoniazid, tricyclic antidepressants, marijuana), or occur in pathologic conditions such as testicular diseases, cirrhosis, hyperthyroidism, Klinefelter syndrome. This entity can be confused with pseudogynecomastia characterized by breast enlargement caused by fat deposition.

COMMON LESIONS IN THE PEDIATRIC GROUP

CYSTIC LESIONS
• *Ductal ectasia* develops in children in rare cases. Most of the time, the retroareolar ducts are involved and the patient has bloody nipple discharge. Surgical excision may be required in patients with persistent or recurrent drainage;

• *Breast cysts* are solitary or multiple, with thin unilocular and regular walls and most commonly located near the nipple and areola;

• *Galactoceles* is a cystic collection of breast milk, and is rare in children. Factors that may play a role in their development in the pediatric population include stimulation by prolactin, epithelial cell secretion forming a cyst after trauma, and ductal obstruction;

• *Mastitis and breast abscesses* may result from obstruction or ectasia of a mammary duct, cellulitis, an immunocompromised state, or nipple injury. The major agent is *Staphylococcus aureus*.

### NEoplastIC PROCESSES

• *Fibroadenoma* is a benign tumor and is the most common breast mass in girls under 20 years of age. The natural history of fibroadenoma is slow growth and eventual regression.

• *Juvenile Fibroadenoma* is an uncommon variant of fibroadenoma seen most often in the African-American population. A minority of these tumors shows rapid growth and can reach large size;

• *Phyllodes tumor* is a rare breast tumor, and is the most common primary breast malignancy in adolescents. 5% of phyllodes tumors may have evidence of malignancy. In children and adolescents, most phyllodes tumors exhibit a benign behavior. However, some lesions show a high rate of recurrence or can metastasize.

• *Metastatic or disseminated tumors* of the breast are more common than primary breast cancer. Typically are secondary to lymphoma, leukemia, rhabdomyosarcoma, and neuroblastoma;

• *Primary breast carcinoma* is extremely rare in children, comprising less than 1% of breast lesions. The tumor most frequently reported in the literature is secretory carcinoma, which is less aggressive than infiltrating ductal carcinoma, although it has malignant potential and can recur locally and metastasize to axillary nodes. Breast cancer in young patients may be related to previous radiotherapy and hereditary familial cancer syndromes, particularly BRCA1 and BRCA2 gene mutations.

• Primary breast sarcomas are a rare group of non epithelial tumors with aggressive behavior, originating from connective breast tissue. Represent less than 1% of all breast malignancies and less than 5% of all soft tissues sarcomas. Sarcomas occur predominantly in women, predominantly at the age of 45 to 50 years old. The main risk factors to develop breast sarcomas are previous radiotherapy due to thoracic neoplasms or Hodgkin lymphoma.
and genetic syndromes such as type 1 neurofibromatosis and Li-Fraumeni syndrome.

In pediatric patients, diagnostic interventions can damage the breast in development and cause subsequent disfigurement. Given this risk and the low prevalence of malignant disease in this population, the diagnosis of breast lesions should be followed with caution. The imaging findings are very useful for the selection of patients for other diagnostic procedures. Although malignancy is rare, lesions with suspected imaging findings or progressive growth should be cytologically or histologically examined.
Findings and procedure details

Mammography (MG) is contraindicated in children because of the extremely low risk of breast cancer, the increased risk of radiation-induced malignant changes in the young glandular breast, and poor image quality due to dense fibroglandular breasts.

Ultrasound (US) is the main imaging modality to study breast masses, aiding in the initial diagnosis differentiating benign and malignant lesions without the need of an interventional procedure, assisting in imaging-guided biopsy when indicated, and offering a safe method of follow-up.

Magnetic resonance imaging (MRI) of the breast is rarely used, though in select cases, it may be useful for surgical planning or assessing the extent of disease.

NORMAL FINDINGS

The normal progression of breast development has been classified into five Tanner stages that can be correlated with characteristic US appearances:

- Stage I is prepubertal, US shows ill-defined hyperechoic retroareolar tissue
- Stage II is clinically appreciated as a palpable subareolar bud before it can be seen as an elevation. US shows a hyperechoic retroareolar nodule with a central star-shaped or linear hypoechoic area that represents mostly simple branched ducts
- Stage III is obvious enlargement and elevation of the entire breast. US shows hyperechoic glandular tissue extending away from the retroareolar area, and a central spider-shaped hypoechoic region is noted.
- Stage IV is the phase of areolar mounding. US shows hyperechoic, mostly periareolar fibroglandular tissue with a prominent hypoechoic nodule in the central region. Subcutaneous adipose tissue is identified in some cases.
- Stage V describes the attainment of mature breast contour. US shows hyperechoic glandular tissue with increased subcutaneous adipose tissue anteriorly and without the hypoechoic central nodule.

GYNECOMASTIA

US shows increased subareolar tissue similar to the appearance of early breast development is seen, usually without a discrete mass.

PSEUDOGYNECOMASTIA
US displays adipose tissue accumulation in the breasts without hyperechoic glandular tissue.

**DUCTAL ECTASIA**

US presents anechoic tubular structures in the subareolar region, which may contain debris.

**SIMPLE CYSTS**

US exhibits oval, circumscribed, anechoic, with a thin wall, at retroareolar position and frequently bilateral mass.

**GALACTOCELES**

A fat-fluid level may be seen on a profile MG and is a specific finding. The appearance on US depends on the proportions of fat and water content of the fluid, and may result in a complex mass (solid-cystic). MRI images present rim enhancement and septations. A clinical evaluation may suggest the diagnosis, however in cases with a complex mass, aspiration is required for definitive diagnosis and also as therapeutic procedure.

**ABSCESS**

US reveals a hypoechoic complex mass, often with a thick wall and peripheral vascularization at color Doppler. US may be used to guide needle aspiration of the abscess and the material should be sent to bacterioscopy and culture.

**FIBROADENOMA AND JUVENILE FIBROADENOMA**

Usually appear at imaging studies as a well-defined, round or oval mass. At MG may present popcorn calcifications. US shows a hypoechoogenic mass, with variable posterior acoustic transmission. Fibroadenomas have a variable appearance at MRI. The literature advocate that pediatric patients with typical clinical and sonographic findings be managed conservatively with clinical and sonographic follow-up. Fine-needle aspiration or core needle biopsy is indicated for rapidly growing masses or if the lesion present suspicious features, because of imaging similarities with phyllodes tumor.

**PHYLLODES TUMOR**

Its radiological appearance is similar to fibroadenomas. At MG, this lesion has a nonspecific characteristics, such as large, dense mass without calcifications. The internal echotexture is usually heterogeneous, with anechoic cysts that are very suggestive of this
diagnosis, but not pathognomonic, as they can also be seen in juvenile fibroadenoma. Because the imaging findings overlap, tissue sampling of suspect lesions is necessary for definitive diagnosis.

**METASTATIC TUMORS**

MG demonstrates hyperdense, circumscribed or partially circumscribed masses, without calcifications. Usually, US exhibits lobulated margins and heterogeneous, hypoechoic echotexture with hyperechoic foci. Posterior acoustic shadowing or lack of acoustic enhancement is typically seen. Leukemia and lymphoma commonly appear as well- or ill-defined hypoechoic solid masses, and metastatic neuroblastoma has been described as multiple hypoechoic masses.

**BREAST CARCINOMA**

Typically appears as an irregular mass with spiculated margins, with heterogeneous echotexture and variable posterior acoustic shadowing, similar to lesions found in adults patients.

**SARCOMAS**

The most common mammographic finding is a single oval hyperdense mass with indistinct or circumscribed margins without calcifications. The presence of indistinct margins and the absence of calcifications are the most valuable mammographic features. Generally, US show an oval mass with indistinct margins, hypoechoic or complex echopattern, posterior acoustic enhancement, internal vascularization on Doppler and without calcifications. As in MG or US, it is common to find an oval mass with irregular margins, hypointense on T1 weighted imaging, hyperintense on T2 weighted imaging, heterogeneous initial rapid enhancement and washout or plateau curves in late kinetic analysis.
Fig. 1: 1 month-old girl with right retroareolar palpable mass. US of this region shows hypoechoic cystic-like tissue. At this age group, these findings can be associated with maternal hormones. No further procedures should be performed.

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**Fig. 2:** 7 month-old girl with bilateral retroareolar palpable mass. US of the retroareolar regions of (A) right and (B) left breasts show hypoechoic ill-defined tissue without mass formation. At this age group, these findings can be associated with maternal hormones.

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**Fig. 3:** 6 year-old girl with left palpable subareolar mass. US of left retroareolar region shows (A) a hyperechoic retroareolar mass with a central irregular hypoechoic area (B) without internal vascularization at color Doppler. Premature thelarche.

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Fig. 4: Bilateral mediolateral oblique mammograms of a female patient with 16 years showing a right normal breast and left breast hypoplasia.

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**Fig. 5:** 17 year-old female with palpable lump in the right axilla. Mediolateral oblique mammography shows breast tissue at right axillary tail. US shows hyperechoic ill defined area at right axilla, representing supernumerary breast tissue.

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**Fig. 6:** 9 year-old girl with right palpable subareolar mass. US of bilateral retroareolar region shows (A) a hyperechoic retroareolar mass with a central irregular hypoechoic area at right breast and (B) similar findings in the left breast. Thelarche.

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**Fig. 7:** 10 year-old girl with bilateral palpable subareolar lump. US of the retroareolar region shows hyperechoic fibroglandular tissue extending away from the subareolar area, and a central irregular, spider-shaped hypoechoic region (A) at right and (B) left breast. Thelarche.

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**Fig. 8:** 15 year-old boy with bilateral palpable subareolar masses. US of (A) right and (B) left retroareolar region of the breast shows a hypoechoic retroareolar mass with
a central irregular hypoechoic area. Mediolateral oblique mammography of (C) right and (D) left breasts shows bilateral retroareolar breast fibroglandular tissue, confirming gynecomastia.

Fig. 9: 1 month-old girl with tender, indurated, erythematous left breast. (A) US of right breast shows a hyperechoic retroareolar mass with central hypoechoic area, probably related to maternal hormones. (B), (C) and (D) US of left breast reveals an inflammatory process characterized by a complex (solid-cystic) mass with thick walls, with associated skin thickening and edema (asterisk).
**Fig. 10:** 15 year-old girl with right breast pain. Ultrasound shows an anechoic unilocular mass, with thin and regular walls and posterior acoustic enhancement. Simple cyst.
Fig. 11: Asymptomatic 14-year girl. On sonography, there is an oval, circumscribed, hypoechogenic mass, with posterior acoustic enhancement. Fibroadenoma.

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Fig. 12: A 17-year-old patient with palpable masses in both breasts. On sonography, there is a large hypoechoic, oval and circumscribed mass in the right breast, with internal vascularity at color Doppler. Other oval, circumscribed, hypoechogenic masses in the left breast. Fibroadenomas.

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Fig. 13: 11 year-old girl with right breast mass with progressive enlargement in 1 month. (A) US shows a hypoechoic, oval and circumscribed large mass with internal vascularization at color Doppler. (B) Panoramic view of the mass. Juvenile fibroadenoma

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Fig. 16: 14 year-old girl with left palpable lump. (A) US shows a hypoechoic, oval and circumscribed mass (B) with internal vascularization at color Doppler. Borderline Phyllodes tumor.

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Fig. 17: 17 year-old female, presented a palpable left breast lump in an external service and diagnosed as benign tumor through excisional biopsy (not available). 1 month later she returned to same service with a new, fast growing and palpable breast mass at the site of previous surgery. US was performed and a complex lesion was described (images not available) and interpreted as mastitis with fluid collection and a antibiotic therapy was initiated. As she was not presenting clinical improvement the patient came to our service with asymmetric breasts, very fast growing left mass, and skin ulceration (A) and (B). MRI subtraction enhanced T1-weighted with fat suppression axial image at (C) 1st, (D) 2nd, (E) 3rd, (F) 4th minutes after contrast injection, (G) region of interest (ROI), (H) kinetic analysis and (I) perfusion study show an irregular mass with necrotic areas and plateau kinetic curve. One week after admission, and before the histological diagnosis from percutaneous biopsy was available, (J) there was rupture of the breast by this extremely fast-growing lesion with continuous bleeding and a urgent surgery was necessary. (K) Reconstruction of right breast after excision surgery. Undifferentiated pleomorphic sarcoma of the breast.

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Fig. 18: 18 year-old patient related a history of mediastinal lymphoma treated with radiotherapy 8 years ago. Mediolateral oblique views of (A) right and (B) left breasts with mediolateral spot view show a hyperdense, irregular and spiculated mass, with associated pleomorphic calcifications. Invasive ductal carcinoma.

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Fig. 14: 10 year-old girl with left breast mass with progressive enlargement in 8 months. (A) US shows a hypoechoic, oval and circumscribed large mass with internal vascularization (B). (C) Panoramic view of the mass. Juvenile fibroadenoma. (D) Left axillary lymph node exhibits cortical thickening and hilar vascularization. FNA was performed with cytologic diagnosis of reactive lymphoid tissue.

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Fig. 15: Juvenile Fibroadenoma. 16 year-old female patient with breast enlargement in 6 months. (A) Posteroanterior and (B) profile chest radiography shows volumetric asymmetry of the breast, with the left breast larger than the right. (C-E) Intraoperator steps of the mass surgical excision.

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Conclusion

It is important to be familiar with the main features of the differential diagnosis of breast in this age group because an inappropriate invasive procedure can determine an irregular development of the mammary gland and esthetic asymmetries in the future. Diagnostic interventions should be reserved to lesions with important growth or suspicious imaging findings.
Personal information

email: fthorigome@gmail.com
References


