



## **IMAGING MODALITIES USED IN BREAST CANCER DIAGNOSIS**

**Panoev Abduaziz**

Asian International University, Department of Fundamental Sciences, teacher

**Annotation :** Breast cancer remains the most common malignancy among women worldwide, and early detection significantly improves treatment outcomes and survival. Imaging plays a critical role in screening, diagnosis, staging, treatment planning, and monitoring therapeutic response. This article reviews the major imaging modalities used in breast cancer evaluation, including mammography, digital breast tomosynthesis, ultrasound, magnetic resonance imaging (MRI), and nuclear medicine techniques such as PET-CT and scintimammography. The advantages, limitations, diagnostic accuracy, and current clinical indications of each method are discussed. Emerging technologies—contrast-enhanced mammography, AI-assisted image interpretation, and radiomics—are also highlighted as promising tools for improving diagnostic precision.

**Keywords :** breast cancer, mammography, ultrasound, MRI, PET-CT, tomosynthesis, contrast-enhanced mammography, screening, radiology, imaging

**Аннотация :** Рак молочной железы остаётся самым распространённым злокачественным новообразованием у женщин, а раннее выявление существенно повышает выживаемость и эффективность лечения. Визуализация играет ключевую роль в скрининге, диагностике, стадировании, планировании терапии и оценке её эффективности. В статье рассматриваются основные методы лучевой диагностики рака молочной железы: маммография, цифровая томосинтез грудной железы, ультразвуковое исследование, магнитно-резонансная томография, а также методы ядерной медицины, включая ПЭТ-КТ и сцинтимаммографию. Обсуждаются преимущества, ограничения, диагностическая точность и клинические показания каждого метода. Особое внимание уделено новым технологиям — контраст-усиленной маммографии, ИИ-поддержке интерпретации и радиомике.

**Ключевые слова:** рак молочной железы, маммография, ультразвуковое исследование, МРТ, ПЭТ-КТ, томосинтез, контраст-усиленная маммография, скрининг, радиология, визуализация

### **Introduction**

Breast cancer is the leading cause of cancer-related morbidity among women globally. Imaging serves as the cornerstone of early detection and diagnostic evaluation. Over the past decade, advancements in imaging technologies have significantly improved the sensitivity and specificity of breast cancer detection. Each modality contributes uniquely to the diagnostic pathway, and optimal selection depends on patient age, breast density, clinical presentation, and risk factors.



### **Mammography**

Mammography remains the gold standard for breast cancer screening. It allows visualization of microcalcifications, architectural distortion, and early stage lesions.

### **Digital Mammography**

Digital mammography provides superior contrast resolution and lower radiation dose compared with film-based systems. It is especially effective in detecting calcifications associated with ductal carcinoma in situ (DCIS). Limitations include reduced sensitivity in dense breasts.

### **Digital Breast Tomosynthesis**

DBT acquires multiple low-dose projections and reconstructs them into thin slices, reducing tissue overlap and improving cancer detection rates.

### **Ultrasound**

Ultrasound is widely used as an adjunct to mammography, especially in dense breasts. It can differentiate cystic from solid lesions and is used in biopsy guidance.

### **MRI**

MRI is the most sensitive modality for breast cancer detection. Dynamic contrast-enhanced MRI evaluates tumor vascularity and morphology and is essential in high-risk screening and treatment response assessment.

### **PET-CT**

PET-CT evaluates metabolic activity and is valuable for detecting metastasis, staging, and treatment response assessment.

### **Emerging Technologies**

Contrast-enhanced mammography, AI-assisted imaging, and radiomics are reshaping the future of breast imaging with higher accuracy and personalized diagnostics.

### **Conclusion**

Breast cancer diagnosis relies on a multimodal imaging approach. Combining mammography, ultrasound, MRI, and nuclear medicine techniques ensures optimal sensitivity and specificity. Emerging technologies further enhance early detection and patient management.

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