DIFFERNCES BETWEEN ULTRASONOGRAPHY AND OTHER RADIOLOGICAL INSTRUMENTS

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Summary:

Annotation. Recent guidelines recommend the prioritized use of ultrasonography as the main imaging method for women under the age of 45, with mammography being considered when additional imaging is deemed necessary.

Key words: ultrasonography, tomosynthesis, diagnosis, mammography

This study aims to evaluate the effectiveness of ultrasonography and the value of mammography in diagnosing breast cancer within this specific patient demographic. The assessment involves a comprehensive review of the roles these imaging techniques play in the diagnostic process for breast cancer within our healthcare unit

Methods and materials.

A retrospective analysis was conducted on all instances of breast cancer diagnoses in patients aged 39 years or younger, spanning from June 2022 to June 2024. The review encompassed a comprehensive examination of various factors, including the presentation, clinical findings, imaging techniques (ultrasonography, mammography, magnetic resonance imaging (MRI), and histological data. The study encompassed both invasive and intraductal carcinoma cases, excluding lobular carcinoma in situ from consideration

Results. During the study period, 3200 patients within this age group were referred to the symptomatic breast clinic. Among them, 50 women were diagnosed with either invasive cancer (n=38) or ductal carcinoma in situ (n=12). Mammography was conducted on 28 patients and was primarily graded as uncertain, suspicious, or malignant, with the majority falling into these categories. Unfortunately, malignancy was overlooked in one patient during mammography evaluation.

All 50 patients underwent ultrasonography, which provided reports categorized as uncertain, suspicious, or malignant, prompting a recommendation for diagnostic core biopsy. Importantly, ultrasonography alone did not miss any instances of cancer.

Conclusions. Within the scope of this study, ultrasonography emerged as a dependable primary imaging modality for women under 45 years old, successfully identifying all instances of cancer in this particular cohort. However, it is emphasized that mammography and/or MRI continue to be crucial supplementary tools. These additional imaging techniques play a vital role in accurately determining factors such as multifocality and the extent of the disease. The study underscores the

complementary nature of different imaging modalities in achieving a comprehensive and precise assessment of breast cancer in this specific demographic

Keywords: Primary imaging, Ultrasonography, Mammography, Women under 40 years

РАЗЛИЧИЯ МЕЖДУ УЛЬТРАЗВУКОВЫМ ИЗМЕРЕНИЕМ И ДРУГИМИ РЕНТГЕНОЛОГИЧЕСКИМИ ИНСТРУМЕНТАМИ

Аннотация. Согласно последним рекомендациям, основным методом визуализации для женщин до 45 лет следует считать ультразвуковое исследование, с маммографией в рассмотрении при необходимости дополнительного исследования.

Ключевые слова: ультрасонография, томосинтез, диагностика, маммография.

Цель данного исследования - оценить эффективность ультразвукового метода и ценность маммографии в диагностике рака молочной железы (РМЖ) в этой возрастной группе. Оценка включает всесторонний обзор роли этих методов в диагностическом процессе рака груди в нашем медицинском учреждении.

Методы и материалы. Проведен ретроспективный анализ всех случаев диагностирования РМЖ у пациенток в возрасте до 45 лет и младше в период с июня 2022 года по июнь 2024 года. Обзор включал всестороннее изучение различных факторов, включая представление, клинические данные, методы визуализации (ультразвук, маммография, магнитно-резонансная томография (МРТ) и гистологические данные. Исследование охватывало случаи как инвазивного, так и интрадуктального рака, исключая лобулярный рак in situ из рассмотрения.

Результаты. В течение исследуемого периода 3200 пациенток данной возрастной группы были направлены в симптоматическую клинику по борьбе с раком груди. Среди них 50 женщин получили диагноз инвазивного рака (n=38) или рака дуктальных карцином in situ (n=12). Маммография была проведена у 28 пациенток и в основном классифицирована как неопределенная, подозрительная или злокачественная, с большинством попадающих в эти категории. К сожалению, злокачественность была упущена у одной пациентки при оценке маммографии.

Все 30 пациенток прошли ультразвуковое исследование, результаты которого были классифицированы как неопределенные, подозрительные или злокачественные, что послужило основанием для рекомендации диагностической биопсии. Важно отметить, что ультразвук в отдельности не

упустил ни одного случая рака. Однако он не смог выявить множественные очаги заболевания у одной пациентки.

Заключение. В рамках данного исследования ультразвуковой метод проявил себя как надежный основной метод визуализации для женщин младше 45 лет, успешно выявляя все случаи рака в этой конкретной группе. Однако подчеркивается, что маммография и/или МРТ остаются ключевыми дополнительными инструментами. Эти дополнительные методы визуализации играют важную роль в точном определении факторов, таких как множественность очагов и степень распространения заболевания. **Ключевые слова:** первичная диагностика, рентгеновская маммография, ультразвуковая диагностика, молодые женщины.

Annotation. The guidelines from 2022 recommend adopting ultrasonography as the primary imaging method for patients below the age of 45 with clinically benign or uncertain breast lesions [4,11]. Mammography is suggested as an option if additional imaging is deemed necessary. There are specific situations outlined in the guidelines where mammography is supported, such as in cases of clinically suspicious lesions, patients aged 35–39 years with normal ultrasonography and a clinically indeterminate lesion, and when additional diagnostic information is needed for indeterminate (B3) lesions [1,5,7]. Ultrasonography demonstrates greater sensitivity and specificity than mammography in women under 35 years of age, making it the preferred imaging investigation in this patient group. Moreover, this superiority of ultrasonography over mammography has been confirmed in studies involving women up to the age of 40–45 years [2,3].

Advancements in technology, particularly the use of high-frequency ultrasonography probes, have significantly improved sensitivity, achieving rates of up to 100% when applied to patients below the age of 45 [6,8,9,12]. This technological progress has demonstrated that ultrasonography is capable of detecting occult malignancies, even in the dense breast tissue characteristic of younger women.

In contrast, mammography in this age group is associated with high recall rates, elevated rates of additional imaging, and relatively low rates of cancer detection [20]. The purpose of this study was to evaluate the effectiveness of ultrasonography and delineate the role of mammography in patients under 40 years of age. The focus was on reviewing the diagnostic accuracy of these imaging modalities within this specific age group in our healthcare unit [10,13,14].

Methods and materials. The Somerset Cancer Register at the hospital served as the data source for this retrospective study, providing details on eligible patients. Between June 1, 2022, and June 30, 2024, a total of 3200 patients under the age of 45 were referred to the breast department at the University Hospital of North Staffordshire. Within this group, 1,736 mammography and 1948 ultrasonography scans

were conducted. Diagnoses were confirmed by reviewing histopathology reports, and eligibility and demographic/presentation details were verified through medical record reviews. Cancer cases included various types of invasive carcinoma and ductal carcinoma in situ, with exclusion of lobular carcinoma in situ cases. Patients with indeterminate (B3) or suspicious of malignancy (B4) imaging features but subsequent benign pathology were excluded.

All imaging was part of the triple assessment process, with clinical breast examinations performed by a breast surgeon in the majority of cases before imaging. In 2022, the 'one-stop' symptomatic clinic transitioned to a radiology-led approach, where imaging reports were available to the clinician on the same day as the patient's consultation with the breast surgeon. Immediate ultrasonography-guided biopsy and needle core biopsy of abnormal axillary lymph nodes were conducted for patients with indeterminate or suspicious findings. Standard practice dictated mammography for all patients aged 35 and over, along with 'targeted' ultrasonography for areas of clinical concern. Patients under 35 underwent ultrasonography as the primary imaging modality. Mammography was performed in all patients, regardless of age, with ultrasonic or clinically suspicious or malignant findings. It was also conducted in patients with clinically indeterminate (B3) lesions if ultrasonography was normal.

From May 2011, following national guidelines, ultrasonography became the primary imaging modality for patients below the age of 45. Magnetic resonance imaging (MRI) was employed in cases of lobular cancer, multifocal disease, or discrepancies between imaging modalities or clinical findings.

During the study period, breast ultrasonography used an Aplio 500 (Toshiba, Crawley, UK) with a 7–15 MHz probe. Suspicious or malignant breast masses (B4 and B5) prompted whole breast and axillary ultrasonography, along with conventional mammography.

Imaging reports were provided by two consultant radiologists and two consultant radiographers specializing in breast disease, and all breast symptomatic imaging was single read/autonomously reported. Reports were summarized using the American College of Radiology's Breast Imaging Reporting and Data System (BI-RADS)/Royal College of Radiologists Breast Group classification. Sonography interpretations followed guidelines reported by Stavros et al., with representative images illustrating benign (B2), indeterminate (B3), suspicious (B4), and malignant (B5) lesions. Figures 1–4 provide examples of these lesions.

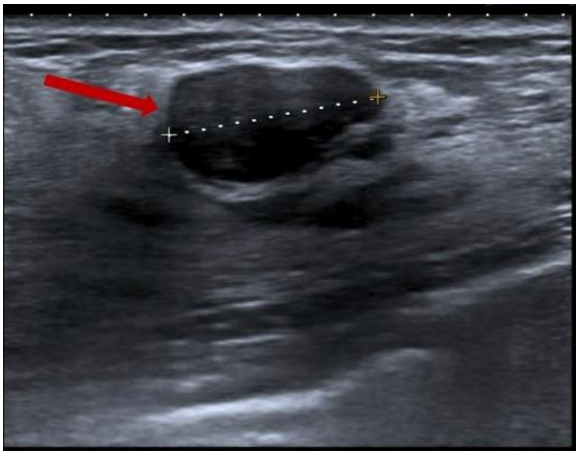

Figure 1. Local characterisation of a benign (B2) lesion. A well defined, solid, homogenous lesion (arrow) with posterior acoustic enhancement.

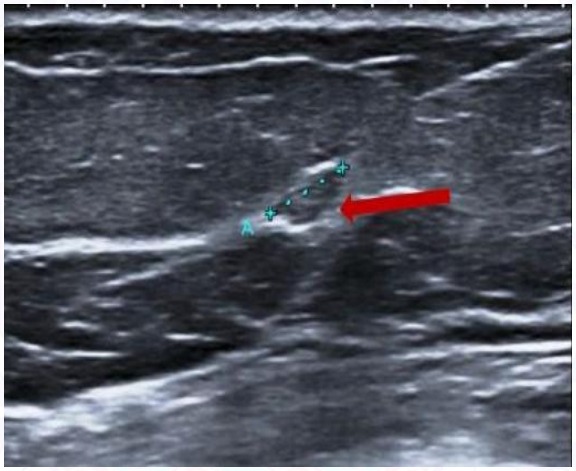

Figure 2. Local characterisation of an indeterminate (B3) lesion. A small solid lesion with indistinct borders (arrow).

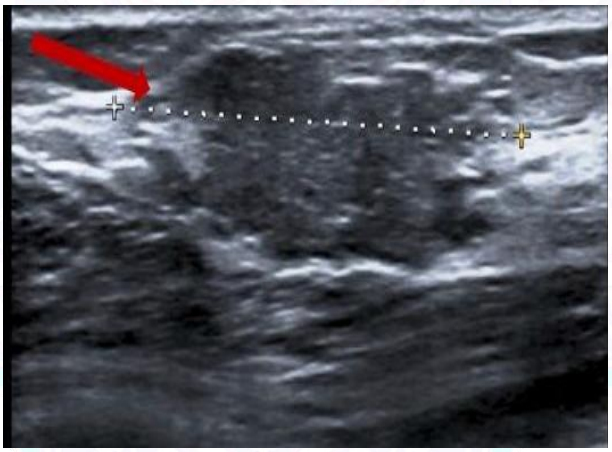

Figure 3. Local characterisation of a suspicious (B4) lesion. An irregular solid lesion infiltrating the breast parenchyma (arrow).

All biopsies in this study were conducted under ultrasonography guidance, utilizing a 14G tru-cut needle mounted on a Pro-Mag™ Ultra (Canada) automated gun with a standard 25mm throw. The procedure involved infiltration with 3–5ml of 1% lignocaine and was performed by a consultant radiologist or consultant radiographer

with specialized training in breast intervention. The operator's discretion determined the acquisition of one to three core samples during the procedure.

Results from all needle core biopsies underwent thorough review at the multidisciplinary team meeting. The pathological analysis of both core biopsies and excised lymph nodes adhered to the National Health Service Breast Screening Programme and the Royal College of Pathologists tissue pathways guidelines for non-operative diagnostic procedures and reporting. The diagnosis of multicentric disease was based on positive histology derived from core biopsies conducted in different quadrants of the breast. The postoperative surgical specimen was considered the 'gold standard' for determining tumor size, grade, type, and lymph node status. The study sought ethical approval from the ethics committee, and it was determined that, as there was no change in practice (mammography still being undertaken in addition to ultrasonography), formal ethics approval was not required.

Results. Between June 2022 and June 2024, a total of 3200 women under the age of 45 attended the symptomatic breast clinic. Out of these, 2,331 were referred for ultrasonography assessment, resulting in 3200 ultrasonography examinations. Additionally, 829 patients underwent mammography, generating 1736 mammograms. Among these patients, 328 (18,9%) were referred for diagnostic biopsy, leading to a total of 372 biopsies. Following histological analysis, 30 patients were identified with either invasive (n=38) or in situ (n=12) breast disease [table 2 and 3]. Consequently, the rate of malignancy was 9.1% in those patients undergoing diagnostic biopsy and 1.3% in those referred for imaging. The average age of these patients was 36 years, with a range from 27.5 to 39.8 years (Table 1). Among the 38 patients with invasive disease, a total of 35 tumors were identified, with the majority (91.4%) being ductal carcinomas of no special type. The median tumor size on histopathological assessment was 32.3 mm, ranging from 10 to 120 mm.

Table 1.

Symptoms of breast cancer

Symptoms	Number of patients	
	abs	%
Breast lump	25	83.3%
Nipple distortion	2	6.7%
Axillary lump	1	3.3%
Axillary pain and breast lump	1	3.3%
Advanced disease	1	3.3%

Table 2

Classification histological system of patients

Histology	abs	%
Invasive ductal carcinoma	20	66.7
Medullary carcinoma	7	23.3
cancer in situ	1	3.3
Invasive lobular carcinoma	2	6.7

Table 3

Classification grade system of patients

Grade	abs	%
Grade 3	16	53.4
Grade 2	11	36.6
Grade 1	3	10.0

Table 4

Classification BIRADS system of patients

Breast Imaging Reporting and Data System	Number of patients
BI-RADS 1	8 (28.6%)
BI-RADS 2	8 (28.6%)
BI-RADS 3	6 (21.4%)
BI-RADS 4	6 (21.4%)
BI-RADS 5	2 (6.6 %)

Among the 30 patients identified with malignant disease, the majority (n=25, 83.3%) presented with a breast lump. Two patients (6.7%) presented with nipple distortion, while one patient (3.3%) each presented with an axillary lump, axillary pain and breast lump, and advanced disease. Detailed patient demographics, presentation, and disease status are summarized in Table 1.

Ultrasonography successfully identified all patients with malignant disease. Within these 30 patients, ultrasonography detected 34 abnormalities on imaging: 5 (14.7%) graded as BI-RADS 3, 12 (35.3%) as BI-RADS 4, and 17 (50.0%) as BI-RADS 5. Of the five lesions classified as BI-RADS 3, two were confirmed as fibroadenomas upon definitive histopathology following core biopsy. It is noteworthy that both lesions occurred in patients who also had malignant lesions.

Twenty-eight out of the thirty patients with malignant breast disease also underwent mammography; one patient refused due to pain, and another presented with advanced fungating cancer. In total, 32 lesions were identified through mammography: 1 (3.1%) graded as BI-RADS 2, 9 (28.1%) as BI-RADS 3, 8 (25.0%) as BI-RADS 4, and 14 (43.8%) as BI-RADS 5. The patient graded as BI-RADS 2 was subsequently proven to have invasive breast cancer upon histopathological assessment following core biopsy, performed due to a BI-RADS 3 score on ultrasonography. Among the nine lesions graded as BI-RADS 3, one was confirmed as a fibroadenoma upon definitive histopathology following core biopsy.

In patients presenting with a breast lump, ultrasonography demonstrated greater reliability than mammography in identifying likely malignant disease. Of the 25 patients in this subgroup, 88% were graded as BI-RADS 4 or 5 on ultrasonography, while 66.7% (16 of 24, with one patient not undergoing mammography due to pain) received similar grading on mammography. The difference, although not statistically significant ($p=0.0955$, Fisher's exact test), suggests a trend favoring ultrasonography.

MRI was performed on 12 patients, primarily due to discrepancies in imaging findings, discrepancies between imaging and clinical findings, or the presence of multifocal disease. In the study population, MRI exhibited higher accuracy than both ultrasonography and mammography in detecting multifocal disease and accurately measuring tumor size. Notably, the study did not find a high false positive rate associated with MRI, contrary to some reports.

Discussion. This study underscores the high accuracy of ultrasonography in identifying suspicious lesions in women under 40 with symptomatic breast disease. Numerous studies have consistently shown that ultrasonography outperforms mammography in terms of both specificity and sensitivity in women up to the age of 40–45. Technological advancements, particularly the use of high-frequency probes, have significantly improved sensitivities, reaching up to 100% in this age group. This improvement has been especially crucial in detecting occult malignancy within the inherently dense breast tissue of younger women. The differentiation between cystic and solid masses has seen notable enhancements, enabling the reliable characterization of these solid masses as either benign or suggestive of malignancy.

In this study, the majority of symptomatic patients presented with a breast lump or nodularity, and 86.7% presented with a breast lump, aligning with findings in other reported series. Ultrasonography performed exceptionally well in this setting, with sensitivities and specificities surpassing those of mammography in younger women. Notably, in the age group with the most contention (36–40 years), ultrasonography exhibited a sensitivity of 84.6% and a specificity of 91.9%, compared to 69.2% sensitivity and 83.3% specificity for mammography. This superior performance of

ultrasonography is attributed to the predominantly dense breast tissue in younger women, favoring the use of ultrasonography.

The sensitivity of ultrasonography is not age-dependent, in contrast to mammography. While diagnostic mammography sensitivity was reported to be 85.7% in women younger than 40, it was slightly lower in those aged 35–39 at 82.5%. Specificity was lower in women presenting with a lump compared to those without, reflecting the challenges in interpretation, especially in denser breasts. The positive predictive value of mammography was reported at 14.6% for all women under 40, improving to 18.6% for the subgroup aged 35–39. Ultrasonography, as demonstrated in this study, was extremely reliable in identifying malignancy in this patient population.

However, despite the exceptional reliability of ultrasonography in identifying malignancy, it showed less reliability in identifying multifocal disease compared to MRI. Preoperative MRI, in particular, has demonstrated superiority over both ultrasonography and mammography in detecting additional suspicious findings, especially in the ipsilateral breast. This series affirms that the correlation between additional MRI findings and proven ipsilateral cancers was particularly strong in patients aged 39 years or younger, possibly owing to MRI's efficacy in imaging dense breast tissue.

Conclusions. The accurate diagnosis of breast cancer in younger women poses challenges due to factors such as inherently dense breast tissue, shorter tumor doubling times, and the absence of routine screening for baseline imaging. This small study suggests that ultrasonography serves as a sensitive and safe primary imaging modality in this specific population. However, the study emphasizes that mammography and/or MRI remain essential complementary tools, especially for identifying multifocal disease. The combined use of these imaging modalities contributes to a more comprehensive and accurate assessment in the diagnosis of breast cancer in younger women.

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