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" Comparison between contrast enhanced spectral mammography BIRADS and KASIER scoring systems in characterization of breast lesions"

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ABSTRACT:

Breast cancer remains a major global health challenge, affecting millions worldwide and standing as the leading cause of cancer-related deaths among women. Over the past 40 years, its incidence has steadily risen, with an annual increase of about 0.5%. Addressing this issue requires advanced diagnostic tools for accurate and timely detection.

One such innovation is contrast-enhanced spectral mammography, which produces four easily interpretable images with sensitivity comparable to magnetic resonance imaging (MRI). CESM is also more cost-effective and less time-consuming, making it a valuable alternative for assessing breast lesions.

This article evaluates findings from various studies comparing two scoring systems used in contrast enhanced spectral mammography: The Breast Imaging Reporting and Data System (BI-RADS) and the Kaiser Score. These systems aim to standardize lesion assessment and improve diagnostic accuracy. The review highlights the strengths and limitations of each approach, particularly in differentiating benign from malignant lesions.

In conclusion, the Kaiser Score demonstrates superior performance in evaluating suspicious borderline breast lesions, potentially reducing unnecessary biopsies. Its ability to provide precise risk stratification makes it a valuable tool in clinical practice, enhancing patient management and minimizing invasive procedures. This underscores the importance of integrating advanced scoring systems like the Kaiser Score into breast imaging protocol[4]s[4]for improved diagnostic outcomes.

Keywords: Contrast enhanced spectral mammography, BIRADS, Kaiser score.

NTRODUCTION:

Breast cancer is the most commonly diagnosed cancer and the leading cause of cancer-related deaths among women globally, with over 2.3 million new cases and 685,000 deaths annually as of 2020. Incidence rates vary significantly by region, with higher rates in developed countries due to factors such as lifestyle, reproductive patterns, and screening practices. Age-standardized incidence rates have risen steadily, particularly in low- and middle-income countries, due to urbanization and adoption of Western lifestyles. Risk factors include age, family history, genetic mutations (e.g., BRCA1/2), hormonal influences, and obesity. Early detection through screening programs remains critical to reducing mortality **(Sung et al., 2021)**.

Contrast enhanced spectral mammography (CESM):

Contrast-enhanced spectral mammography (CESM) is an advanced imaging technique that combines the anatomical detail of traditional mammography with the functional information provided by iodinated contrast agents. CESM involves the intravenous injection of a contrast medium, which highlights areas of increased vascularity, a hallmark of malignant lesions. The procedure captures both low-energy (LE) images, similar to standard mammograms, and high-energy (HE) images, which emphasize contrast uptake. These images are then processed to produce recombined (RC) images, enhancing the visibility of suspicious lesions. CESM has demonstrated sensitivity comparable to magnetic resonance imaging (MRI) in detecting breast cancer, particularly in dense breast tissue, while being more cost-effective and less time-consuming **(Zanardo et al., 2019)**.

Clinical applications and indications:

CESM is particularly valuable in evaluating suspicious lesions, staging newly diagnosed breast cancer, and assessing treatment response. It is also effective in screening high-risk patients and clarifying ambiguous findings from conventional mammography or ultrasound. Studies have shown that CESM improves diagnostic accuracy, reduces false positives, and aids in distinguishing benign from malignant lesions **(Sung et al., 2021)**.

Additionally, CESM is less prone to artifacts compared to MRI and does not require specialized facilities, making it more accessible. However, its limitations include the use of iodinated contrast, which carries risks of adverse reactions and nephrotoxicity, and higher radiation exposure compared to standard mammography **(Nicosia et al., 2023)**.

Technique:

Contrast-enhanced spectral mammography (CESM) is an advanced imaging technique that utilizes iodinated contrast agents to improve the detection and characterization of breast lesions. The procedure involves the intravenous injection of a contrast medium, followed by the acquisition of dual-energy mammographic images. Low-energy (LE) images, similar to standard mammograms, provide anatomical details, while high-energy (HE) images highlight areas of contrast uptake, reflecting increased vascularity associated with malignancies **(Figure.1)**. These images are processed using a weighted logarithmic subtraction algorithm to generate recombined (RC) images, which enhance the visibilit y of suspicious lesions **(Nicosia et al., 2023)**.

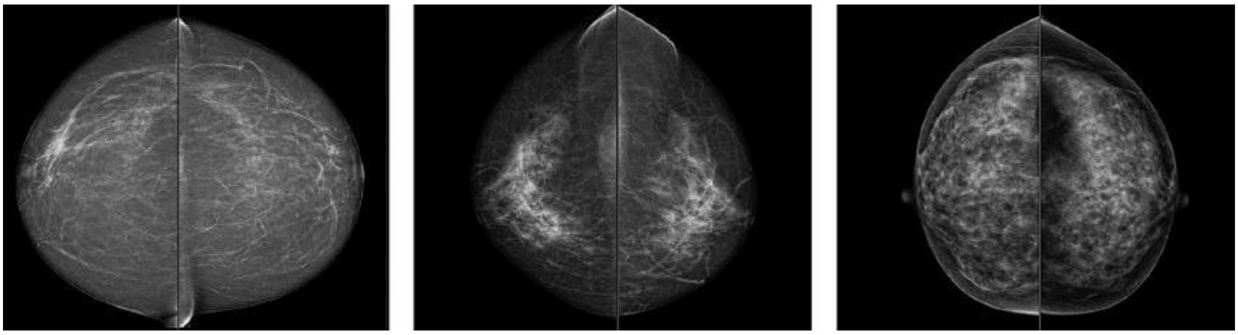

Figure 1: Standard views of CESM *(Wang et al., 2016*).

CESM BI-RADS:

The BI-RADS lexicon, developed by the American College of Radiology (ACR), standardizes breast imaging reporting. In CESM, BI-RADS categorizes lesions based on morphology and enhancement patterns to differentiate benign from malignant lesions. Categories include:

- **Category 0 (Incomplete)**: Requires additional imaging or prior comparisons.
- **Category 1 (Negative)**: No significant findings; routine screening recommended.
- **Category 2 (Benign)**: Clearly benign findings; routine screening advised.
- **Category 3 (Probably Benign)**: Lesions with ≤2% malignancy risk; short-term follow-up recommended.
- **Category 4 (Suspicious)**: Lesions with 2–95% malignancy risk; tissue diagnosis required.
- **Category 5 (Highly Suggestive of Malignancy)**: Lesions with ≥95% malignancy risk; biopsy recommended.
- **Category 6 (Known Malignancy)**: Confirmed malignancy; surgical or therapeutic intervention advised **(D'Orsi et al., 2013)**.

Kaiser score:

The Kaiser Score, originally developed for breast MRI, has been adapted for use in contrast-enhanced spectral mammography (CESM) to improve the diagnostic evaluation of breast lesions. This scoring system integrates key imaging features, such as lesion morphology, enhancement patterns, and kinetic curves, into a structured flowchart to quantify the likelihood of malignancy **(Klaric et al., 2023)**.

In CESM, the Kaiser Score assesses parameters like shape, margins, internal enhancement, and washout kinetics, assigning a cumulative score that correlates with malignancy risk. Studies have demonstrated its effectiveness in reducing unnecessary biopsies, particularly for BI-RADS 4 lesions, by providing a more objective and reproducible risk stratification. The adaptation of the Kaiser Score to CESM has shown diagnostic performance comparable to MRI, making it a valuable tool for enhancing clinical decision-making and patient management **(Rong et al., 2022)**.

The Kaiser Score evaluates breast lesions in CESM based on five key features: shape, margins, internal enhancement, kinetic curves, and associated findings (e.g., edema). **(Figure.2)** Each feature is scored, with cumulative scores determining risk categories: 1–4 (low risk, BI-RADS 3), 5–6 (intermediate risk, BI-RADS 4), and 8–10 (high risk, BI-RADS 5). Kinetic curve analysis, particularly washout (≥10% decrease in enhancement), is associated with malignancy, while persistent enhancement suggests benignity. The Kaiser Score improves diagnostic accuracy, reduces unnecessary biopsies, and enhances interreader agreement, especially for BI-RADS 4 lesions, streamlining patient management **(Neeter et al., 2021).**

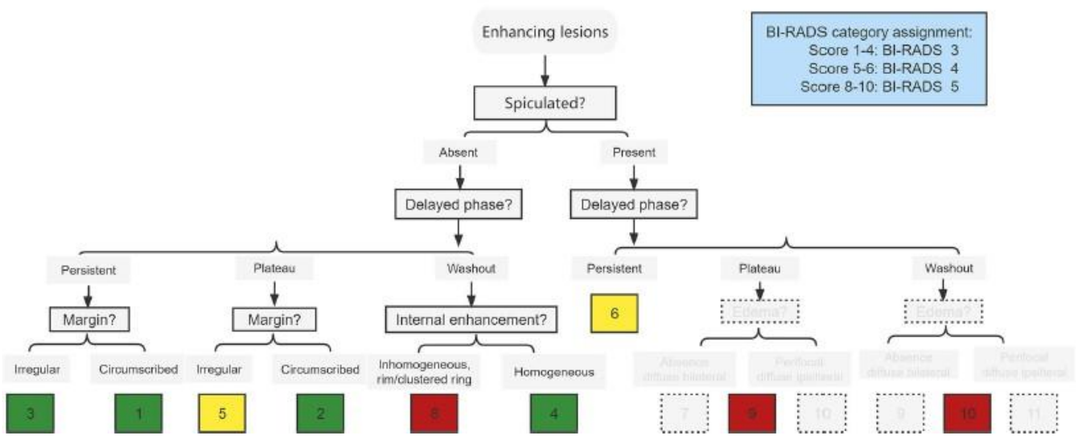

Figure 2: Kaiser Score flow chart for CESM *(Rong et al., 2022)* **.**

Diagnostic performance of Kaiser score and BI-RADS:

The Kaiser Score and BI-RADS differ significantly in their approach and outcomes. BI-RADS categorizes lesions based on morphological and enhancement features, providing a standardized framework for reporting. However, its reliance on subjective interpretation can lead to variability, particularly for BI-RADS 4 lesions, which have a wide malignancy risk range (2–95%). In contrast, the Kaiser Score uses a structured flowchart to quantify lesion characteristics, such as shape, margins, internal enhancement, and kinetic curves, assigning a cumulative score that correlates with malignancy risk **(Marino et al. 2016)**.

The Kaiser Score's primary strength lies in its ability to provide a precise, quantitative risk assessment, reducing unnecessary biopsies and improving diagnostic confidence. It is particularly effective for BI-RADS 4 lesions, where it helps stratify lesions into low, intermediate, and high-risk categories, minimizing overdiagnosis. In contrast, BI-RADS, while comprehensive and widely adopted, can be limited by its subjective nature, leading to inconsistencies in lesion classification. For example, a study by **Rong et al. (2024)** demonstrated that the Kaiser Score reduced the false-positive rate for BI-RADS 4A lesions by 30%, highlighting its clinical utility.

Conclusion and Recommendations:

The integration of the Kaiser Score into CESM workflows has significant potential to enhance patient management, particularly in cases of ambiguous or borderline lesions. The Kaiser Score can serve a complementary role for BI-RADS in evaluating breast lesions using contrast-enhanced spectral mammography (CESM). While BI-RADS provides a standardized framework for lesion categorization, its subjective nature can lead to variability, particularly for BI-RADS 4 lesions, resulting in unnecessary biopsies.

Combining the strengths and universal acceptance of BI-RADS with Kaiser Score can optimize breast imaging protocols, particularly for challenging cases. Future research should focus on validating the Kaiser Score in larger, multi centric studies and exploring its integration with artificial intelligence (AI) to further enhance diagnostic performance. Together, these systems represent a significant advancement in personalized breast cancer diagnostics, reducing unnecessary interventions and improving patient outcomes.

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