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**Clinical Image Quality in Daily Practice of Breast Cancer
Mammography Screening**

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Abstract

Objective: To assess the quality of screening mammograms performed in daily practice in the Quebec Breast Cancer Screening Program.

Subjects and Methods: Clinical image quality of a random subsample of 197 screening mammograms performed in 2004-2005 was independently evaluated by 2 radiologists based on the criteria by Canadian Association of Radiologists (CAR). When disagreement occurred for overall judgement or positioning score, the mammograms were reviewed by a third radiologist. Cohen's kappas for interrater agreement were computed. Multivariable robust Poisson regression models were used to study associations of overall quality and positioning with body mass index (BMI) and breast density.

Results: The CAR criteria were not satisfied for 49.7% of the mammograms. Positioning was the quality attribute most often deficient, with 37.2% of mammograms failing positioning. Interrater agreement ranged from slight ($\kappa = 0.02$ for compression and sharpness) to fair ($\kappa = 0.30$ for exposure). For overall quality, women with a BMI ≥ 30 kg/m² had a failure proportion of 67.5% compared with 34.9% for women with a BMI < 25 kg/m² (risk ratio 2.1 [95% confidence interval, 1.5-3.0]). For positioning, women with a BMI ≥ 30 kg/m² had a failure proportion of 53.8% compared with 27.9% for women with a BMI < 25 kg/m² (risk ratio 1.9 [95% confidence interval, 1.2-3.1]). Effects of breast density on image quality differed among radiologists.

Conclusion: Despite measures to ensure high-quality imaging, including CAR accreditation, approximately half of this random sample of screening mammograms failed the CAR quality standards. It would be important to define quality targets for screening mammograms carried out in daily practice to interpret such observations.

Résumé

Objectif : Évaluer la qualité des mammographies de dépistage en pratique quotidienne dans le cadre du programme québécois de dépistage du cancer du sein.

Sujets et méthodologie : La qualité des images cliniques d'un sous-échantillon aléatoire de 197 mammographies de dépistage effectuées entre 2004 et 2005 a fait l'objet d'une évaluation indépendante par 2 radiologistes en fonction des critères de l'Association canadienne des radiologistes (CAR). Dans les cas de désaccord sur le jugement général ou le score du positionnement, les mammographies étaient soumises à l'examen d'un troisième radiologiste. On a consigné des kappas de Cohen relativement aux accords interévaluateurs. Des modèles

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multivariés de régression de Poisson avec une estimation robuste de la variance ont été utilisés pour étudier les associations entre la qualité globale et le positionnement, d'une part, ainsi que l'indice de masse corporelle (IMC) et de la densité mammaire, d'autre part.

Résultats : Les critères de la CAR n'ont pas été satisfaits dans 49,7 % des mammographies. Le positionnement correspondait à l'attribut de la qualité le plus souvent problématique, soit dans 37,2 % des mammographies. L'accord interévaluateurs variait de médiocre ($\kappa = 0,02$ au chapitre de la compression et de la netteté) à modéré ($\kappa = 0,30$ pour ce qui est de l'exposition). En ce qui a trait à la qualité globale, les femmes présentant un $IMC \geq 30 \text{ kg/m}^2$ connaissaient un échec dans 67,5 % des cas par rapport à 34,9 % des femmes présentant un $IMC < 25 \text{ kg/m}^2$ (risque relatif de 2,1 [intervalle de confiance à 95 % : 1,5-3,0]). Pour ce qui est du positionnement, les femmes ayant un $IMC \geq 30 \text{ kg/m}^2$ connaissaient un échec dans 53,8 % des cas par rapport à 27,9 % des femmes présentant un $IMC < 25 \text{ kg/m}^2$ (risque relatif de 1,9 [intervalle de confiance à 95 % : 1,2-3,1]). Les effets de la densité mammaire sur la qualité de l'image variaient d'un radiologiste à l'autre.

Conclusion : Malgré les mesures adoptées pour garantir la grande qualité des examens d'imagerie, notamment l'agrément de la CAR, environ la moitié des mammographies de dépistage d'un échantillon aléatoire n'ont pas satisfait aux normes de qualité de la CAR. Il serait donc important de définir les cibles de qualité pour les mammographies de dépistage effectuées en pratique clinique, afin d'être en mesure d'interpréter de telles observations.

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Key Words: Mammography; Quality; Screening; Breast cancer

Breast cancer screening by mammography aims at reducing breast cancer mortality. Achieving high-quality mammograms may improve sensitivity [1] and possibly reduce the false-positive rate. Clinical image quality refers to the quality of mammograms carried out for clinical purposes and is based on positioning, breast compression, exposure, contrast, sharpness, noise, artifacts, and labeling [1–3]. High-quality mammography allows clear visualization of all breast tissue [2,4–6]. In most organized mammography screening programs, measures are implemented to ensure high-quality mammograms. In the Quebec Breast Cancer Screening Program, centres must follow a specified quality-control program [7,8], which includes regular tests of technical quality to ensure that the mammography unit, processor, and all related equipment are working properly. Centres must also be certified by the Laboratoire de santé publique du Québec, for which a physicist annually examines the installations and the equipment as well as technical image quality. Before certification, the centres must also be accredited by the Mammography Accreditation Program of the Canadian Association of Radiologists (CAR) where both technical aspects and clinical image quality are evaluated. Centres are invited to choose 2 mammograms (one from a woman with mostly fatty breasts and one from a woman with mostly dense breasts) to represent the highest quality they can produce. Thus, the accreditation process does not inform directly on the level of quality of clinical mammograms carried out in daily practice.

Little information is available on the level of mammography quality reached in daily practice in screening programs. We found few studies that used the American College of Radiology (ACR) criteria [1,3,9,10], which are similar to the CAR criteria. A first study by Taplin et al [1] examined mammography quality in daily practice of women who had an invasive cancer detected at screening or in the interval after a normal screening mammogram performed between 1988 and 1993. They found that 51.1% of 548 mammograms failed overall quality evaluation. Bassett et al [3] examined the quality of mammograms in the ACR accreditation

context in 1997. In their study, 44% of 2341 mammography units failed clinical image quality for at least 1 of 2 submitted mammograms. These mammograms were chosen by the centres to represent their best quality mammograms and were not representative of daily practice. A study by Rauscher et al [10] examined clinical image quality based on the ACR quality attributes among women who developed breast cancer. They did not attribute a final pass or fail score. Finally, a study by Gwak et al [9] used the ACR criteria to evaluate a mix of mammograms, including some chosen for accreditation and others that represented clinical practice. They report a 19.9% failure rate. All the above studies found positioning to be the component most often inadequate.

Given the paucity of information on mammography quality achieved in daily practice, we evaluated the quality of a random sample of screening mammograms carried out within the Quebec Breast Cancer Screening Program by using the CAR criteria. The interrater agreement in quality ratings was assessed. Because body mass index (BMI) and breast density [3,11,12] have been shown to be associated with clinical image quality, variation of these associations according to reviewer also was examined.

Subjects and Methods

Setting

The current analysis is embedded in a larger study that aimed at identifying determinants of screening mammography quality. All study women signed an informed consent that allowed their data to be used for program evaluation. The ethics committee of the Centre hospitalier affilié universitaire de Québec evaluated the project and established that it met its ethical requirements.

Population and Sample

The study sample was drawn from mammograms performed in the Quebec Breast Cancer Screening Program in

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