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CAR Practice Guidelines on Breast Imaging and Interventions: Breast Magnetic Resonance Imaging

Carolyn Flegg[1], Priscila Sacilotto Crivellaro[2], Rachel Fleming[3], Wade Koberstein[4,5], Anat Kornecki[6], Anisa Mnyusiwalla[7], Saly Zahra[8,9], and Samantha Fienberg[10]

Abstract

This guideline presents Part IV of the Canadian Association of Radiologists (CAR) Practice Guidelines on Breast Imaging and Intervention and addresses breast magnetic resonance imaging (MRI). As the most sensitive imaging modality for breast cancer detection, MRI plays an established and expanding role in screening, staging, problem-solving, and treatment monitoring. This guideline provides updated recommendations on indications, technical requirements, contrast administration, reporting standards, quality assurance, patient safety, and facility readiness for MRI-guided intervention. Emphasis is placed on bilateral imaging protocols, multimodality correlation, and integration within multidisciplinary breast care. This guideline is intended to be used alongside the other components of the CAR Breast Practice Guidelines series, which collectively replace the 2016 consolidated guidelines and reflecting current evidence and clinical practice in Canada. While defining best practices and minimum expectations, this guideline supports flexibility in application based on patient factors, available resources, and evolving knowledge, with clinical judgment remaining the responsibility of the supervising radiologist.

Résumé

La présente ligne directrice présente la partie IV des Lignes directrices de pratique en matière d'imagerie et des interventions mammaires de la CAR, et porte sur l'imagerie mammaire par résonance magnétique (IRM). En tant que modalité d'imagerie la plus sensible pour la détection du cancer du sein, l'IRM joue un rôle établi et croissant dans le dépistage, la stadification, la résolution de problèmes et la surveillance du traitement. Cette ligne directrice fournit des recommandations mises à jour sur les indications, les exigences techniques, l'administration du produit de contraste, les normes de rapports structurés, l'assurance de la qualité, la sécurité des patientes et la préparation des établissements pour les interventions guidées par IRM. L'accent est mis sur les protocoles d'imagerie bilatérale, la corrélation multimodale et l'intégration au sein des soins mammaires multidisciplinaires. Cette ligne directrice est destinée à être utilisée conjointement avec les autres composantes de la série de Lignes directrices d'imagerie mammaire de la CAR, qui reflètent les données probantes actuelles et la pratique clinique au Canada. Tout en définissant les meilleures pratiques et les attentes minimales, cette ligne directrice favorise la souplesse dans l'application en fonction des facteurs propres aux patientes, des ressources disponibles et de l'évolution des connaissances, le jugement clinique demeurant la responsabilité du radiologiste superviseur.

Keywords

practice guideline, magnetic resonance imaging, breast neoplasms, image-guided biopsy, contrast media, early detection of cancer

Preamble

The practice guidelines of the Canadian Association of Radiologists (CAR) are not rules, but are guidelines that attempt to define principles of practice that should generally produce radiological care. The radiologist and medical physicist may modify an existing practice guideline as determined by the individual patient and available resources. Adherence to CAR practice guidelines may not ensure a successful outcome in every situation. The practice guidelines should not be deemed inclusive of all proper methods of care or exclusive of other methods of care reasonably directed to obtaining the same results. The practice guidelines are not intended to establish a legal standard of care or conduct, and deviation from a practice guideline does not, in and of itself, indicate or

imply that such medical practice is below an acceptable level of care. The ultimate judgment regarding the propriety of any specific procedure or course of conduct must be made by the physician and medical physicist in light of all circumstances presented by the individual situation.

Introduction

The **CAR Practice Guidelines on Breast Imaging and Intervention** have been published as a comprehensive five-part series in the *Canadian Association of Radiologists Journal (CARJ)* to provide targeted, modality-specific guidance. While this section focuses on **Breast MRI**, it is intended to be used in conjunction with the other 4 components of the update:

- **Part I: Mammography and Digital Breast Tomosynthesis**[1]
- **Part II: Contrast-Enhanced Mammography (CEM)**[2]
- **Part III: Breast Ultrasound**[3]
- **Part IV: Breast Magnetic Resonance Imaging (MRI)**
- **Part V: Breast Intervention and Biopsy Procedures**[4]

Together, these documents replace the previous 2016 consolidated guidelines to reflect the current evidence base and clinical landscape in Canadian breast imaging, and complement the recently published Breast Disease Imaging Referral Guidelines, which provide guidance on the most appropriate breast imaging test for a given indication or patient population.[5]

These guidelines aim to provide radiologists, technologists, and other allied staff with a consensus-based approach to performing and interpreting breast imaging. These recommendations align with those published by the Canadian and American Cancer Societies, the National Comprehensive Cancer Network, and the American College of Radiology. While the guidelines serve as an educational tool and outline best practices and minimum requirements, the Working Group acknowledges that alternative actions may be appropriate depending on available resources, patient factors, technological advances, and evolving medical knowledge.

Ultimately, the supervising radiologist is responsible for determining the most appropriate examination or intervention for each patient.

Overview: Breast Magnetic Resonance Imaging (MRI)

Breast MRI is the most sensitive clinical imaging tool available for detecting breast cancer, whether used for problem-solving, screening, or staging patients.[6] These guidelines outline the current applications of breast MRI as well as the fundamental requirements for its use in clinical practice.

Appropriate indications for breast MRI can be reviewed in the Canadian Association of Radiologists Breast Disease Imaging Referral Guideline.[1]

Technique

With few exceptions, patients should undergo standard mammography prior to breast MRI, and the mammography study and report should be available for review at the time of interpretation of the MRI. The prior mammograms should have been performed 6 months or less before the MRI examination.

In the diagnostic setting, MRI should be performed in a timely fashion according to the indication.[1] Radiologists should work with their technologists and equipment vendors to ensure that their protocols are as efficient as possible.

Basic Requirements

- **Minimum field strength:** 1.5 T
- **Dedicated breast coil:** Various options are available on the market. If the system does not have the ability to biopsy, a compatible biopsy unit should be onsite.
- **Temporal resolution:** 2 minute maximum, but ideally 90 seconds with center of k-space filling at 80 to 110 seconds for wash-in. Aim for 1 to 3 minutes; ideally 60 to 90 seconds per acquisition.
- **Dynamic imaging:** First post contrast should have center of k-space filled at optimal wash-in time 80 to 110 seconds and washout scanned ending no later than 10 minutes post contrast injection. Take an additional

[1]University of Saskatchewan, Saskatoon, SK, Canada
[2]Western University, London, ON, Canada
[3]University of Toronto, Guelph, ON, Canada
[4]Radiology & Diagnostic Imaging Department, University of Alberta, Edmonton, AB, Canada
[5]MIC Medical Imaging, Edmonton, AB, Canada
[6]St. Joseph's Health Care London, Western University, ON, Canada
[7]Waterloo Regional Health Network, ON, Canada
[8]The Moncton Hospital, NB, Canada
[9]Department of Diagnostic Radiology, Dalhousie University, Halifax, NS, Canada
[10]Ontario Health/Ontario Breast Screening Program (OH/OBSP), Lakeridge Health, Oshawa, ON, Canada

Corresponding Author:
Carolyn Flegg, University of Saskatchewan, 103 Hospital Drive, Room 1566, Saskatoon, SK S7N 5A2, Canada.
Email: cflegg3@gmail.com

image for kinetics plotting taken right after wash-in. It is essential to obtain an image approximately 60 to 90 seconds after contrast material administration, as most breast cancers will show peak enhancement at that time.[6]

- **Spatial resolution:** Use the largest imaging matrix possible; the image matrix should be 448×448 or higher. In-plane pixel size should be 0.5×0.5 to 1.0×1.0 mm, and through-plane pixel size should be 1 to 3 mm. For optimal imaging, ensure isovolumetric imaging and voxel size of 1 mm or less.
- **Specific imaging parameters:** Including repetition time and echo time etc., and types of T2 and T1-weighted pulse sequences (eg, short tau invasion recovery, conventional spin echo, gradient echo, etc.) should be determined at the facility or programmatic level.
- **Bilateral imaging protocols:** Required for all individuals undergoing screening (especially those at increased risk) and for staging known breast cancer. This enables contralateral assessment and comparison to reduce diagnostic errors; unilateral imaging is rarely indicated.
- **Fat suppression:** If fat suppression is used, measures should be taken to achieve homogeneous fat saturation across the entire field of view.
- **Subtraction imaging:** Good subtraction is essential to improve the contrast between enhancing and non-enhancing regions.
- **Kinetic data acquisition:** Software may be used to automate assessment of kinetic curves. Careful attention should be paid to the fact that patient motion has not corrupted the curve.
- **GRE T2 imaging:** Use with or without fat saturation to evaluate fluid, cysts, and edema in the breasts. STIR can be used as an alternative sequence.
- **Gadolinium contrast:** Must be administered as a bolus with a standard dose of 0.1 mmol/kg followed by a saline flush of at least 10 mL.

Additional Sequences

- GRE T1 without fat saturation-for evaluation of fat, lymph nodes, and architecture of the breast and to see clip placed after previous image guided biopsy.
- Silicone Saturation and STIR with water saturation sequences can be used to determine the integrity of breast implants.

Documentation

Image labeling should include a permanent identification label that contains:

- The facility name and location
- Examination date
- Patient's first and last name
- Identification number and/or date of birth

The radiologist's report of the MRI findings should be placed in the patient's medical record. Retention of the breast MRI images should be consistent with the policies for retention of mammograms, in compliance with federal and provincial regulations, local health care facility procedures, and clinical need. Images of all important findings should be recorded in a retrievable and reviewable image storage format. Images should also include the skin and the chest wall.

The report should include:

- All pertinent observations, including assessment of parenchyma and background enhancement
- Documentation/correlation with prior imaging studies and/or procedures
- Areas of clinical or radiologic concern
- Level of suspicion based on imaging findings
- Specific recommendations for patient management
- BI-RADS® classification

Facilities and Quality Assurance

Given the rising prevalence of MRI in the screening and diagnosis of breast cancer, it is imperative that facilities contemplating the establishment of breast MRI programs take comprehensive steps to ensure optimal patient care. Specifically, these facilities must possess not only the capability to perform breast MRI but also the proficiency to conduct MRI-guided biopsies. Therefore, any facility considering the acquisition of new MRI coils must ensure that these coils are compatible with and fully supportive of biopsy procedures, and that there is sufficient administrative capacity to launch a robust breast MRI program. Facilities that overlook this aspect risk compromising the quality of care provided to patients, potentially leading to delays in diagnosis and treatment.

Clinical Practice Recommendations

- Breast MRI should be practiced in a facility with the capacity for mammography, ultrasound, and breast intervention, including MRI-guided biopsy.
- Facilities are strongly discouraged from performing breast MRI without the capacity to perform breast MRI-guided biopsies. If MRI-guided biopsy is not offered by the facility, a defined relationship with a referral center offering MRI-guided biopsy is required.
- The results of biopsies initiated based on MRI findings require radiologic-pathologic correlation regardless of where the biopsy is performed. They should also be tracked by the radiologist recommending the biopsy.
- Emergency equipment, along with necessary medications, should be readily accessible to address any adverse reactions related to administered medications, including gadolinium-based contrast agents.
- Staff at the facility must be trained in the proper use of this emergency equipment and medications, following the guidelines outlined in the ACR Manual on Contrast Media.[7]

A breast MRI accreditation program is not currently available in Canada. The ACR has established an accreditation program for quality assurance of a breast MRI program that can serve as a guideline for a breast MRI practice. The criteria evaluated in the program include:

- Establishment and maintenance by the facility of an outcomes audit program to follow-up positive interpretations and correlate histopathology with the imaging findings
- Reporting that uses the BI-RADS® terminology and final assessment codes
- Calculation of statistics for each radiologist and facility.

Personnel Requirements

Radiologist

Radiologists involved in the performance, supervision, and interpretation of magnetic resonance imaging must have a Fellowship or Certification in Diagnostic Radiology with the Royal College of Physicians and Surgeons of Canada and/or the *Collège des médecins du Québec*. Equivalent foreign radiologist qualifications are also acceptable if the radiologist is certified by a recognized certifying body and holds a valid provincial license.

Before interpreting or performing new imaging modalities and interventional techniques independently, radiologists should obtain additional clinical training under supervision, with proper documentation, which must comply with pertinent provincial/regional regulations. Continuing professional development must fulfill the Maintenance of Certification Program requirements of the Royal College of Physicians and Surgeons of Canada.

To ensure a safe MRI practice, the supervising radiologist should be familiar with the MRI safety literature including the ACR Manual on MRI Safety,[8] and policies of appropriate contrast and sedation use.

Breast MRI should only be conducted and reported in facilities where there is multi-modality breast imaging, and support for patients across the care pathway.

In addition, the interpreting radiologist should practice and possess knowledge of imaging and diagnosis of breast disease.

- The radiologist should be CAR Mammography Accreditation Program (MAP) approved, reading a minimum of 1000 mammograms per year and meeting the CAR MAP CPD requirements.
- The radiologist should also meet the ultrasound requirements set out by the American College of Radiology, of having overseen, performed, and interpreted 200 breast ultrasound examinations in the prior 36 months.
- The radiologist should be reading at least 100 breast MRI annually to maintain competence.

The responsibilities of the supervising and interpreting radiologist include:

- Review and validation of the clinical indication for the examination
- MRI protocol
- Use and dose of contrast
- Ensuring a physician is available when contrast is given
- Interpretation of imaging, including review of pertinent prior breast imaging studies and clinicopathologic review
- Provision of a report
- Quality assurance of the imaging examination and interpretation

Medical Radiation Technologist

The technologist is primarily responsible for performing the MRI scans and maintaining the overall safety of patients, staff, and equipment within the MR environment. This includes careful screening and preparation of patients, ensuring patient comfort, adjustment of protocols (if required) to produce high quality, diagnostic scans, technical and quality evaluation of images and relevant quality assurance. MR technologists are also responsible for the MRI room safety and ensuring that no maintenance staff enters the room without direct supervision. All personnel must be screened and educated about MRI by the MR technologist. MR technologists, if adequately trained, could also perform intravenous gadolinium injections requested by the responsible radiologist. Continued education of MR technologists is encouraged by the Canadian Association of Medical Radiation Technologists (CAMRT) and should meet pertinent provincial regulations.

Medical Physicist

An MRI medical physicist should perform initial acceptance testing of the MRI system immediately following installation, and prior to any clinical scanning. The medical physicist is preferably someone on site, but they can also be contracted to perform the testing. The credentials of the medical physicist should include a college certification in MRI physics (or other related MRI technology). Furthermore, they should also be accredited by either the Canadian College of Physicists in Medicine (CCPM), or one of the affiliated professional engineering societies in Canada (ie, PEng) and shall have specific training and experience in MRI. Training and experience shall include detailed knowledge of the physics of MRI, system components and performance, safety procedures, acceptance testing, and quality control testing. Acceptance testing may be done by a team of medical physicists if at least one of the group members has the credentials and takes responsibility for signing the report.

Information Systems Specialist

An Information Systems Specialist (ISS) is required by facilities performing digital imaging. This individual must be either on site or available upon request. He/she must be trained and experienced in installation, maintenance, and quality control of information technology software and hardware. The required qualifications of this individual will depend highly on the type of facility and the type of equipment.

The ISS should possess any relevant qualifications required by federal/provincial/territorial regulations and statutes and should be certified according to a recognized standard such as that of the Society of Imaging Informatics in Medicine or the PACS Administrators Registry and Certification Association. Expertise should include computer and database basics, networking concepts (such as DICOM, HL7, RIS, and HIS), security systems, medical imaging terminology, positioning and viewing characteristics, imaging characteristics of various modalities for image acquisition, transmission and storage, and facility workflow. The ISS should also be knowledgeable about federal, provincial, territorial, and institutional privacy legislation and policies, such as the *Personal Information Protection and Electronic Documents Act* (PIPEDA).

Responsibilities include ensuring patient record confidentiality, understanding facility policies and procedures, and the importance and requirements of an information systems quality assurance program. They also include communicating any changes/upgrades to staff and the resulting operational impacts.

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Co-Chairs

Samantha Fienberg, MD, FRCPC
Carolyn Flegg, MD, FRCPC

Committee Members

Priscila Sacilotto Crivellaro, MD, FRCPC
Rachel Fleming, MD, FRCPC
Wade Koberstein, MD, FRCPC
Anat Kornecki, MD, FRCPC
Anisa Mnyusiwalla, MD, FRCPC
Saly Zahra, MD, FRCPC

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Jean Seely, MD, FRCPC
Nancy Wadden, MD, FRCPC

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ORCID iDs

Carolyn Flegg https://orcid.org/0009-0001-4055-4513
Priscila Sacilotto Crivellaro https://orcid.org/0000-0003-1600-034X
Anat Kornecki https://orcid.org/0000-0001-6098-2091

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