Annals of Clinical and Analytical Medicine

Breast Cancer Screening using Film Mammography versus Digital Mammography: A Systematic Review

Turki Abdullah Yousef Al Makrami (1) *, Mohammed Saleh Ali Al Motah (2), Mohammed Ahmad Ali Alkastaban (2), Saleh Yahay Alshai (3), Ali Hamad Ali Al Abbas (4), Abdullah Hussain Alajabi (4), Hamad Bardan Mana Alshamlan (5)

(1) Radiological Department, King Khaled Hospital.
(2) Radiological Department,New Najran General Hospital
(3) Biomedical Department, Maternity And Children Hospital.
(4) Radiological Department, Forensic Medical Services Canter.
(5) Radiological Department, Thar General Hospital.

Received 15/9/2022; revised 7/10/2022; accepted 20/10/2022

*Corresponding author

Abstract

Introduction: Digital mammography may provide better images than does film mammography in women who are younger than 50 years, the age group usually associated with dense breast tissue because greater density reduces the sensitivity of mammography, and increases the risk of breast cancer. This review aim to study breast cancer screening using film mammography versus digital mammography.

Methods: Electronic databases including PubMed and Embase was searched by two independent reviewers. Furthermore, the search was conducted in databases and repositories of grey literature such as Open Grey. The databases of systematic review and clinical trials such as Cochrane libraries and Center for Reviews and dissemination were screened for eligible primary studies. The electronic search with keywords in titles and abstracts of these articles was conducted to identify eligible studies. Based on the primary screening results the irrelevant studies, duplicated and reviews were excluded. Finally, four eligible studies were included in this review.

Results: Comparison between film mammography and digital mammography was done by estimation of sensitivity and specificity of each in a Cohort study done by Pisano et al., 2005, in which the sensitivity was ranged between 35% - 38% when using film mammography, and between 38%- 49% when using digital mammography. While the specificity was 97%-98% for film mammography, and 79% for digital mammography. Cancer detection rate was evaluated in two studies. The first study was a Prospective study done on 43,429 women, aged between 45–69 years. Cancer detection rate was 41% when using film mammography.

Conclusions: Digital mammography offers other advantages over film mammography easier access to images and computer-assisted diagnosis, improved means of transmission, retrieval, and storage of images, and the use of a lower average dose of radiation without a compromise in diagnostic accuracy.

Keywords: Mammography, Breast cancer, Digital, Radiology, Screening.

Introduction

Mammography is the most effective modality to early detect of breast cancer [1].The use of screening mammography is associated with the detection of breast cancer at an earlier stage and smaller size [2] and there is now general agreement that screening mammography reduces the rate of death from breast cancer among women who are 40 years of age or older [3], However, the positive predictive value of mammographic diagnosis is only about 15%–30% [2]. As the number of patients undergoing mammography increases, it will be increasingly important to improve the positive predictive value of this procedure in order to decrease patient discomfort and costs [4]. Recent studies have shown that mammography is sensitive in diagnosis and screening of breast cancer, but with a high false-positive rate[5]. So far, conventional screen-film mammography with high spatial resolution has been the modality of choice for screening programs [6].

Digital mammography, which was developed in part to address some of the limitations of film mammography [7], separates image acquisition and display, allowing the optimization of both. Image processing of digital data allows the degree of contrast in the image to be manipulated, so that contrast can be increased in the dense areas of the breast with the lowest contrast [8].

Digital mammography may provide better images than does film mammography in women who are younger than 50 years, the age group usually associated with dense breast tissue [9] because greater density reduces the sensitivity of mammography [10], and increases the risk of breast cancer [11]. This review aim to study breast cancer screening using film mammography versus digital mammography.

.

Methods

Electronic databases including PubMed and Embase was searched by two independent reviewers. Furthermore, the search was conducted in databases and repositories of grey literature such as Open Grey.

The databases of systematic review and clinical trials such as Cochrane libraries and Center for Reviews and dissemination were screened for eligible primary studies.

The electronic search with keywords in titles and abstracts of these articles was conducted to identify eligible studies. Based on the primary screening results the irrelevant studies, duplicated and reviews were excluded. Finally, four eligible studies were included in this review.

Results

The search resulted in four potentially relevant studies, that reported clinical trials on a comparison between breast cancer screening using film mammography versus digital mammography. Only one study was excluded because it had non consistent outcome. Overall sample size was ranged between 200 [13] to 49,528 patients [12], aged over 40 years old. The stage of breast cancer was not reported in three studies , only one study reported that the stage was between T1- T4 [12].

Comparison between film mammography and digital mammography was done by estimation of sensitivity and specificity of each in a Cohort study done by Pisano et al., 2005, in which the sensitivity was ranged between 35% - 38% when using film mammography, and between 38%- 49% when using digital mammography. While the specificity was 97%-98% for film mammography, and 79% for digital mammography. The technique used for film mammography was not reported , while five digital-mammography systems were used in digital mammography: the Seno Scan (Fischer Medical), the Computed Radiography System for Mammography (Fuji Medical), the Senographe 2000D (General Electric Medical Systems), the Digital Mammography

System (Hologic), and the Selenia Full Field Digital Mammography System (Hologic) [12]. In this study the mean age was 54 years old, the stage of breast cancer was T1- T4. The overall diagnostic accuracy of digital and film mammography as a means of screening for breast cancer is similar, but digital mammography is more accurate in women under the age of 50 years, women with radiographically dense breasts, and premenopausal or perimenopausal women [12].

Cancer detection rate was evaluated in two studies. The first study was a Prospective study done on 43,429 women, aged between 45–69 years. Cancer detection rate was 41% when using film mammography, it was performed using one of three mammography units (Mammomat 300; Siemens Medical Systems, Erlangen, Germany) with Min-R 2000 film and Min-R 2190 screens (Eastman Kodak, Rochester, NY) in both standard and large formats. A molybdenum anode, molybdenum filter, and 29 kV were used for all examinations. while cancer detection rate was 59% when using digital radiography , it was acquired by using one of two available FFDM units (Senographe 2000D; GE Medical Systems, Milwaukee, Wis) equipped with an automatic mode (automatic optimization of parameters, or (AOP) in which an anode track-filter combination and kV were selected automatically after analysis of premammographic data obtained with a brief exposure. FFDM allowed a higher cancer detection rate than did SFM in the group aged 50–69 [9].

The second study was a randomized trial done by Skaane et al 2007 on 23929 women aged between 45–69 years. The cancer detection rate was 38% using film mammography which was performed with one of two units (Mammom at 300; Siemens Medical Systems, Erlangen, Germany) with Min-R 2000 film and Min-R 2190 screens (Eastman Kodak, Rochester, NY) in both standard and large formats. While cancer detection rate using digital mammography was 59%, the image of which were acquired with another unit (Senographe 2000D; GE Medical Systems, Milwaukee, Wis). Mammograms from both imaging modalities (SFM and FFDM) included the two standard views (craniocaudal and mediolateral oblique) of each breast. FFDM resulted in a significantly higher cancer detection rate than did SFM [14].

Image quality was rated by Fischmann et al., 2005, the study was carried on 200 women above 40years of age. Image quality was excellent for digital mammography which was performed using the GE Senographe 2000D. Comparison was made on hardcopies, printed on a Kodak DryView 8610 laser-printer. Printout parameters were set in standard mode. While image quality was decreased when using film mammography which was performed using a GE Senographe DMR+ with Kodak MinR 2000 film–screen system (Kodak, Rochester, NY), and developed using a Kodak Xomat M35 developer with RP. Digital mammography demonstrated improved image quality compared with film–screen mammography [13].

Discussion

Mammography is the primary tool for the early detection of breast cancer. The use of screening mammography is associated with the detection of breast cancer at an earlier stage and smaller size and, thus, with a reduction in mortality from breast cancer in women aged 40–69 years, as has been shown in randomized trials [15]. Conventional screen-film mammography (SFM) with high spatial resolution has been the modality of choice for screening programs[6]. digital mammography was significantly better than conventional film mammography at detecting breast cancer in young women, premenopausal and perimenopausal women, and women with dense breast[12], it allowed a higher cancer detection rate than did SFM in the group aged 50–69 years [9].

Digital mammography also demonstrated improved image quality compared with film–screen mammography[13]. In a digital image, the x-ray transmission can be manipulated to enhance visualization of subtle structural changes in tissue over the entire breast. For mammograms, the most problematic areas are those in which cancers can be hidden by adjacent dense tissue owing to small differences in contrast between lesions and the fibroglandular background [12].

Screening mammography reduces the rate of death from breast cancer and that if digital mammography detects cancers at a rate that equals or exceeds that of film mammography, its use in screening is likely to reduce the risk of death by as much as or more than that conferred by film mammography. The cancers detected by digital mammography and missed by film mammography in women under the age of 50 years, women with heterogeneously dense or extremely dense breasts, and premenopausal and perimenopausal women included many invasive and high-grade in situ cases. These are precisely the lesions that must be detected early to save lives through screening. Neither digital nor film mammography found all the breast cancers in the population. Palpable findings and symptoms that develop after screening should be evaluated even if a woman has negative findings on digital mammography [12].

Conclusions

Digital mammography offers other advantages over film mammography easier access to images and computer-assisted diagnosis, improved means of transmission, retrieval, and storage of images, and the use of a lower average dose of radiation without a compromise in diagnostic accuracy. Also it has some limitations, a further limitation is the subjective character of the parameters examined. As the radiologist is one of the major limiting factors in breast imaging, the non-objective parameters play an important role in the diagnostic process.

Conflict of interests

The authors declared no conflict of interests.

References

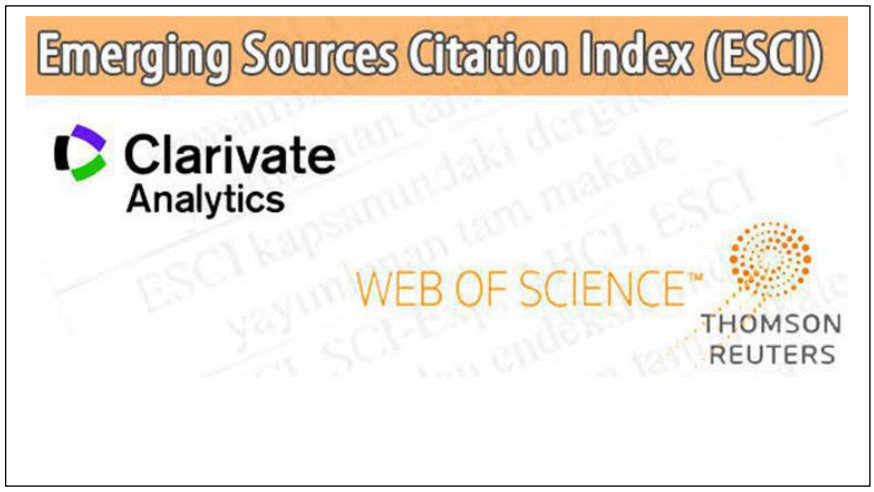
1. Ariel, I.M. and J. Clearly, Breast cancer: Diagnosis and treatment. 1987.
2. Kopans, D.B., The positive predictive value of mammography. AJR. American journal of roentgenology, 1992. 158(3): p. 521-526.
3. Council, N.R., Saving women's lives: strategies for improving breast cancer detection and diagnosis. 2005: National Academies Press.
4. Sahiner, B., et al., Computerized characterization of masses on mammograms: The rubber band straightening transform and texture analysis. Medical Physics, 1998. 25(4): p. 516-526.
5. Sterns, E.E., Relation between clinical and mammographic diagnosis of breast problems and the cancer/biopsy rate. Canadian journal of surgery, 1996. 39(2): p. 128.
6. Berns, E.A., R.E. Hendrick, and G. Cutter, Performance comparison of full-field digital mammography to screen–film mammography in clinical practice. Medical physics, 2002. 29(5): p. 830-834.
7. Shtern, F., Digital mammography and related technologies: a perspective from the National Cancer Institute. Radiology, 1992. 183(3): p. 629-630.
8. Pisano, E.D., et al., Diagnostic performance of digital versus film mammography for breast-cancer screening. New England Journal of Medicine, 2005. 353(17): p. 1773-1783.
9. Skaane, P. and A. Skjennald, Screen-film mammography versus full-field digital mammography with soft-copy reading: randomized trial in a population-based screening program—the Oslo II Study. Radiology, 2004. 232(1): p. 197-204.
10. Carney, P.A., et al., Individual and combined effects of age, breast density, and hormone replacement therapy use on the accuracy of screening mammography. Annals of internal medicine, 2003. 138(3): p. 168-175.
11. Boyd, N.F., et al., Heritability of mammographic density, a risk factor for breast cancer. New England Journal of Medicine, 2002. 347(12): p. 886-894.
12. Pisano, E.D., et al., Diagnostic performance of digital versus film mammography for breast-cancer screening. N Engl J Med, 2005. 2005(353): p. 1773-1783.
13. Fischmann, A., et al., Comparison of full-field digital mammography and film–screen mammography: image quality and lesion detection. The British journal of radiology, 2005. 78(928): p. 312-315.
14. Skaane, P., S. Hofvind, and A. Skjennald, Randomized trial of screen-film versus full-field

digital mammography with soft-copy reading in population-based screening program: follow-up and final results of Oslo II study. Radiology, 2007. 244(3): p. 708-717.

15. Tabár, L., et al., Beyond randomized controlled trials. Cancer, 2001. 91(9): p. 1724-1731.

Table (1): Summary table of the included studies that compared digital mammography versus film mammography in detection of breast cancer

Citation	Study design	Sample size	Age of patients	Digital mammography	Film mammography	Accuracy of digital mammography	Accuracy of film mammography	Comparison
(Pisano et al., 2005b)	Cohort study	49,528	Mean 54 years	Five digital-mammography systems were used: the SenoScan, the Computed Radiography System for Mammography, the Sonographer 2000D, the Digital Mammography System, and the Selenia Full Field Digital Mammography System.	Not reported	Sensitivity= 38_49% Specificity= 97%	Sensitivity= 35_38% Specificity= 97_98%	The overall diagnostic accuracy of digital and film mammography as a means of screening for breast cancer is similar, but digital mammography is more accurate in women under the age of 50 years, women with radiographically dense breasts, and premenopausal or perimenopausal women.
(Skaane and Skjennald, 2004)	Prospective study	43,429	45–69 years	FFDM images were acquired by using one of two available FFDM units equipped with an automatic mode (automatic optimization of parameters, or AOP) in which an anode track-filter combination and kV were selected automatically after analysis of premammographic data obtained with a brief exposure.	All SFM examinations were performed by using one of three mammography units with Min-R 2000 film and Min-R 2190 screens in both standard and large formats. A molybdenum anode, molybdenum filter, and 29 kV were used for all examinations.	Cancer detection rate= 59%	Cancer detection rate= 41%	FFDM allowed a higher cancer detection rate than did SFM in the group aged 50–69
(Fischman et al., 2005)	_	200	Above 40 years	All images of one patient were taken by one radiographer compressing the breasts with identical force to identical thickness with both modalities. FFDM was performed using the GE Senographer 2000D. Comparison was made on hardcopies. Printout parameters were set in standard mode	All images of one patient were taken by one radiographer compressing the breasts with identical force to identical thickness with both modalities. FSM was performed using a GE Senographer at 33.5°.	Image quality was rated by reader A/B/C as excellent for FFDM in 153/155/167 cases.	For FSM in 139/116/114 cases.	FFDM demonstrated improved image quality compared with film–screen mammography.
(Skaane et al., 2007)	Randomized Trial	23929	45– 69 years	Mammograms from both imaging modalities (SFM and FFDM) included the two standard views (craniocaudal and mediolateral oblique) of each breast. FFDM images were acquired with another unit (Senographer, 2000D).	SFM examinations were performed with one of two units with Min-R 2000 film and Min-R 2190 screens in both standard and large formats	Cancer detection rate was 0.59%, while sensitivity was 77.4% at FFDM and specificity was 96.5%	Cancer detection rate 0.38% and 61.5% at SFM 97.9%.	FFDM resulted in a significantly higher cancer detection rate than did SFM


Emerging Sources Citation Index (ESCI)
Clarivate
Analytics
WEB OF SCIENCE™
THOMSON
REUTERS