European Group for Breast Cancer Screening

E2. Current issues in breast screening

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Introduction

There continues to be debate about the overall effectiveness of mammography screening and whether is delivers any significant reduction in mortiality from breast cancer. The first session of this meeting considers two aspects of this debate. If screening is effective it would be expected that the incidence of advanced breast cancer in the screened population would fall. Data presented will suggest that this has not been observed in several screening populations and the implications of this will be debated. The second issue is the effectiveness of screening older women and an overview of the evidence and modelled assessment of mortality reduction will be presented. Both of these topics will be debated by the audience with the expert panel.

Mammography has been the last of the conventional imaging techniques to 'go' digital because of the technical challenges of the high resolution required. Digital mammography is now becoming routine and this technology provides several opportunities to enhance screening performance. The following summarises the current state of this new technology and its potential applications.

What new evidence on digital mammography and screening?

Full-field digital mammography (FFDM) provides several benefits over screen-film mammography (SFM) for breast cancer screening, especially in women with dense breasts. A total of 13 studies have been reported so far comparing FFDM and SFM in screening (chronologically listed): the Colorado-Massachusetts study, Oslo I and II studies, DMIST trial, Tromsø study (abstract), Helsingborg study, Florence study, Vestfold County study, Sogn and Fjordane study (abstract), Central-East London study, Barcelona study, the Dutch DSPP study, and the Irish study.[1,2,3] These studies show somewhat conflicting results. The two pioneer studies (the Colorado-Massachusetts and Oslo I studies) reported a lower cancer detection rate for FFDM. The other eleven have all shown a higher cancer detection at FFDM, reaching statistical significance in some of the studies. An important finding has been the higher detection rate for microcalcifications (DCIS) using FFDM. However, overall, the recall rates have been higher for FFDM in most European studies and, consequently, the positive predictive value has been comparable for the two imaging techniques.

Computer aided detection (CAD) has the potential to improve sensitivity in screening mammography.[4] Several studies have shown that single reading with CAD may achieve cancer detection rates comparable to those of double reading. However, the results of CAD in breast cancer screening have been conflicting. The very high sensitivity of CAD in detection of microcalcifications may prove to be of special importance in digital soft-copy reading but further prospective studies are necessary to assess the optimal integration of CAD in digital soft-copy reading (see below).

Digital breast tomosynthesis provides multiple images of the breast and may have the potential, not only to improve detection of masses (sensitivity) in women with dense breast parenchyma, but also to improve the specificity in a screening setting. Theoretically, this new imaging technique may have a potential in mammography screening. The few reported studies on tomosynthesis have been in experimental clinical settings and, so far, no trials comparing tomosynthesis with conventional two-dimensional imaging have been carried out in the screening setting.

Making digital mammography work for screening

The implementation of digital mammography in a decentralised screening setting requires adaptations in image transmission, reconciliation with previous mammograms, storage, on-screen reading and reporting and workflow changes. This conversion is an informatics challenge for both radiology units and the screening programme. The experience of running a digital based decentralised screening programme in Switzerland is presented.

Eight public /private radiology units using four different mammography systems (two Sectra, three GE, two

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Lorad's full field digital systems and one Fuji/Siemens CR system) collaborate with the breast screening programme in the canton of Fribourg in Swizterland. For image transmission, each centre installed a KISANO server that ensures high security image transmission over the internet on a peer to peer basis. After acquisition, the images are sent to the KISANO server and reconciled with the previous mammography if available (received from the central archive). The first radiology reading is done following the work list on the local workstation. The web-based electronic screening reporting form follows the work list and when validated, the information is transmitted to the screening centre with the current and prior images. There, the second reading takes place on a multi-modality workstation. All communications between the radiology units, the screening centre and the archive is provided by a central hosted communication centre. Automated DICOM image transmission and reconciliation with previous mammograms using the KISANO server modality proved to be a robust system in a multi-vendor mammography environment. Electronic reporting decreased the number of incomplete reports.

This project has shown that integration of multi-vendor digital mammography devices in a decentralised screening programme can be implemented successfully.

Overview on current data on digital breast tomosynthesis imaging

Digital breast tomosynthesis (DBT), like contrast-enhanced mammography, is an advanced application of digital mammography that was developed following the advent of dedicated large field detectors. DBT provides three-dimensional imaging of the breast with the advantage of high in-plane spatial resolution, approaching that of standard mammography. DBT, thus, has the potential to overcome the limitation of overlapping breast tissue on a standard two-dimensional mammogram.

Obtaining three-dimensional information requires the acquisition of multiple projections of the breast from different angles. These form a set of low-dose source images.[5] Different algorithms are used to reconstruct the breast volume in 1-mm slices. The breast may be displayed in multiple planes at various depths parallel to the detector surface. Thin and thick slices (maximum intensity projection and average algorithm images) are available for review. Depending on technique parameters, the total dose of one-view DBT is about that of one to two standard digital mammograms. Perspectives include contrast-enhanced DBT, and coupling radiographic imaging with other modalities such as ultrasound or elastography.

Tomosynthesis has been proposed for use in both diagnostic and screening applications. Initial experience in 98 patients with abnormal digital screening mammograms showed that image quality of up to three-view DBT performed on the index breast was equivalent or superior to diagnostic mammography in most cases. Adding DBT to screening would potentially have decreased the recall rate by 40%, this benefit largely due to better assessment of focal asymmetry and architectural distortion.[6]

An observer performance study reported the findings in125 patients (with 35 malignant lesions).[7] Based on BIRADS rating, the adjunct of DBT to digital mammography reduced the recall rate by 30% ($p < 0.0001$). However, there was no evidence that using DBT alone or in combination with mammography would result in a significant improvement in sensitivity.

Andersson and colleagues[8] compared breast cancer visibility in one-view DBT to cancer visibility in one- or two-view digital mammography in a series of 40 cancers with subtle mammographic findings in a non-blinded consensus review. One-view DBT was performed at the mammographic angle where the lesion was the least/not visible. The cancers were significantly more visible on DBT compared to one- and two-view mammography in 22 and 11 cases, respectively. Comparing one-view, then two-view mammography to one-view DBT, 21 and 12 cancers were upgraded on BIRADS classification, respectively.

Teertstra and colleagues evaluated DBT in a larger series of 513 women with an abnormal screening mammogram or with clinical symptoms, resulting in 112 detected breast cancers.[9] The sensitivity of both mammography and DBT was high (92.9% and specificities were similar at 86.1% and 84.4%, respectively). Combined mammography and DBT detected 109 cancers but both techniques missed three carcinomas. These authors found that additional lesions detected by DBT were also likely to be detected by other techniques routinely used in the clinical work-up.

DBT appears to offer valuable imaging information in both diagnostic and screening applications, mainly by improved visibility of lesions and lesion margins. To date, a relatively small number of patients have been investigated. The largest available series conducted in a diagnostic population with comparison to standard of care seems to show only a marginal gain in performance when using DBT for clinical decision-making. Large-scale clinical evaluation is needed to better determine the role of this new breast imaging technique and its perspectives.

Criticial review of CAD

One source of evidence about the effectiveness of CAD comes from a pair of linked systematic reviews, looking first at comparisons of single reading and CAD and then at comparisons of single and double reading. Double reading with arbitration shows a significant increase in detection rate and a decrease in recall rate. CAD studies

do not show a significant increase in cancer detection rate and show an increased recall rate.[10] However, perhaps the best evidence about the impact of CAD is from the CADET II trial, an equivalence trial powered to detect a 10% difference between the intervention and control conditions.[11] No difference was detected so the two are considered equivalent.

We calculated the mean annual cost for a variety of possible configurations.[12] No installation will be cost-effective if the impact on recall rate is high and recall appointments are long. If, for example, four machines and four additional softcopy workstations are required to handle throughput in a large screening unit, then either the appointments will have to average less than 40 min, or the impact on recall rate will have to be no more than 15%. It is clear, however, that there is scope for a cost-effective use of CAD.

It is worth reflecting on the clinical significance of the changes in cancer detection rate under consideration here. We built a mathematical model, populated with data obtained from published statistics describing the UK NHSBSP and the incidence and mortality of breast cancer in the UK, and ran it with values of sensitivity from 75 to 95%.[12] The results show the proportion of cancers detected at screening increasing as screening improves, and deaths from breast cancer falling. The drop in breast cancer deaths is, however, modest. Increasing sensitivity from 75% to 85% reduces the number of breast cancer deaths from 28 to 27 per 1000. This suggests that improvements in the sensitivity of screening that we might obtain with CAD will not have a marked effect on breast cancer mortality.

Conflict of interest statement

None declared.

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