

Surgical attitudes toward preoperative breast magnetic resonance imaging in women with early-stage breast cancer

S.D. Mukherjee MD MSc,* N. Hodgson MD MSc,*† P.J. Lovrics MD,‡ K. Dhamanaskar DMRD DNB,†
S. Chambers MA,§ and J. Sussman MD MSc*§

ABSTRACT

Background Preoperative breast magnetic resonance imaging (MRI) is commonly requested by surgeons in the initial workup of women with breast cancer; however, its use is controversial. We performed a survey of breast cancer surgeons across Canada to investigate current knowledge about, attitudes to, and self-reported use of preoperative breast MRI in a publicly funded health care system in light of the limited evidence to support it.

Methods All identified general surgeons in Canada were mailed a survey instrument designed to probe current practice and knowledge of published trials.

Results Of 403 responding surgeons, 233 (58%) indicated that they performed breast cancer surgery. Of those 233, 218 (94%) had access to breast MRI and completed the entire survey. Overall, 54.6% of responding surgeons felt that breast MRI was useful in surgical planning, and more than half (58.3%) indicated that their frequency of use was likely to increase over the next 5 years. Surgeons found preoperative MRI most useful in detecting mammographically occult disease (71.5% of respondents) and in planning for breast-conserving surgery (57.3%). The main limitations reported were timely access to MRI (51%) and false positives (36.7%). Responses suggest a knowledge gap in awareness of published trials in breast MRI.

Conclusions Our study found that, in early-stage breast cancer, self-reported use of MRI by breast cancer surgeons in Canada varied widely. Reported indications did not align with published data, and significant gaps in self-reported knowledge of the data were evident. Our results would support the development and dissemination of guidelines to optimize use of MRI.

Key Words Preoperative assessment, breast cancer, magnetic resonance imaging

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INTRODUCTION

Breast cancer (BCA) is the most common cancer affecting women, with more than 26,300 patients diagnosed in Canada each year¹. The usual preoperative workup for a suspected breast mass includes clinical breast and lymph node examination, mammography, breast ultrasonography, and biopsy of the lesion in question. After pathology confirmation, women with early-stage BCA are seen by their surgeon for a discussion about the choice between breast-conserving surgery and mastectomy.

The use of preoperative breast MRI in addition to routine mammography and breast ultrasonography has

become increasingly common since about 2010. Breast MRI can help to identify when disease in the affected breast is more extensive and to identify contralateral BCA. Although breast MRI is known to have a high sensitivity (>90%), it is associated with low-to-moderate specificity (~70%)². Estimates of specificity for breast MRI in the detection of BCA in the literature have varied greatly, with different results arising because of variability in study populations, technical methods, and the criteria used for interpretation of an abnormal result³. Breast MRI became much more widely available across Canada starting by about 2005, and there were considerable expectations that preoperative breast MRI would result in better surgical outcomes through more

Correspondence to: Som Mukherjee, Juravinski Cancer Centre, 699 Concession Street, Hamilton, Ontario L8V 5C2.
E-mail: mukherjee@hhsc.ca ■ DOI: <https://doi.org/10.3747/co.26.4227>

accurate estimation of tumour location, size, and extent. The hypothesis was that improved imaging with MRI would enhance the preoperative surgical plan, which would lead to fewer positive margins, fewer local recurrences, and improved disease-free survival (DFS).

As preoperative breast MRI was becoming increasingly popular among surgeons, two randomized controlled trials (RCTs)^{4,5} and a meta-analysis by Houssami *et al.*⁶ found that preoperative breast MRI did not improve local recurrence rates, DFS, or overall survival (OS). Despite that evidence showing no clinical benefit, breast MRI continues to be commonly requested for many women with early-stage BCa before surgery. Several guidelines have been developed to help steer clinicians with respect to the use of preoperative breast MRI, but the applicability and uptake of those guidelines by surgeons has not been studied to any great extent. To date, significant controversy attends the routine use of breast MRI in assessing extent of disease before surgery⁷.

Few studies have evaluated the reasons that BCa surgeons request a breast MRI before surgery, and few data about the awareness of surgeons concerning published RCTs and guidelines in this area have been developed. We surveyed surgeons across Canada with the following objectives:

- Assess surgeon awareness concerning the literature and guidelines relating to preoperative breast MRI
- Determine patient-related clinical factors that affect the surgical decision to request or not request MRI in this setting
- Understand the clinical context and rationale that led surgeons to request MRI
- Determine if any access issues arise with respect to preoperative breast MRI
- Understand which patient-related clinical outcomes are most important to surgeons, with respect to planning future research related to preoperative breast MRI

Approval from the McMaster University Research Ethics Board was obtained for the study.

METHODS

A survey consisting of 37 questions was developed in a multi-step process that included a review of the literature and expert opinion. Domains of interest included detailed demographic data and information about access to MRI and barriers to its use. Key outcomes of interest included patient and tumour characteristics that informed the decision to request MRI and the perceived benefits of MRI. The instrument was pilot-tested for content and clarity with 5 oncologists (3 surgeons, 1 radiation oncologist, 1 medical oncologist). A revised survey consisting of 37 questions was developed and tested with 2 different surgeons before the study survey was finalized. The final survey was mailed to all accredited general surgeons across Canada. The survey was accompanied by a cover letter explaining the purpose of the study; a self-addressed stamped envelope was included to encourage return of the completed survey. No specific identifying information from the survey participants was requested aside from basic demographic information and type of practice (community vs. academic setting).

The survey questions covered 5 topics:

- Basic demographic information
- Clinical factors used in determining which patients should undergo preoperative breast MRI
- Practical considerations for preoperative breast MRI, including
 - whether a biopsy of all additional lesions identified on breast MRI, but not seen on mammography or breast ultrasonography, was routinely performed; and
 - average local wait times to obtain MRI
- The surgeon's understanding of the literature and awareness of any clinical practice guidelines about the use of preoperative breast MRI
- The surgeon's interest in future research evaluating the role of preoperative breast MRI

Descriptive statistics are used for surgeon demographics, clinical factors affecting the decision to request breast MRI, and for all other questions. Univariate analyses were conducted. All statistical analyses were performed using the IBM SPSS Statistics software application (version 24; IBM, Armonk, NY, U.S.A.).

RESULTS

Of 1430 surveys sent to various general surgeons across Canada, 403 surveys were returned. Of the 403 respondents, 233 (57.8%) reported that they currently perform BCa operations. Of those 233 breast surgeons, 13 (5.6%) indicated that they had no access to breast MRI. Of the 220 surveys completed by BCa surgeons with access to MRI, 218 were fully completed (Figure 1). Table I shows the demographic characteristics of those 218 surgeons. All provinces across Canada were represented, with most responses coming from Ontario (39.9%), Quebec (22.9%), British Columbia (11.5%), and Alberta (9.2%).

Surgeons participating in the survey were asked to indicate the number of years that they had been in practice. Surgical experience was fairly evenly distributed, with 23.9% of surgeons having been in practice for more than 25 years, 20.2% in practice for 6–10 years, 16.5% in practice for 11–15 years, and 16.5% in practice for 16–20 years. More than half the surgeons (59.6%) did not complete fellowship training after general surgery training, and more than two thirds (68.3%) were based primarily in the community setting, with the rest being based in an academic centre.

At the time of the survey, 218 of 233 surgeons (93.6%) indicated that they had access to breast MRI in the preoperative setting (Table II). Of those 218 surgeons, 149 (68.3%) had breast MRI located within their community, and 68 (31.2%) had breast MRI located outside their community. The average wait time to obtain preoperative breast MRI varied greatly, from less than 1 week in some centres (1.4%) to more than 4 weeks (18.8%) in others (Table III).

Surgeons were asked to indicate the clinical or mammographic features that led them to request breast MRI (Table IV). Overall, young age, high breast density, lobular histology, discordance between mammogram and breast exam, and assessment for overall extent of invasive tumour

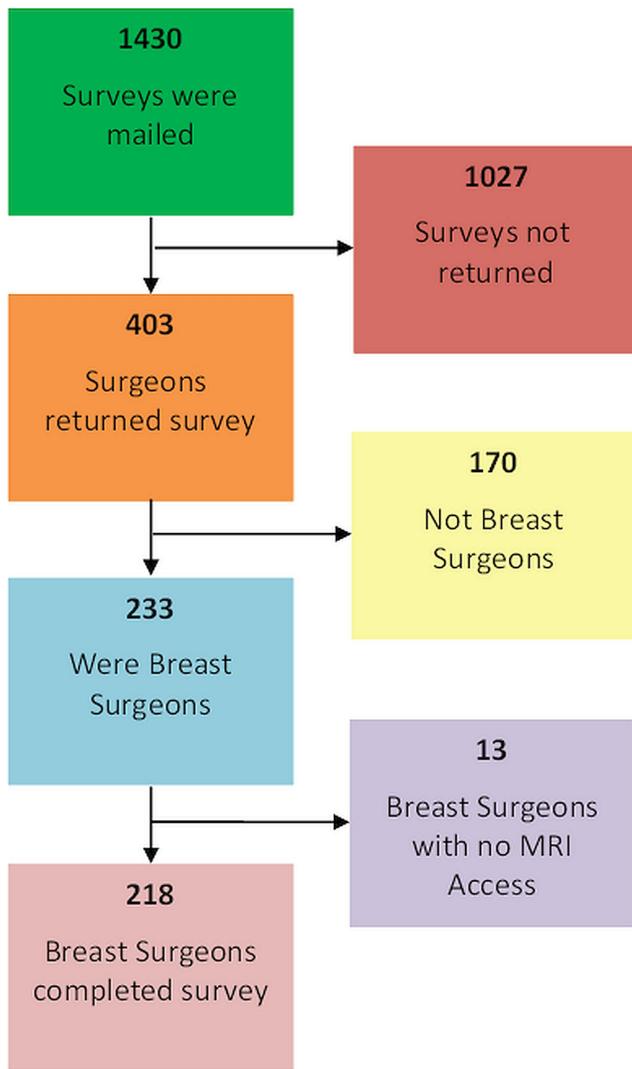


FIGURE 1 CONSORT diagram for the study. MRI = magnetic resonance imaging.

or ductal carcinoma *in situ* (or both) were all reasons that surgeons requested preoperative breast MRI.

Surgeons were also asked to quantify how often an additional abnormality was found on preoperative breast MRI compared with mammography or breast ultrasonography. The responses varied mostly in the range of less than 10% of the time (16.1% of surgeons) to 50% of the time—indicating quite a wide variation. Surgeons were asked to indicate how often they biopsy all additional abnormalities seen on breast MRI that were not present on the initial mammogram. Overall, 39.9% and 23.4% of surgeons indicated that they “almost always” or “often” biopsy all additional lesions found on breast MRI.

Surgeons felt that all of the following factors (Table v) are benefits of preoperative breast MRI:

- Identifying the extent of disease within the breast
- Planning for breast-conserving surgery
- Identifying mammographically occult disease

TABLE I Characteristics of 218 survey participants

Characteristic	Participants [n (%)]
Geographic location	
Ontario	87 (39.9)
Quebec	50 (22.9)
British Columbia	25 (11.5)
Alberta	20 (9.2)
Manitoba	7 (3.2)
Nova Scotia	7 (3.2)
Saskatchewan	6 (2.8)
Newfoundland and Labrador	6 (2.8)
Prince Edward Island	3 (1.4)
Northwest Territories	0 (0.0)
Nunavut	0 (0.0)
Yukon	0 (0.0)
Not provided	7 (3.2)
Duration of practice	
0–5 Years	18 (8.3)
6–10 Years	44 (20.2)
11–15 Years	36 (16.5)
16–20 Years	36 (16.5)
21–25 Years	29 (13.3)
>25 Years	52 (23.9)
Not provided	3 (1.4)
Fellowship training	
Yes	82 (37.6)
No	130 (59.6)
Not provided	6 (2.8)
Nature of practice	
Community	149 (68.3)
Academic	68 (31.2)
Other	1 (0.5)

- Identifying contralateral bca
- Identifying axillary lymph node involvement
- Looking for potential chest wall involvement of the breast tumour

Of 218 surgeons with complete surveys, 63 indicated that they were aware of preoperative breast MRI guidelines; 146 were not aware. Some surgeons indicated using Cancer Care Ontario guidelines or regional or provincial recommendations, or guidelines from the local hospital, the American College of Surgeons, the Canadian Society of Radiologists, the U.S. National Comprehensive Cancer Network, BC Cancer, the COMICE trial, the American Society of Radiology, the American Cancer Society, and the National Cancer Institute of Canada.

Surgeons participating in the survey indicated that the limitations of preoperative breast MRI included false positives (80 of 218, 36.7%), access to breast MRI (64 of 218, 29.4%), wait time (47 of 218, 21.6%), inability to obtain MRI-guided biopsy (21 of 218, 9.6%), reliance on radiology approval of

MRI and local expertise in interpreting MRI (10 of 218, 4.6%), increased patient anxiety (9 of 218, 4.1%), and increased mastectomy rate (5 of 218, 2.3%).

On being asked whether they felt that a RCT of the effectiveness of preoperative breast MRI in young women (<50 years of age) would provide useful information, 187 of the 218 participants responded “yes,” and 26 responded “no.” In addition, 164 indicated willingness to enrol patients in a

trial of that type. When asked to rank the order of primary outcomes for the trial, surgeons indicated that they considered the outcomes of local recurrence rate and DFS to be most important; cosmetic outcome was ranked as least important (Figure 2).

Overall, 54.6% of the surgeons felt that preoperative breast MRI was helpful in their surgical decision-making, and 58.3% expected that their use of MRI would increase during the next 5 years. Surgeons gave multiple reasons that breast MRI would be helpful, including helping to decide on breast-conserving surgery in younger patients, identifying contralateral bca, assessing the size of the tumour and ruling out additional disease within the breast for lobular cancer or for women with dense breast tissue, and helping to decide on the type of surgery.

Surgeons felt that the main disadvantages of preoperative breast MRI included a relatively high false-positive rate, association with more frequent recommendations for mastectomy, and lack of a survival benefit.

TABLE II Access to preoperative magnetic resonance imaging for 233 respondents

Access	Respondents [n (%)]
Yes	218 (93.6)
No	13 (5.6)
No response	2 (0.9)

TABLE III Average wait time to access magnetic resonance imaging

Wait time	Respondents [n (%)]
<1 Week	3 (1.4)
1 Week	13 (6.0)
2 Weeks	76 (34.9)
3 Weeks	43 (19.7)
4 Weeks	39 (17.9)
>4 Weeks	41 (18.8)
No response	3 (1.4)

DISCUSSION

The role of preoperative breast MRI in women with early-stage bca remains controversial. Our national survey found that a large proportion of Canadian bca surgeons request preoperative breast MRI in selected patients to help in determining the overall extent of disease and in planning for surgery. Surgeons indicated that they request preoperative breast MRI more often for patients of younger age, lobular histology, or higher breast density, or when the mammogram and physical examination are discordant.

TABLE IV Characteristics that trigger a preoperative magnetic resonance imaging request

Characteristic	Triggers request					
	Almost always	Often	Sometimes	Rarely	Never	No response
Young age (<50 years)	15.1	10.6	37.7	20.6	13.3	3.7
High breast density	15.6	22.9	31.2	19.3	9.6	1.4
Lobular histology	33.0	16.1	20.6	16.1	11.9	2.3
Mammogram discordant	18.3	26.6	28.4	14.7	8.7	3.2
Assess overall extent	10.1	15.1	34.7	22.9	14.2	2.8
Extent of DCIS	5.5	12.8	30.3	29.4	20.2	1.8

DCIS = ductal carcinoma *in situ*.

TABLE V Benefits of preoperative magnetic resonance imaging in breast cancer (BCa)

Variable	Provides benefit?					
	Almost always	Often	Sometimes	Rarely	Never	No response
Extent of disease	15.1	44.0	25.7	8.7	2.3	4.1
Planning BCS	17.4	39.9	22.9	12.4	3.2	3.2
Occult disease	22.0	49.5	16.5	4.6	4.1	3.2
Contralateral BCa	16.1	40.8	26.6	9.2	3.2	4.1
Axillary lymph node–positive	4.6	12.4	45.9	26.6	6.4	4.1
Chest wall involvement	9.2	33.9	38.1	11.0	3.7	4.1

BCS = breast-conserving surgery.

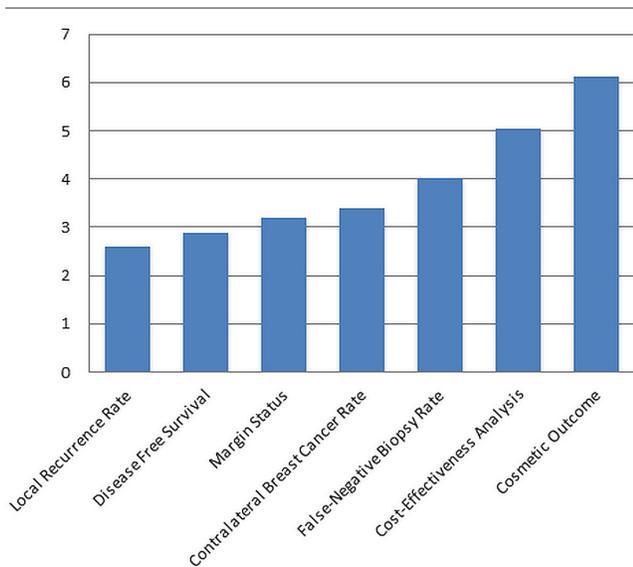


FIGURE 2 Weighted outcome rankings for randomized controlled trials.

Two large RCTs evaluating the role of preoperative breast MRI in women with early-stage BCa have been published to date. The original COMICE (Comparative Effectiveness of MRI in Breast Cancer) trial randomized 1625 women with early-stage BCa to preoperative breast MRI or no MRI⁴. That study found no difference between the two arms in its primary endpoint of re-excision rates for positive or close margins and no statistically significant difference in DFS after 3 years of follow-up⁴. In addition, no OS benefit was observed for patients who received preoperative breast MRI. A second and much smaller RCT involving 149 patients, MONET (MRI of nonpalpable breast tumours), evaluated whether preoperative breast MRI in addition to mammography or ultrasonography, or both, reduced the number of surgical procedures or biopsies in patients with suspicious breast lesions⁵. Paradoxically, the addition of breast MRI to routine clinical care in patients with nonpalpable BCa was found, in that trial, to be associated with an increased re-excision rate for positive resection margins after breast-conserving surgery. The authors concluded that breast MRI should not be used in the routine preoperative workup for women with early-stage nonpalpable BCa⁵.

The results from both COMICE and MONET showing no benefit for preoperative breast MRI were unexpected, and several methodologic limitations of both trials must be highlighted. First, the COMICE trial was performed at a time when breast MRI was a relatively new technology, and the quality of breast MRI technology was variable. The level of expertise in breast MRI image interpretation by radiologists also varied widely from centre to centre. Second, surgeons enrolling patients onto the COMICE trial lacked experience with preoperative breast MRI. Third, additional concerns were raised about the unexpectedly low re-excision rates in the trial (approximately 10% in each group) and the very low patient accrual rate. Fourth, many centres lacked the capability to perform MRI-guided biopsy and had to rely on ultrasound-guided biopsy after the initial breast MRI⁸. The

MONET trial demonstrated strong selection bias because, in 50% of the compared cancer cases, mammographically detected microcalcifications turned out to be ductal carcinoma *in situ*. Neither the MONET trial nor the COMICE trial outlined a strategy within the study protocol to guide study surgeons in making surgical management decisions based on findings from the preoperative breast MRI.

Compared with patients in the no-MRI arm, those who underwent preoperative breast MRI in the COMICE trial experienced a rate of mastectomy that was higher by 6 percentage points (7% vs. 1%). Another trial evaluating preoperative breast MRI, the MIPA trial, found an increased mastectomy rate of only 1.7%⁹. Other studies evaluating the role of preoperative breast MRI in women with BCa have been performed and have demonstrated no statistically significant increase in mastectomy rates^{10–16}.

A systematic review and meta-analysis by Houssami and colleagues, which included 2160 women from nineteen studies, evaluated the accuracy and surgical impact of preoperative breast MRI in BCa patients of all ages⁶. In that study, the proportion of patients undergoing a change in surgical management from breast-conserving surgery to modified radical mastectomy was 11.3% (95% confidence interval: 6.8% to 18.3%). Additional tumour foci in the ipsilateral breast were found in 11%–31% of patients, and contralateral BCa was identified in 3%–6%⁶. However, no difference in the primary endpoint and no improvement in DFS or OS were observed.

To date, no prospective RCTs of preoperative breast MRI that have used long-term recurrence rates as an endpoint have been conducted. Together with the limitations of the evidence relating to preoperative breast MRI and the issues of generalizability, that lack of long-term recurrence rate information is likely behind the continued requests by many surgeons for preoperative breast MRI in their patients with early-stage BCa.

A study by Vapiwala *et al.*¹⁷ in 2017 found that preoperative breast MRI had no significant effect on 15-year rates of local control, OS, freedom from distant metastases, or contralateral BCa. But the low baseline rate of local recurrence in women with early-stage BCa limits the ability of any study to detect a true benefit. Assuming a 10-year local recurrence rate of 5%, a sample size of approximately 14,000 would be required to have sufficient power to detect a 20% difference between the arms in a 1:1 randomized study. If a 10% local recurrence rate were to be assumed, a sample size of approximately 6600 would be required to detect the same benefit of preoperative breast MRI¹⁸.

Additional issues connected with preoperative breast MRI trials include

- a lack of standardization in the reporting of breast MRI results and in the clinical investigation and management relating to preoperative breast MRI findings;
- a lack of controls relating to potential differences in management between general surgeons and surgical oncologists with BCa-specific training;
- a lack of standardized surgical procedures and decision-making;
- a low rate of multidisciplinary team discussion of management issues relating to preoperative breast MRI; and

- a potential for selection bias, given that MRI tends to be requested more often in younger women with mammographically dense breast tissue or high-risk personal or tumour-related factors.

This collection of methodologic limitations in the published literature has affected confidence in the claimed lack of outcome benefit from preoperative breast MRI. The Houssami meta-analysis included only three randomized trials that contributed to the pooled estimates, and the contralateral bca detection rate in the COMICE trial was only about half that in the American College of Radiology Imaging Network 6667 trial (1.6% vs. 3.1%)¹⁹. A meta-analysis by Brennan *et al.*²⁰ showed a contralateral bca detection rate of 4.1%. Before any definitive conclusions about the benefits of preoperative breast MRI can be drawn, trials are needed that control for grade and aggressiveness of disease, tumour biology and receptor status, tumour histology or morphology (especially invasive lobular carcinoma), breast density, family history, lymphovascular invasion, and multifocal or multicentric disease.

Despite the stated limitations of the literature concerning preoperative breast MRI, evidence suggesting that preoperative breast MRI might have clinical benefit in certain subtypes of bca is building. Studies of preoperative MRI in women with triple-negative bca suggest that not having an MRI could result in inferior outcomes such as local recurrence and recurrence-free survival²¹. In addition, there is some evidence that breast MRI features such as rim enhancement and peritumoural edema could serve as potential prognostic biomarkers to predict risk for metastatic disease²².

Our survey found that only approximately one third of bca surgeons were aware of clinical practice guidelines relating to preoperative breast MRI. Self-reported knowledge gaps about the literature concerning randomized trials of preoperative breast MRI were evident. The literature currently contains a number of guidelines about the use of preoperative breast MRI. Some of the guidelines commonly mentioned by the participating surgeons in our study included those from the American College of Radiology²³, the U.S. National Comprehensive Cancer Network²⁴, the American Cancer Society²⁵, and the American Society of Breast Surgeons²⁶. Other guidelines available in the literature that were not mentioned by the participating surgeons include those from the European Society of Breast Cancer Specialists²⁷ and the European Society of Breast Imaging²⁸. Most of the guidelines mentioned share similar recommendations with respect to the role of preoperative breast MRI in women with early-stage bca. In general, the guidelines acknowledge that breast MRI has higher sensitivity than mammography and ultrasonography for identifying bca, but that its use is not associated with any improvement in DFS or OS in the preoperative setting. All guidelines recommended biopsy of new lesions identified on MRI but not found on mammography or ultrasonography. In addition, all guidelines stated that preoperative breast MRI might be useful to determine the extent of disease within the breast before definitive surgery for the breast tumour. Most guidelines acknowledged the limitations of

preoperative breast MRI in affecting local recurrence rates or survival. For example, the American College of Radiology guideline²³ states that

MRI determines the extent of disease more accurately than standard mammography and physical examination in many patients. It remains to be shown conclusively, however, that this increased accuracy results in any reduction in recurrence rates following surgery, radiation, or systemic therapy.

There appeared to be significant variability in the types of guidelines that were being used by the small proportion of surgeons in our study who were aware of such guidelines. On the Canadian front, the *CAR Practice Guidelines and Technical Standards for Breast Imaging and Intervention*²⁹ from the Canadian Association of Radiologists is quite similar to other guidelines, as is *Magnetic Resonance Imaging for Breast Cancer Screening, Pre-operative Assessment, and Follow-Up* from Alberta Health Services³⁰. Both of the latter guidelines seem to have been based primarily on the COMICE and, to a lesser extent, the MONET RCTS.

The guideline from the European Society of Breast Cancer Specialists states that, to be acceptable, the wait time to having a preoperative breast MRI should be no more than 1 month²⁷. Our survey found that at some centres in Canada, the average wait time for a preoperative breast MRI ranged from less than 1 week to more than 4 weeks, with 18.8% of surgeons indicating that their average wait time exceeded 4 weeks. A retrospective cohort study of 1274 patients by Zhang *et al.*³¹ found that, compared with no preoperative breast MRI, use of preoperative breast MRI increased surgical wait times by 11–12 days. In that single-centre retrospective study, the time-to-treatment results could have been affected by patient selection bias. Also no uniform MRI practice guidelines were available at the time of the study. Aside from breast MRI, obtaining further imaging or biopsies for new lesions discovered on MRI could also result in a delay to definitive surgery. Well-organized centres might be more able to overcome the issue of delays in diagnosis, MRI-guided biopsy of MRI-detected lesions, and definitive therapy. Another recent study by Preibsch *et al.*¹² showed no delay accruing from preoperative breast MRI.

We acknowledge that our study has several limitations. First, our cross-sectional survey asked surgeons questions about their own surgical practice. Requests for self-reported data are subject to several potential sources of bias, including recall bias and selective memory bias. The second limitation is that the study included only surgeons practicing in Canada. Given the similarity of the health care funding model in all provinces, we decided to limit our study to one country. Third, our survey response rate was 28%. But although the study had a low response rate, it should be noted that the survey was sent to all general surgeons across Canada, many of whom do not perform bca surgery routinely. Our aim was to be as inclusive as possible, and we believe that we captured a significant proportion of the bca surgeons who regularly perform bca surgery in Canada.

CONCLUSIONS

Our national survey demonstrates that breast surgeons request breast MRI in select patient populations to help with surgical planning and to estimate the extent of disease in the ipsilateral and contralateral breast before surgery. Self-reported use of preoperative breast MRI in women with early-stage BCa varied quite widely for BCa surgeons in Canada, and reasons for requesting preoperative breast MRI often varied from published guidelines. Surgeons also indicated significant gaps in self-reported knowledge of the data concerning the use of preoperative breast MRI. Our study supports the development and dissemination of Canadian guidelines to optimize the appropriate use of preoperative breast MRI.

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CONFLICT OF INTEREST DISCLOSURES

We have read and understood *Current Oncology's* policy on disclosing conflicts of interest, and we declare that we have none.

AUTHOR AFFILIATIONS

*Juravinski Cancer Centre, †Juravinski Hospital, ‡St. Joseph's Hospital, and §McMaster University, Hamilton, ON.

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