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Surgeon-Read Screening Mammography: An Analysis of 11,948 Examinations

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ABSTRACT

Introduction. Mammography was pioneered by surgeons but is now the domain of radiologists. With ever-increasing cost pressures it must be examined whether interpretation of mammography by clinicians and radiation technologists is comparable to that of breast radiologists. We present the largest series of surgeon-read screening mammography to date.

Methods. All mammography performed between 2003 and 2009 at a comprehensive breast centre was recorded prospectively. First assessment was by a radiation technologist and consensus established after second reading by a breast surgeon, who took responsibility for the reading. Data recorded were: age, hormonal replacement therapy, prior breast surgery, indications for mammography and outcomes. Outcomes were classified based using the Breast Imaging Reporting and Data System (BIRADS). Indeterminate lesions were imaged further or underwent tissue acquisition. All BIRADS 5 lesions underwent tissue acquisition.

Results. Of 11,948 mammograms, 538 were reported as indeterminate/compatible with malignancy; 240 biopsies were performed, and 87 cancers diagnosed. In 40–49-year-old women (4,956 mammograms), the recall rate was 4.2%, the biopsy rate was 1.6%, the malignancy rate of biopsy was 23.7% and the cancer diagnosis rate was 3.6/1,000 examinations; for 50–69-year-old women these figures were 6,546, 4.7, 2.2, 44.1% and 10.0/1,000, respectively, and in women older than 70 years, they were 446, 5.6, 3.4, 33.3% and 11.2/1,000, respectively. Of all cancers, 32.2% were non-invasive; of invasive cancers, 49.1% were 10 mm or less in diameter and 75% were node negative.

Conclusions. These results are similar to those in high-quality organized screening programs. The role of breast surgeons in mammography interpretation should be expanded.

While mammography was pioneered by surgeons in the early decades of the last century, it is currently conventionally accepted to be the domain of radiologists.[1] With the global lack of radiologists in general and breast radiologists in particular, several series have reported on interpretation of symptomatic mammography by surgeons and reading of screening mammography by radiation technicians.[2–12] In a highly specialized clinical environment such as a one-stop breast clinic, clinicians and radiation technicians are at hand to interpret breast imaging. In an environment of ever-increasing cost pressures, it must be examined whether interpretation of mammography by these clinicians and radiation technologists is comparable to that of specialized breast radiologists.

The results and analysis of symptomatic mammography reading are largely dependent on the referral pattern to such clinics. Therefore, benchmarks of reading performance cannot be accurately defined by analyzing reading performance in such environments. In contrast, screening is one of the best researched areas in women's health with the well-known early studies and later in-service experience establishing the benefits of mammographic screening and the consequent establishment of performance benchmarks to which any screening centre should adhere to minimize harm due to increased anxiety, false-positive results leading to unnecessary biopsies and increased cost.[13–25] To contribute to the debate of who should be reading mammography and examine whether breast surgeon and technician reading in an intensely clinical environment

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produces results fulfilling these performance benchmarks, we present herein the largest series of surgeon-read screening mammography to date.

METHODS

All mammography performed between 2003 and December 2009 at a comprehensive breast centre was entered into a prospective database with permission of the patients. The centre caters to the health-insured female population of the Cape Peninsula in South Africa. Mammography was performed exclusively by fully qualified radiation technologists, i.e. professionals with a 4-year university education in diagnostic radiography. All radiation technologists had an additional 1-year postgraduate certificate course in breast imaging. All mammography was performed on state-of-the-art equipment: Initially film-screen equipment was used (Phillips MammoDiagnost, Phillips Ltd., Eindhoven, The Netherlands; Agfa Mamoray HDR films, Agfa Corporation, Mortsel, Belgium, developed using a dedicated Konica processor, Konica Corporation, Tokyo, Japan) and from July 2006 full-field digital equipment (GE Senographe DS; GE Healthcare, Chalfont St. Giles, UK). While first assessment of the mammogram was by radiation technologist, all imaging was double-read by a breast surgeon (J.P.A. or K.J.B.), not aware of the initial assessment. Consensus was established and recorded after the second reading, with the breast surgeons taking responsibility for the reading. All readers had a special interest in breast health, had completed an internationally recognized course in mammography interpretation, read at least 2,000 mammograms annually and had a minimum of 50 h annually of continued professional development in clinical-pathologic and imaging correlation in breast health; both breast surgeons have extensive experience in clinical management of breast cancer as consultants responsible for the management of more than 400 new cases of breast cancer annually for 15 years (J.P.A.) and 6 years (K.J.B.).

Data recorded were: age, hormonal replacement therapy and its duration, prior breast surgery, indications for mammography and outcomes. Indications for screening mammography as published by the American Cancer Society were adhered to.[26] Incidence was arbitrarily defined as prior mammography within 18 months of the current examination and the prior mammogram available for comparison. Patients with personal history of breast cancer were excluded from the analysis. Outcomes were classified in a simplified classification system based on BIRADS: BIRADS categories 3 and 4 were combined as indeterminate.[27] Patients with these lesions were either asked to return for further imaging examinations, such as spot compressions, magnification and extended views, short-term follow-up examination or a tissue sample was obtained for pathologic examination. Patients not returning for follow-up examination were contacted telephonically to ensure compliance. All lesions categorized as BIRADS 5 underwent tissue acquisition for histopathology. Tissue acquisition was either stereotactic or ultrasound guided.

Data were entered into and analyzed with a commercially available software package (MS Office XP Pro; Microsoft Corporation, Redmond, Washington, USA). Data were stored in a password-protected database and, for purposes of the analysis, de-identified.

The study was approved by the Ethics Committee of The University of Stellenbosch.

RESULTS

A total number of 16,164 mammograms were performed. Of these, 11,948 (74%) were done for screening of

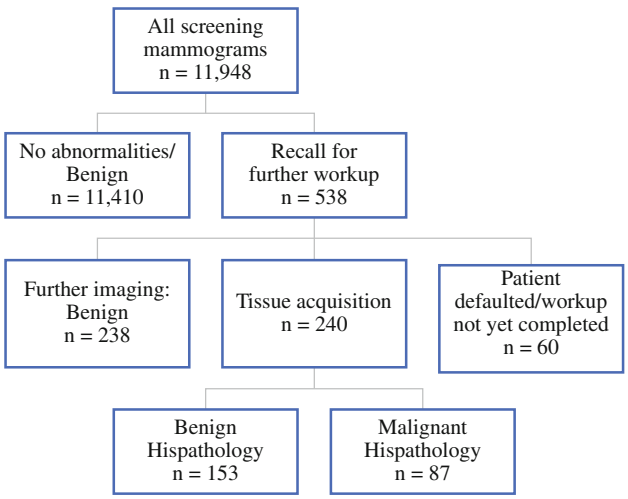

FIG. 1 The outcome of all screening examinations

TABLE 1 Number of screening mammograms per age group and their outcome

Screening mammograms per age group (years)		% on HRT	Prior surgery (%)	Incidence mammography (%)	Recall rate (%)	Biopsies, *n* (% of screening mammograms)	Cancers, *n* (% of biopsies performed)
40–49	4,956	7.5	21	29.2	4.2	80 (1.6)	18 (22.5)
50–69	6,546	48.7	25.9	39.4	4.7	145 (2.2)	64 (44.1)
70+	446	46.6	24.4	33.0	5.6	15 (3.4)	5 (33.3)

TABLE 2 Analysis of screening performance indicators

Age group	No of cancers diagnosed, *n*	Per 1,000 examinations
40–49 years	18	3.6
50–69 years	64	10.0
70+ years	5	11.2
In situ cancers	28	32.2%
Invasive cancer	59	67.8%
Invasive cancers[a]		
<5 mm	10	18.2%
6–10 mm	17	30.9%
11–20 mm	21	38.2%
>20	7	12.7%
Node negative	44	75%
Node positive	11	25%

[a] Four patients were censored as they had neoadjuvant systemic therapy

The average diameter of invasive tumours was 12.6 mm

asymptomatic women aged 40 years or older. Results of the examinations are reflected in Fig. 1 and Tables 1 and 2.

DISCUSSION

The availability of a service attracts individuals who seek to be screened; consequently the vast majority of the examinations at our centre are screening examinations.[28] The population, with its heavy hormone replacement therapy use, high prevalence of prior breast surgery and large proportion of women aged 40–49 years, presents a challenging population for mammographic screening.[29,30] Racial classification of our screening population might be considered interesting, but is unacceptable in the current political environment in South Africa.[31]

In opportunistic screening less emphasis is placed on quality controls than in organized screening programs.[28] Even in a resource-rich country such as the USA, with legislation to govern the quality of mammography, collection of outcome data of screening mammography is likely to be incomplete and generally there is no reimbursement for the substantial cost incurred in collection of these crucial data.[25,32] Therefore it is unclear whether the promise of a reduced mortality of breast cancer achieved at reasonable cost is fulfilled in many breast centres.

In her seminal paper, Osuch detailed a decade-long effort to improve the mammographic quality in Michigan.[33] Her quest vividly illustrates that, even in a litigious environment such as the USA, the mere presence of a mammographic service does not guarantee quality levels sufficient for effective screening. Consequently, complex mechanisms have been established to ensure mammographic quality in the USA, the European Union and Australia.[32,34,35] It is our opinion that a simplified system of outcome reporting based on the principal measures of efficacy and safety we have reported here is the minimum for any breast centre and should be universally enforced.

The caseload–quality of reading relationship is well documented in mammography, with specialized readers with caseloads of more than 2,000 mammograms per year working in dedicated breast units detecting more cancers and generating fewer false positives than general readers.[39–44] It is interesting that the Mammography Quality Standards Act requires a much lower caseload. In a large sample from the USA, Smith-Bindman and colleagues reported that, depending on location, 42–63% of all mammography was read by readers with experience of fewer than 2,000 mammograms per year.[44] The efficacy of screening outside high-volume units has been questioned.[44,45]

Surgeons can read symptomatic mammography as accurately as radiologists: In a series of 1,053 women with histopathologically confirmed benign or malignant breast lesions, which were read by surgeons versus radiologists, Vidya concluded, "that symptomatic mammograms should be read by surgeons as well as radiologists".[6] Rao et al. compared surgeon versus radiologist reading of 144 mammograms in a symptomatic one-stop clinic and felt that, due to the accuracy of their reading, surgeons can "be involved in double reading of mammograms in symptomatic breast disease patients and improve the sensitivity".[3] We reported the results of surgeon-reading of a series of 8,743 mammograms performed in a symptomatic breast clinic and compared the results with radiologist reading reported from comparable environments; the reading accuracy was similar.[46] Burns and colleagues analyzed a series of 694 stereotactic needle core biopsies with 2-year follow-up performed by surgeons and found that "the false-negative rate and negative predictive value in this series compare favorably with those in other reports, supporting the fact that surgeons can confidently use stereotactic needle core biopsies in the evaluation and treatment of breast disease".[2] De facto, surgeons already need to interpret mammography of patients referred for biopsy to confirm the indication for the intervention. Sterns examined this effect in an analysis of 2,936 patients referred for breast evaluation. He concluded, that "because of the large number of women referred for surgical evaluations who have normal results on a mammogram or whose mammograms show a benign problem, a conservative approach is appropriate to reduce the number of biopsies performed in women of all ages".[4] Stolier examined the results of 244 surgeon-performed stereotactic needle core biopsies and reported an accuracy of 97.7%.[5] In the USA, about a

TABLE 3 Outcome measures and comparison with international benchmarks

Criterion	USA[25]	NHS, UK[36,37]	Breast Screen Australia[38]	Present series
Recall rate	9.8%	4.6%	4.2–9.8%	4.2–5.6%
Biopsy rate	–	50–69 years: 1.78%	–	50–69 years: 2.2%
Malignancy rate of biopsies	33.8%	50–69 years: 44.8%	–	50–69 years: 44.1%
Cancers per 1,000 examinations, 40–49 years old	4.7 all examinations	–	5.6	3.6
Cancers per 1,000 examinations, 50–69 years old		8.0	5.6	10.0
Percentage of in situ cancers	21.6%	21.9%	20.2%	32.2%
Percentage invasive cancers	78.4%	78.1%	79.8%	67.8%
<5 mm	10.2%[a]	25.3%	62.9% (tumours <15 mm)	18.2%
6–10 mm	27.0%[a]			30.9%
11–20 mm	31.6%[a]	48.0%	37.1% (tumours ≥15 mm)	38.2%
>20 mm	21.2%[a]	26.7%		12.7%
Node-negative cancers (%)	79.8%	76%	–	75%
Node-positive cancers (%)	20.2%	24%	–	25%

[a] In 8.5% of invasive cancers, the size was unknown

quarter of all stereotactic biopsies are performed by surgeons; surgeons regularly perform ultrasound-guided biopsies, with results comparable to radiologists.[2,5,47–49] Indeed, performance of these interventions by surgeons was found to be less inconvenient and more cost-effective.[48] A common finding of these series is that surgeons tend to recommend fewer biopsies to be performed than radiologists. Breast surgeon reading of mammography may thus reduce the "harm" generated in screening programs by reducing unnecessary recalls and biopsies, especially when it takes place outside of high-volume units.

For this series, mammography reading was conducted entirely by surgeons and radiation technologists dedicated to breast health management. The results achieved not only compare favourably with those achieved in community screening series worldwide but also are similar to results achieved in benchmark organized screening programs, and are—with low recall and biopsy rates—at the top end of "the desirable range recommended for highly skilled radiologists" in the USA (Table 3).[25,36–38,50] This is despite patients with a personal breast cancer history being excluded and about 10% of patients not having completed their work-up; both factors lead to underestimation of cancer diagnosis rate. Evidence from large series examining interpretation of mammograms by radiographers in Canada, The Netherlands and England indicates that radiographers in screening programs can read mammography "at least as well as" radiologists.[7–11] This confirms the importance of dedication to breast health and stringent quality control at all levels of the diagnostic process in the achievement of desired outcomes in breast cancer screening over and above the initial specialization of the readers.

Our series is the only one that reports on the results of the reading of screening mammography by surgeons. It closes the last gap in mammography interpretation: As quoted above, surgeons have been shown to be competent in symptomatic mammography interpretation, interventional diagnostics and now also in screening mammography, and therefore in all clinical situations arising in busy breast health clinic. Breast surgeons who are willing to dedicate time and effort to honing and monitoring their skills in mammography interpretation should play a much more prominent role in the reporting of breast imaging than currently for the benefit of their patients. The notion that breast imaging and its interpretation must be restricted to radiologists is more likely a result of skilful lobbying for turf interests than of scientific evidence.

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