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Breast Imaging-Reporting and Data System (BI-RADS) classification in 51 excised palpable pediatric breast masses ☆,☆☆

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ABSTRACT

Introduction: The American College of Radiology Breast Imaging Reporting and Data System (BI-RADS) classification was developed to risk stratify breast lesions and guide surgical management based on imaging. Previous studies validating BI-RADS for US do not include pediatric patients. Most pediatric breast masses present as palpable lesions and frequently undergo ultrasound, which is often accompanied with a BI-RADS classification. Our study aimed to correlate BI-RADS with pathology findings to assess applicability of the classification system to pediatric patients.
Methods: We performed a retrospective review of all patients who underwent excision of a breast mass at a single center from July 2010 to November 2013. We identified all patients who underwent preoperative ultrasound with BI-RADS classification. Demographic data, imaging results, and surgical pathology were analyzed and correlated.
Results: A total of 119 palpable masses were excised from 105 pediatric patients during the study period. Of 119 masses, 81 had preoperative ultrasound, and BI-RADS categories were given to 51 masses. Of these 51, all patients were female and the average age was 15.9 years. BI-RADS 4 was given to 25 of 51 masses (49%), and 100% of these lesions had benign pathology, the most common being fibroadenoma.
Conclusions: Treatment algorithm based on BI-RADS classification may not be valid in pediatric patients. In this study, all patients with a BI-RADS 4 lesion had benign pathology. BI-RADS classification may overstate the risk of malignancy or need for biopsy in this population. Further validation of BI-RADS classification with large scale studies is needed in pediatric and adolescent patients.

Breast masses are uncommon in the pediatric population and when identified can cause considerable concern for the patient and their parents. The vast majority of breast masses in children are benign, with surgical specimens typically consisting of fibroadenomas, gynecomastia, and macromastia [1,2]. Current clinical recommendations for management include observation or excisional biopsy [3], and surgical excision may be requested by patients or parents because of the desire for definitive diagnosis [4–7]. The decision to observe a mass as opposed to excise it is often determined by its size, the presence of symptoms or growth of the mass. Adequate lesion characterization with physical examination is fundamental. Patients and their families often, however, want more information, especially if they choose observation. Diagnostic testing can further describe breast lesions and can assist in patient counseling and guide the treatment algorithm.

Ultrasound (US) is ideal for imaging the pediatric breast because of its lack of ionizing radiation, adequate tissue characterization, widespread availability, and ability to guide tissue sampling if needed [4,5,8]. Mammography is not advised in children because of the low incidence of malignancy [9], risk of radiation to the immature glandular tissues [10], and poor lesion conspicuity caused by the typically dense fibroglandular adolescent breasts [4]. The mammographic Breast Imaging Reporting and Data System (BI-RADS) lexicon developed by the American College of Radiology (ACR) has enabled more consistent assessment and management of nonpalpable lesions, categorizing lesions based on likelihood of malignancy (Table 1) [11]. In 2003, the BI-RADS lexicon was expanded to include breast ultrasound [12]. While BI-RADS-US classification has been used to determine malignancy risk and guide management and follow up in adult patients, further data investigating the use of BI-RADS-US criteria in the pediatric and adolescent breast are needed. Prior studies validating the predictive value of

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Table 1
Concordance between BI-RADS assessment categories and management recommendations.

BI-RADS US category	Management	Likelihood of cancer
0: Incomplete—need additional imaging evaluation	Recall for additional imaging	N/A[a]
1: Negative	Routine screening	Essentially 0% likelihood of malignancy
2: Benign	Routine screening	Essentially 0% likelihood of malignancy
3: Probably Benign	Short-interval (6-month) follow-up or continued surveillance	>0% but ≤2% likelihood of malignancy
4: Suspicious	Tissue diagnosis	>2% but <95% likelihood of malignancy
4A: Low suspicion for malignancy		>2% to ≤10% likelihood of malignancy
4B: Moderate suspicion for malignancy		>10% to ≤50% likelihood of malignancy
4C: High suspicion for malignancy		>50% to <95% likelihood of malignancy
5: Highly suggestive of malignancy	Tissue diagnosis	≥95% likelihood of malignancy
6: Known biopsy-proven malignancy	Surgical excision when clinically appropriate	N/A[a]

[a] N/A—not applicable.

breast ultrasound have included no pediatric patients [13–21] or predominantly adult populations [6,22,23]. The purpose of the current investigation is to correlate the use of BI-RADS-US classification in preoperative ultrasound with pathology on surgical excision biopsy in a pediatric population.

1. Materials and methods

Approval for our study was obtained from the institutional review board and the study was performed in compliance with the Health Insurance Portability and Accountability Act. A retrospective review was conducted of all surgically excised breast masses at a single tertiary care pediatric hospital between July 2010 and November 2013. Patients operated on for gynecomastia or breast abscess were excluded. Those patients who received preoperative breast ultrasound were identified and of those, patients whose ultrasound had a BI-RADS-US classification were selected. Ultrasounds were either ordered by the referring physician prior to surgical evaluation or ordered at the discretion of the pediatric surgeon. Clinical notes, laboratory data, and surgical pathology were abstracted from the single institution's electronic medical record. Specific BI-RADS lexicon terms were also identified and recorded. Surgical pathology reports were reviewed, and these results were correlated with the preoperative ultrasound reports and BI-RADS classifications. When available, core needle biopsy results were correlated with excisional biopsy pathology. Maximum single dimension of every mass was recorded from the surgical pathology reports. Patient databases including demographic and clinical data were recorded in Microsoft Excel (2007; Microsoft Inc., Redmond, WA).

All ultrasounds were performed and interpreted prospectively and preoperatively, and surgical pathology was retrospectively compared to the ultrasound reports. No images were reinterpreted during the course of the retrospective analysis. Ultrasounds were performed at multiple referral imaging centers and were interpreted independently in the community setting by one of 35 different radiologists. Excisions were all performed at a single children's hospital and were performed by one of 7 different board certified pediatric surgeons. Pathology was interpreted by a pediatric pathologist.

2. Results

A total of 119 breast masses were identified in 105 patients and chart review revealed that 81 masses were scanned with ultrasound preoperatively. Reasons cited for the surgeon ordering an ultrasound were: to assist with diagnosis ($n = 8$) and family request ($n = 2$) and to evaluate the size ($n = 2$). Of these 81 masses, reports were not available in the electronic medical record for 22 masses, resulting in 59 masses with ultrasound data recorded either in the clinical notes or as a formal report from the radiologist. BI-RADS classifications were available for 51 masses in 48 patients (Table 2). In the three patients assigned BI-RADS with multiple masses, one patient had one mass in each breast and two patients had two unilateral masses each. Average patient age was 15.9 years (range: 11–19 years). Only one patient was 19 years old, and the remaining were 18 years old or younger. All patients were postmenarche females.

All masses in this cohort were palpable at presentation. Symptom length ranged from 1 week to 156 weeks, with an average of 28.2 weeks. Twenty-six of 51 masses (51%) presented with pain, and no patients had a history of trauma or discharge from the nipple or breast. Twelve of 48 patients (25%) had a family history of breast cancer.

No patients were assigned BI-RADS 1, 5, or 6. Standard BI-RADS US lexicon terms were used in all of the ultrasound reports, even if BI-RADS categories were not assigned in the radiologists' reports. Of note, all masses were described with benign imaging features including hypoechoic or isoechoic echotexture, circumscribed margins, and parallel orientation. No masses had calcifications, and none were described as having angular or spiculated margins, demonstrating posterior shadowing, or having an echogenic halo. No masses that underwent ultrasound demonstrated changes in the surrounding normal breast tissue or overlying skin.

Surgical pathology results were available in all masses that were assigned BI-RADS categories with preoperative ultrasound, with conventional fibroadenoma being the most commonly seen pathology (Table 2, Fig. 1). Complete surgical pathology in all 119 masses in the current cohort is included in Table 3. Average maximum mass dimension was 3.49 cm (range: 0.8 cm–13.2 cm). Average clinical follow-up was 62.6 days (range: 9–511 days). Mean operative time was 38.9 minutes (range: 7 minutes–93 minutes).

Eight masses underwent needle biopsy prior to excisional biopsy, 7 revealing fibroadenomas which were consistent with the excisional biopsy final pathology results, and one with a differential of fibroadenoma versus phyllodes tumor which was a fibroadenoma on final surgical pathology. Six patients were followed initially without excisional biopsy, with follow-up ranging from 3 months to 2 years. Three of these patients returned for excisional biopsy because of growth of the masses, two with persistent pain, and one with no change with oral contraceptive treatment after 8 months.

3. Discussion

BI-RADS classification has become fundamental for clinicians to help interpret imaging findings in breast disease in adult patients. Indeed, clinical treatment algorithms are based on this grading system [24].

Table 2
BI-RADS US categories in 51 masses with surgical pathology.

BI-RADS US category	Number of masses ($n = 51$)
BI-RADS 0	2 fibroadenoma
BI-RADS 2	5 fibroadenoma, 1 myxoid fibroadenoma, 1 juvenile fibroadenoma
BI-RADS 3	15 fibroadenoma, 1 fibroadenoma with PASH[a], 1 PASH[a]
BI-RADS 4	21 fibroadenoma, 3 tubular adenoma, 1 fibrocystic change

[a] PASH—pseudoangiomatous stromal hyperplasia.