

Abstracts from Symposium Mammographicum 2000

1 Future of breast cancer services

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2 Future of breast cancer services

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3/4 The Swedish Two-County Trial 20-years on: updated mortality results and new insights from long-term follow-up

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The Swedish Two-County Trial is a randomized controlled study of invitation to breast cancer screening. It was initiated in late 1977. The follow-up to the end of 1998 provides results at approximately the twentieth anniversary of the trial. A significant decrease in breast cancer death among women invited to screening was published 7–8 years after randomization and at 20-year follow up there is a significant 32% reduction in mortality associated with invitation to screening. The advent of screen-film mammographic screening with the ability to detect potentially fatal tumors at an early stage provides an opportunity to study the natural history of breast cancer at an earlier

phase in its development than was possible in the past. Our findings show that breast cancer is not a systemic disease at its inception, but is a progressive disease and its development can be arrested by screening. Detection of <15 mm and lymph node negative invasive tumors will save lives and confer an opportunity for less radical treatment.

Mammography is clearly a very useful tool, not only for early detection of cancers but also for successful discrimination between the highly fatal and nonfatal cancers. The four mammographic prognostic features will be presented.

5 Screening and its effect on breast cancer mortality rates

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In the Health of the Nation document published by the Department of Health in 1993 it was stated that the eventual success of the breast screening programme would be measured in terms of the breast cancer mortality reduction achieved. Unfortunately, outside the environment of randomised controlled trials the actual mortality reduction from screening is extremely difficult to measure with any precision. This is because national mortality statistics between the start of screening in 1988 and the present day have been affected not only by screening, but also by treatment improvements, cohort effects, earlier presentation outside the screening programme and even changes in the way breast cancer deaths are coded.

Additionally, the full effect of screening in national statistics is not likely to be achieved until 2005–2010 rather than the year

2000, as often reported. This is because of two major factors. Firstly, many deaths from breast cancer in the 1990s will be from women who were diagnosed with breast cancer before invitation to screening (full coverage was not achieved until 1995). Secondly, the screening sensitivity of the NHSBSP did not achieve parity with the Swedish-Two County study until 1996/97. In the early years of screening there was a major shortfall of invasive cancers, which led to high interval cancer rates and a projected mortality reduction much less than 25%. The combination of these two factors will lead to a considerably lower mortality reduction than 25% by the year 2000. Nevertheless some mortality reduction from screening would be expected and standard epidemiological techniques (age-cohort modelling) have been employed in an attempt to measure this.

6 Introducing MRI into clinical breast practice

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Although there are numerous publications regarding the value (and limitations) of MRI in the diagnosis of a variety of breast conditions, access to MRI in the UK is severely limited. Because prioritisation of all cases needing MRI is necessary,

only those that will lead to a clear alteration in clinical management can be justified. Against this background, the current use of MRI in a busy symptomatic and screening practice will be presented and justified.

7 MR-guided breast biopsy

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MRI is capable of detecting small malignancies or malignant foci not visible by other methods. However, its specificity is limited. In order to render work-up of MR-detected lesions as cost-effective and as minimally invasive as possible, percutaneous MR-guided biopsy is desirable.

So far various biopsy coils for imaging and fixation of the breast during percutaneous biopsy have been developed. However, MR-guided core or fine needle biopsy has so far been limited to few cases mainly with lesions >1 cm.

An overview will be given over the presently available equipment and techniques for percutaneous core needle biopsy.

Furthermore, MR-guided vacuum biopsy will be presented. It allows percutaneous biopsy of an area of up to 15 mm diameter and thus can compensate for inaccuracies which might occur during needle insertion or due to field distortion. Furthermore, in most cases disappearance of the enhancing lesion or visualisation of the cavity directly after the procedure allows us to directly prove representative removal.

First-year results of a multicentre study on MR-guided vacuum biopsy will be shown as well.

Conclusion: MR-guided vacuum biopsy promises accurate and reproducible work-up of MR-detected lesions.

8 Lymph node diagnosis

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Lymph node involvement remains the most powerful individual prognostic factor in breast cancer. Conventional axillary staging is either by axillary node clearance or some form of sampling. BASO data show that around one-third of surgeons in the UK are sampling and two-thirds performing some type of clearance. The exact definition of clearance is not well defined and surgeons have different techniques. Evidence does suggest that, although lymph node sampling is qualitatively similar to clearance, the morbidity is little different, if the sample nodes prove positive and treatment is completed by radiotherapy to the breast and axilla. In view of these facts there is now enormous current interest in the technique of sentinel node biopsy, which aims to remove the first level

(draining node – a so-called sentinel node). The technique, which is best performed by a combination of radioisotope and blue dye, has been shown to detect a lymph node about 95% of the time and the false negativity varies from an average of 5% up to 30%. Current trials are taking place in the USA, Europe and the UK, looking at sentinel node biopsy in the breast cancer setting. The British trial, ALMANAC, is just completing the audit phase where each surgeon carries out 40 sentinel nodes biopsies, followed by a full axillary clearance or sampling. This has shown an acceptably low false-negative rate and the main randomised portion of the trial is just beginning. This will compare sentinel node biopsy alone against conventional axillary treatment.

9 Surgical management

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The first aim is to establish a definitive diagnosis to ensure that the patient has a single operative procedure. The roles of FNA

and core biopsy will be considered. Cytology can be reported immediately, but core biopsy can establish a diagnosis of inva-

sive cancer. Approximately 30% of patients with DCIS diagnosed on a core biopsy are shown to have invasive cancer at subsequent surgery. A lower percentage of patients are found to have invasive cancer when DCIS is diagnosed on a mamotome biopsy. The aim is to achieve complete excision at a single procedure and to minimise the amount of tissue removed. Studies have shown that, although there are significant differences in the amounts of tissue different surgeons remove when excising lesions of similar size within a single unit, the variations are small. Margins are the single most important factor affecting local recurrence. For impalpable

cancers, there are a variety of different options for localising the lesion, including wire localisation, radioisotope injection and carbon marking. When wires are used for areas of microcalcification, consideration should be given to placing more than one wire in the breast to assist the surgeon. Intraoperative-orientated specimen X-ray is essential and can significantly increase the rates of complete excision. Not all screen detected breast cancers are small and some require more extensive resections or mastectomy. In both these groups of patients, consideration should be given to partial or total breast reconstruction.

10 Oncology

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11 Electrical impedance imaging of the breast (TranScan TS 2000): initial UK experience

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The TranScan TS 2000 (Siemens Medical Systems) is a real-time non-invasive radiation-free imaging device for breast examination, which utilises the inherent differences in electrical impedance between neoplastic and normal tissue.

Tissue changes associated with cancer cause significant variations in dielectric properties. These result in cytological and histological changes involving intra- and extracellular water, membrane properties and packing density associated with malignant transformation. Electrical impedance (both conductivity and capacitance) is typically 20–40 times lower than normal tissue. Therefore, when a small alternating current is applied across the breast, malignant tissue distorts the electric field generated and this can be detected and displayed.

Since February 2000 we have been evaluating the TranScan TS 2000 in our unit, both for symptomatic patients and women with screen-detected abnormalities. We have retrospectively analysed patients undergoing both mammographic and TranScan examinations who subsequently underwent excision or core biopsy. Initial data suggests the TranScan is a useful addition to the assessment of patients, increasing diagnostic accuracy in terms of both sensitivity and specificity. Further large-scale studies are needed to demonstrate whether a substantial reduction in biopsies of benign lesions and/or an increase in number of cancers detected will result from the use of the TranScan.

12 Pre-operative diagnosis and staging of symptomatic breast disease using ^{99m}technetium scintimammography

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Triple Assessment (TA) may fail to distinguish benign from malignant disease, underestimate locoregional spread or miss occult multifocal disease. This study evaluated complementary scintimammography (SMM) in the pre-operative diagnosis and staging of symptomatic breast disease.

Patients underwent initial TA followed by planar SMM of both breasts using 740 MBq ^{99m}technetium sestamibi injected into a pedal vein. Ten-minute acquisition images were graded both blindly and with knowledge of TA as either normal, benign, equivocal, suspicious or malignant.

SMM was performed in 75 patients (45 palpable lumps, 26 impalpable and four axillary masses) without complication. SMM accurately predicted the nature of disease (sensitivity 90%, specificity 92%, PPV 90%, NPV 92%) and reporting was not improved by knowledge of TA. Axillary node histology from 52 patients with malignancy showed SMM sensitivity 19%, specificity 100%, PPV 100% and NPV 65%. SMM detected two occult bilateral cancers (6%) and multifocality in three patients (9%) missed by TA. Consequently, SMM altered the management of 14 breasts from 12 patients (19%).

Complementary SMM after TA improves the accuracy of pre-operative diagnosis and staging of symptomatic breast disease. SMM

may improve the management of breast cancer, particularly when planning breast conservation or management of regional nodes.

13 Preliminary results of a pilot study into the diagnostic value of T scan in detecting breast malignancies

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Research into the electrical impedance of tissues has demonstrated a spread of dielectric data from tumour tissue, suggesting structural inhomogeneities. Correlations have been found that may aid in the detection of breast carcinoma. The T scan measures these changes. This study reports on the results, when used in a clinical setting.

Twenty-seven women, mean age 50 years, referred from a symptomatic clinic, volunteered to have additional T scanning. The results from all imaging modalities were compared and correlated with cytology or histology.

Patients under 35 years old did not have mammography; all patients had ultrasound. The T scan agreed with the other

imaging modalities in 18 cases, giving a bright signal in malignancy and no signal when there was no abnormality or a benign condition (14 true-positives, four true-negatives).

There were three false-positives, a fat necrosis, a simple cyst and a normal breast; four indeterminates, a pale signal for a 14-mm complex cyst (C2), a 40-mm carcinoma (B5), a 16-mm malignancy (B5), and a 15-mm malignancy (C5); two false-negatives, a 15-mm malignancy (B5) and an 8-mm malignancy (R5, U5).

The T scan demonstrated a sensitivity of 78% and a specificity of 57% excluding indeterminates. This study is ongoing.

14 The evaluation of four small-field digital mammography systems

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Continuing developments in diagnostic imaging technology have resulted in the gradual replacement of film screen imaging systems by digital devices. Small-field mammographic imaging is one area in which this new technology has been successfully implemented. These systems are designed primarily for stereotactic localisation, although a number can be additionally used for spot imaging. In the past year, nearly all mammography X-ray units purchased with a stereotactic attachment have been supplied with a digital imaging option. As part of its continuing evaluation programme, KCARE has evaluated the four systems currently offered in the UK. All these are based on charge couple device (CCD) technology. Measurements of breast dose and image quality were made. The use of conventional mammography test objects, although

providing relevant image quality data, is made difficult by the limited field size. Thus, additionally, one commercially available and two in-house test objects were employed, all based on a contrast detail format.

The results showed that, when compared to film screen imaging, low contrast sensitivity is improved and limiting resolution is poorer. Dose levels were generally slightly higher for the digital imaging systems.

In addition to subjective measurements, an objective evaluation was also carried out. Several parameters including detective quantum efficiency (DQE) and modulation transfer function (MTF) were derived and the results are presented.

15 A comparative evaluation of two full-field digital mammography units

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At the present time there are two full-field digital mammography units available to the UK market: 1) GE Senographe 2000D; 2) Trex Medical Corporation Digital Mammography System

The Senographe 2000D uses a caesium iodide/amorphous silicon flat panel detector and provides a field size of 19 × 23 cm. Automatic exposure control is via the detector, and the grid can

be removed for magnification techniques. The image is displayed on a high-resolution monitor and can be manipulated using a number of image processing tools.

The Trex Digital Mammography System uses an array of 12 charge couple device (CCD) cameras. The data are 'stitched' together by the associated software to provide a single image. This is dis-

played on a high-resolution monitor, although currently the manufacturer recommends reporting from laser printer hard copy images. KCARE has carried out an evaluation of both of these

units in terms of breast dose and image quality using a range of standard test objects. The results of these evaluations will be discussed and where possible compared to film screen systems.

16 Preoperative detection of multicentric breast cancer using tetrafosmin mammoscintigraphy

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^{99m}Tc tetrafosmin has been shown to have favourable properties for the imaging of breast carcinoma. We have analysed our experience with this agent in a phase III study to determine its value preoperatively in detecting multicentric breast cancer.

^{99m}Tc tetrafosmin mammoscintigraphy (TMS) was performed prospectively in 15 patients scheduled for excision of breast lesions known or suspected to be carcinoma on clinical examination, mammography or core biopsy. The isotope (700 MBq) was administered via a pedal vein. Anterior and lateral static views were acquired of the breasts and axillae. Scan results were compared with histology to determine the sensitivity of the test for cancer and its utility for guiding breast conservation.

Breast cancer was diagnosed in 14 of the 15 cases. Seven of these cases were mammographically malignant, the lesions being impalpable in three. TMS was falsely negative in three cases but was correctly positive in 11 (79%). One case was true-negative. There were two management decision changes (13%) correctly based on TMS. In both cases, TMS identified previously unknown multicentricity which required mastectomy rather than local excision.

TMS is limited as a screening tool but is potentially useful to assess suitability for conservative breast surgery.

17 A comparison of prone breast biopsy procedures using a digital imaging system with a conventional upright technique

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The study aims to compare the prone biopsy procedures carried out using the Fischer Mammostest Plus 5/Mammovision system with conventional upright biopsy techniques using an IGE 600T/Stereo system. Stereotactic biopsy procedures have been carried out using upright stereo in the centre since 1994. It is anticipated that the introduction of the prone table will enhance the biopsy service currently offered by allowing biopsies to be performed on lesions which were previously too technically difficult on upright stereo, improving the pre-operative diagnosis of the service. Initial measurements indicate that the dose per view (mean glandular dose) for the 'standard breast' is comparable with that for film mammography in the

NHSBSP [1]. An assessment of dose per procedure will be made when the technique is established. The limiting resolution assessed using a Leeds TOR(MAS) test object plate (without scatter) was 9.5 lp/mm at 26 kv. It is intended to investigate the use of a small contrast detail test object (Nuclear Associates Contrast Detail Phantom) designed for a prone biopsy system for optimising selected kv and checking the performance of the system.

Reference

1. NHSBSP Publication 45 (2000)

18 Radiological review of interval cancers in an Australian mammographic screening programme

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Objectives: To determine the proportion and features of invasive interval cancers that could be detected at the time of screening and the proportion classified as true-intervals, false-negatives, minimal signs or radiographically occult lesions.

Setting: BreastScreen Victoria (Australia).

Methods: Review methodologies adopted: (1) a blinded review by five readers of interval, screen-detected and normal cases,

followed by a confirmation exercise to determine the proportion detectable at the time of the previous screen; (2) an unblinded review to classify interval cases as true-interval, false-negative, minimal signs or radiographically occult.

Results: From the blinded review, 38% of interval cases were considered 'potentially detectable' at screening. Comparison of interval and screen-detected cases shows that interval cases are more likely to be smaller, equivocal and ill-defined masses.

In the unblinded exercise, 41% of interval cases were classified as false-negatives, 16% as minimal signs, 33% as true-intervals and 10% as radiographically occult.

Conclusions: This highlights the importance of adopting staged review methods with blinded and unblinded compo-

nents. The blinded review and confirmation exercise determines the proportion of interval cases that were detectable at screening. The unblinded review provides an opportunity for professional development and links into the blinded review through further classification of interval cases.

19 Extending routine invitation to breast screening to the 65–69 year age group: report of the Scottish pilot study

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In parallel with the UK demonstration projects, looking at the question of extending the age of invitation to 69 years, the Scottish Breast Screening Programme was funded to produce a model with the following aims: (1) predict increase in demand; (2) relate this increase to current capacity; (3) identify increased resources required.

A study group aged 65–69 years from practices routinely being invited was identified, reflecting the deprivation category profile of Glasgow and screening was offered in both static and mobile settings. Full screening histories, both in relation to current and

previous attendance, were taken and all attendees compiled a self-completion questionnaire. In addition, interviews of samples of attendees and non-attendees were undertaken. The screening history deprivation category and mobile units each proved to be significant determinants of attendance following routine invitation. In addition, the model correctly predicted attendance for 88.3% of attendees and correctly predicted non-attendance for 74.8% of non-attendees. This model has been used as a basis to predict the resource implications of an extension of the Programme up to and including the age of 69 years. The detailed results of the study and resource implications will be discussed.

20 How do radiographers compare to radiologists when double reading screening mammograms

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Since January 1998, three experienced mammographic radiographers have been trained in image interpretation and analysis at the Nottingham National Training Centre. Since this time, these three radiographers have been acting as second readers of screening mammograms. Prior to this, screening mammograms were single reported by a consultant radiologist. The radiographers and radiologists report the films blind to the opinion of the other reader. In cases of disagreement between the two

readers, a consensus decision is made at a weekly meeting of all the screen readers. To date, 2200 women have been recalled for further assessment having had their mammograms double reported in this way. We will present our complete results following these assessments, which show the trained radiographers to be as competent as the radiologists as screen readers. There is no statistical difference in the recall rates or cancer detection of the radiographers compared to radiologists.

21 Stages of screen-detected breast cancer

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Purpose of study: To present the stages and tumour size of screen-detected breast cancers during the first and second round of the Greek mammography screening programme.

Materials and methods: The target population was women aged 50–64 years, permanent residents of Iliia and Messinia. During the first and second round of our screening programme, 11909 and 13562 women were screened, respectively. Eighty-seven cases of breast cancer were detected. The required treatment was offered to women by the medical staff

of four Reference Hospitals. Tumour size and pathological stage according to TNM classification were recorded for each patient.

Results: During the first round, 46 breast cancer cases were detected among 102 women who were operated on (benign to malignant ratio 1.21:1). The size of these screen-detected tumours was as follows: Tis 2, T1 22, T2 20, T3 1 and T4 1. Disease stage was: stage 0, 2; stage I, 15; stage II, 27; stage III, 2. Of the 65 biopsied women during the second round,

41 had cancer (benign to malignant ratio 0.58:1). Tumour size was as follows: Tis 5, T1 26, T2 8, T3 1 and T4 1. Disease stage of the screen-detected cancers was: stage 0, 5; stage I, 17; stage II, 16; stage III, 1; stage IV, 1; and unknown, 1.

Conclusions: Screen-detected cases of ductal carcinoma *in situ* (DCIS) and the number of smaller tumours (<T2) in the

second round were increased. The percentage of DCIS/all cancers was raised from 4.3% (2/46) to 12.2% (5/41). Biopsy rate was reduced almost by half in the second round. Additionally, reduction of the benign to malignant biopsy ratio was achieved. This improvement was due to the experience gained and the application of the European Guidelines for Quality Assurance in Mammography screening.

22 How long does it take to become a competent mammographer?

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This study reviewed the training of 62 individuals who gained their Certificate of Competence in Mammography through the Nottingham unit between June 1997 and June 1999. The time taken and the number of mammograms from practical training to accreditation were audited. These were evaluated in association with past experience and type of work carried out.

Results: The mean number of mammograms taken was 322 (range 250–770); the mean number of weeks was 34 (16–54); the number of weeks for those with no experience was 35 (16–54), for those with limited was experience 35 (19–49) and for an experienced individual was 34 (16–44). The number of mammograms for those with no experience was 385 (253–770), for those with limited experience was 308 (250–551) and for an experienced individual was 292

(251–350). The number of weeks for a trainee participating in breast screening was 32 (16–54) and for those performing symptomatic mammograms only 35.5 (26–49). The number of mammograms for screening was 352 (250–770) and for symptomatic alone was 281 (251–350).

Conclusion: The average time taken to reach the required standard to gain the Certificate of Competence in Mammography is not dependent on the previous experience in mammography. However, the number of mammograms taken before the standard is reached may be less the greater the previous experience. The type of work undertaken during the training bears little relevance to the number of weeks taken to accreditation. The number of mammograms taken during the period of training was greater for the individuals working in a screening unit.

23 The early impact of the breast cancer screening programme in the city of Florence: methods of evaluation and first results (1990–1996)

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Since 1990, the female population of Florence aged 50–69 years ($n = 59\,601$) has been invited to have a 2-view, high quality mammogram every 2 years. As of December 31, 1996, the first and second round were completed and the third was under way. The analysis is based on the breast cancer staging with or without the screening programme. The total women-years in the study period were 419 179; 129 603 before the invitation. Case incidence in the not-yet-invited women group are used as the estimate of the underlying incidence. Two-hundred and twenty-eight breast cancer cases were detected at the first screening

round. The total number of cases expected in the invited women population on the basis of the underlying incidence was 1051. There were 1216 observed in the 289 576 women-years group, with an excess of 165 breast cancer cases (16%). All incident cases were staged according to TNM and Grade. An approach to the analysis based on the 'unbiased set' (Day and Duffy, 1999) will be presented and, in this subset, a reduction of the advanced carcinomas (Stage II+) from 57% to 42% was estimated. Detailed data of the incidence over time, stage distribution and methodological issues will be discussed.

24 The long term follow up of a cohort of women invited to NHS breast screening

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We describe the long-term follow-up of a closed cohort of 44 349 women first invited to screening between January 1, 1989, and September 30, 1990. For all members of the cohort, screening histories up to September 30, 1999 were obtained. Individual

records were matched with the North West Regional Cancer Registry and the NHS Central Register to determine all breast cancers occurring before December 31, 1998, deaths that have occurred before December 31, 1999 and losses to follow-up

during the study period. This has allowed us to identify, for the first time, inter alia compliance with invitations to repeated screening, occurrence of cancers and deaths in non-attenders and the distribution of cancers and deaths in women attending screening.

Nine-hundred and twenty-one cancers were identified after the first invitation to screening and 155 women died of breast

cancer. Preliminary findings suggest that only 53% of women invited to four routine screens attend every screen. The incidence of breast cancer in non-attenders is low, but their survival is poor. In 443 women, cancers were detected at screening; 43 (10%) died of breast cancer. In 222 women, cancers were detected in the interval between screens; 49 (22%) died of breast cancer.

25 Can radiographers reliably read screening mammograms?

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This study aims to evaluate the ability of training radiographers to read screening mammograms. One thousand sets of screening films previously single-reported by a consultant radiologist were reviewed and re-reported independently by two trained radiographers. Films included prevalent and incident screens. The radiographers viewed the same films for each case in the same conditions used for the original screen reading. Each was blind to the other's opinion and to that of the radiologist. In cases of disagreement between the radiographers, a consensus opinion was recorded as well as their individual opinions.

The radiographers recalled 3.9% more to assessment. However, they recalled all the women with a subsequent diagnosis of cancer and also 32/91 (35%) of the women who subsequently developed an interval cancer. None of the cases which became interval cancers had been recalled to assessment by the radiologists. Overall the radiographers' sensitivity is 61.1% and specificity 89.7% compared to the radiologists' 39.6% and 90.5% for this set of films. Our study indicates that, with training, radiographers can become proficient at mammographic interpretation.

26 The lateral arm for stereotactic biopsy: how good is it?

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The aim of this study was to evaluate the lateral arm needle guide for upright stereotactic biopsy. Conventional upright stereotactic biopsy results in the biopsy device approaching the breast often in front of the woman's face. The lateral arm enables access to the breast from the side without visualisation by the woman. Its accuracy as a needle guide has not, however, previously been documented. The results of 120 stereotactic biopsies performed using the lateral guide are presented. Our unit changed from analogue to digital at the beginning of this year and results are shown for the two machines, and by mammographic sign, in the table alongside.

| Mammographic sign | No of cases | Absolute sensitivity | Complete sensitivity |
|------------------------------|-------------|----------------------|----------------------|
| High suspicion calcification | 9 | 87 | 87 |
| Low suspicion calcification | 93 | 66 | 71 |
| Architectural deformity | 3 | 33 | 100 |
| Asymmetric density | 3 | 100 | 100 |
| Mass lesion | 12 | 75 | 75 |
| Analogue | 70 | 66 | 69 |
| Digital | 50 | 68 | 72 |

These results show that lateral arm guided stereotactic biopsy, either analogue or digital, is reliable and accurate.

27 Sclerosing lymphocytic lobulitis (SLL): a diagnostic challenge

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SLL is a relatively rare condition first described in 1984. The clinical presentation, ultrasonographic and mammographic appearances and histology in 10 patients have been reviewed. The median age was 47 years (range 23–70 years). Eight patients presented with a hard mass (mean size 2.0 cm) and two patients had ill-defined thickening. Ultrasonography showed an irregular hypoechoic area in four cases. There was non-visualisation of the lump in three cases, a discrete mass in two cases and an area of distortion in another. Mammography was performed in six patients which showed an appearance suggestive of carcinoma in two, increased density with distortion in

one, dense glandular tissue in two and an increased density with a lucent mass in another. Fine needle aspiration cytology was performed in nine cases and reported as C1 in two, C2 in three, C3 in two and C4 in two patients. Core biopsy in eight cases showed SLL in four and B2 in four cases. Surgical biopsy confirmed the diagnosis of SLL in nine patients.

SLL can mimic carcinoma both clinically and radiologically. A wide variation in radiological appearances means that following triple assessment surgical biopsy to confirm the diagnosis may be required.

28 Are too many breast cancers missed at assessment?

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The objectives of this study were to ascertain the proportion of interval breast cancers arising after incorrect return to routine 3-year recall following assessment at the screening unit. Two hundred and fifty-six interval cancer cases known to the unit were reviewed; 31 of these women had attended for assessment, seven of which had been recalled for assessment of the contralateral breast and eight for assessment for an apparent abnormality in the same breast, but at a different site to where

the interval cancer subsequently developed. The remaining 16 women (6%) had undergone false-negative assessment. Some cancers may have been detected earlier if image-guided FNAC or core biopsy had been included in the assessment of: (1) all solid masses and complex cysts; (2) radiologically suspicious abnormalities, even if unchanged in appearance compared to previous films; (3) areas of stromal deformity thought to be composite if there was associated palpable thickening.

29 Breast ultrasound in a “moderate risk” population

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The objective of this study is to test the hypothesis that screening for breast cancer with ultrasound, in a cohort of women at moderately increased risk of breast cancer, does not lead to an unacceptably high biopsy rate. One hundred and thirty-two asymptomatic patients with a family history of breast cancer that places them at a moderately increased lifetime risk of breast cancer were recruited. All had mammography and an experienced radiologist, blinded to the mammography report, then examined both breasts with ultrasound [US]. All focal solid lesions detected were recommended to core biopsy. All the mammograms were then read by a second radiologist blinded to the result of the ultrasound examination. During the study

period, April 29, 1999 to March 29, 2000, 132 patients were examined with US (mean age 42.8 years). Eighty-one examinations showed normal breast tissue, 41 had at least one breast cyst and two patients had lesions that had previously been diagnosed as benign. None of the 132 mammograms were reported as abnormal. There were seven focal solid lesions that were recommended to biopsy on their US findings alone. Histology showed four to be fibroadenomas, two were areas of fibrocystic change with dense sclerosis and one was an adenoid cystic carcinoma. Screening for breast cancer with ultrasound, in a cohort of women at moderately increased risk of breast cancer does not lead to an unacceptably high biopsy rate.

30 Does preoperative diagnosis reduce the number of operations required for treatment of screen-detected breast cancer?

G Ralleigh, M Michell, S Henderson and S Bose

Breast Assessment Unit, King’s College Hospital, London, UK

A minimum standard for preoperative diagnosis of breast cancer of 70% has been set by the National Health Service Breast Screening Programme, (NHSBSP). Nationally, rates are 80% [BASO 1998–1999] and the rate in the southeast Thames region approaches 90%. Confirmation of malignancy by fine needle aspiration cytology or core biopsy avoids surgical biopsy, thus reducing the number of operations required for patients with breast cancer. We reviewed data from the regional breast screening QA

database on 4402 cancers diagnosed in the years 1990 to 1999 of the NHSBSP in the southeast Thames region to measure the effect of a positive preoperative diagnosis (C5 cytology or B5 histology) on the number of operations required for treatment.

Conclusion: Women with screen-detected cancer with no preoperative diagnosis are between 2 and 4.5 times more likely to require two or more operations.

Preoperative diagnosis rates and percentage of patients with two or more operations in invasive and non-invasive screen-detected cancers

| | Non-invasive 1990–1993 | Non-invasive 1993–1996 | Non-invasive 1996–1999 | Invasive 1990–1993 | Invasive 1993–1996 | Invasive 1996–1999 |
|---|---------------------------|---------------------------|---------------------------|-----------------------|-----------------------|-----------------------|
| Preop diagnosis rate | 18% | 36% | 68% | 37% | 52% | 84% |
| % with 2 or more operations without preop diagnosis | 38% | 54% | 42% | 27% | 43% | 50% |
| % with 2 or more operations with preop diagnosis | 17% | 34% | 26% | 6% | 11% | 11% |

31 The technical aspects of adapting add-on digital stereotactic equipment for use with patient lying horizontally

G Rubin, R Evans and A Page

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Digital stereotactic-guided biopsies using add-ons to conventional mammogram machines are usually performed with the patient sitting upright. We have adapted the procedure so that the patient lies horizontally on a fully reclining chair. The mammogram machine is placed vertically as if for a conventional craniocaudal view; however, as the patient is horizontal breast compression is in a lateral plane. The patient (lying semi-prone or semi-supine) and the trolley are positioned according to the site and side of the lesion to bring the affected breast closest to the machine with the lesion "uppermost". This ensures maximum depth for needle movement. Our experience is with over 200 screening patients using a GE DMR Mammogram Machine with

a Senovision digital add-on. The machine is in a 3.88 × 2.96 m room previously used for conventional stereotaxis.

The horizontal position means that the patient cannot faint and is more likely to keep still. Additionally, the patient does not look directly down on the procedure and her head does not obstruct the tube gantry.

The procedure requires a trolley or reclining chair that can be elevated enough to put the breast in the mammogram machine. A conventional lateral view is always taken at assessment to plan the site of the lesion.

32 UK NHSBSP multicentre image guided biopsy trial: an interim analysis

BK Shah and the UK Mammotome Trial Group (W Teh, MJ Michell, ARM Wilson and P Britton)

Edgware, King's, Nottingham and Cambridge Breast Screening Units, Edgware, London, Nottingham and Cambridge, UK

There are no randomised control trials (RCT) evaluating the efficacy of 11-gauge Mammotome (Ma) to 14-gauge core biopsy (CB). The aim of the study is to compare the diagnostic accuracy of the two stereotactic biopsy techniques in the diagnosis of microcalcifications and architectural distortion. A total of 600 women with impalpable clustered microcalcifications and/or distortions are prospectively recruited in a multicentre (Edgware, King's, Nottingham, Cambridge) RCT. Lesions with associated mass or density are excluded. Specimen radiographs are obtained for all biopsies performed for microcalcifications. A total of 370 women have been recruited so far and complete data for 135 women analysed. Seventy-two CB and 63 Ma had been performed on 124

microcalcifications, two distortions with microcalcifications and nine distortions. There are 34 cancers (25%) consisting of five invasive and 29 *in situ* carcinoma. Comparing CB and Ma, the absolute sensitivity for malignancy was 47% and 76.4%, respectively ($P = 0.07$) with a complete sensitivity of 76.4% and 100%, respectively ($P = 0.05$). CB produced more inadequate results compared to Ma (13.9% versus 4.8%, respectively; $P = 0.06$). Calcification retrieval was successful in 95% cases using Ma compared to 85.1% using CB ($P = 0.06$). The preliminary findings indicate that the use of Ma biopsy is more likely to produce a diagnostic result in the assessment of clustered microcalcifications compared to CB.

33 Using new technology to achieve the ideal mammogram

KC Young

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It is well established that the ideal mammogram should have the optimal average film density, which depends on selecting the correct exposure. It also needs to have the optimal contrast. This is more difficult to ensure as it depends on the intrinsic breast contrast, the radiographic contrast and film contrast. The operator has control over the radiographic contrast, by adjusting the kV, target material and filter material used and modern machines provide the operator with a greater range of choices. The use of modern very high contrast mammographic films may affect the optimal choice of beam quality.

By theoretical modelling and experimental measurement it is possible to estimate the impact of beam quality choices on dose, contrast and exposure time. The publication of new data on the composition of the breasts involved in screening allows this modelling to be more accurate than in the past. This presentation discusses the principles that should guide operators in making these choices. The two pitfalls to be avoided are excessive contrast due to using a very high contrast film with an inappropriate beam quality (eg 25 kV Mo/Mo). Equally one should avoid excessive contrast loss caused by using an inappropriate target filter combination (eg W/Rh).

34 Full-field digital mammography

U Bick

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Due to the extremely high image quality requirements in mammography, there has for a long time been no adequate digital alternative to conventional film-screen mammography. The longest experience so far exists with digital mammography on the basis of storage phosphor (CR) systems. However, at normal dose this technique has a relatively poor signal-to-noise ratio and has not found general acceptance. Recently, three novel systems for digital mammography by Fischer (slot-scan detector), Trex (CCD-array) and GE (amorphous silicon detector) have been introduced and are currently under clinical investigation.

Initial results from clinical trials indicate that the new digital mammography systems are at least equivalent to film-screen

mammography in the detection of breast cancer. The main advantage of digital mammography lies in the linear relationship between dose and detector signal with the possibility of a tailored optimisation of image contrast. This may lead to improved detection of early or subtle cancers especially in patients with dense parenchyma. Other advantages include digital storage, telemammography and computer-aided diagnosis.

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35 Computer aided detection

PM Taylor

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Computer scientists first started thinking how computers could be programmed to interpret mammograms in 1967. The field (known as computer-aided diagnosis or CAD) became increasingly active in the 1990s with the promise of digital mammography. The research continues, but the best of the algorithms developed over the last decade have now been incorporated in commercial systems. These algorithms are capable of high degrees of sensitivity only at relatively low levels of specificity. The systems that depend on them are therefore best used to prompt a radiologist (or other trained film-reader) to the possible presence of an abnormality.

Investigating the potential of prompting systems means addressing questions about how technology affects the way people work: how does prompting affect screening performance? How much information can film readers make use of? Does it make new models of screening cost-effective? The challenge is to answer these questions within a timescale appropriate to the pace of technological change. We expect, over the next 18 months, to conduct an NHS-funded trial of the R2 Imagechecker. Economic models of the screening process will then be developed to compare the cost-effectiveness of prompting in a variety of screening protocols, including film reading by non-radiologists.

36 Upright digital stereotaxis

A Evans

Breast Screening Training Centre, City Hospital, Nottingham, UK

37 Minimally invasive treatment of the breast

M Hall-Craggs

MR Unit, Department of Imaging, Middlesex Hospital, London, UK

38 An overview of workforce issues

H Gwynn

Deputy to Acting Medical Director, NHS Executive Working Group on Workforce Issues in the Breast Screening Programme, Department of Health, Leeds, UK

39 Who does what? Comments from radiographers

SJ Cush

Breast Screening Unit, St Margaret's Hospital, Epping, UK

The increasing pressures on the National Breast Screening Programme due to population increases, the post-war baby boom as well as the increasing complexity of assessment procedures, gives us the opportunity to debate "who does what in the NHSBSP".

Already radiographers have expanded their skills by taking on roles that have previously been the domain of a radiologist.

Reading screening films and undertaking ultrasound and more specialised investigations are being considered as an expansion of a radiographer's role in breast screening. For many radiographers this is an exciting opportunity.

If more radiographers are required where do we get them from? How can we ensure that the Breast Screening Programme continues to deliver a high quality service in the future?

40 Comments from a breast clinician

EMC Denton

Breast Care Centre, Glenfield Hospital, Leicester, UK

The concept of a breast clinician was first recognised during the Edinburgh and Guildford Pilot Programme. The Forrest Report on Breast Screening Services established the role to give assessment units the choice between a breast surgeon and a breast clinician for undertaking the clinical role in a breast assessment clinic. From this, some breast clinicians were also employed as film readers and trained in breast ultrasound. As the breast symptomatic service developed to keep up with the National Breast Screening service, the breast clinician developed a recognised role in breast diagnoses, providing both clinical and radiological input.

Over the past few years it has become difficult to summarise their duties, as each individual is employed to fulfil a local need. The aim of this presentation is to describe who presently undertakes the role of breast clinician, what is their background training, and the diversity of the different roles undertaken by breast clinicians. From this, it is important to look to the future in developing recognised training and career pathways. The concept of a multi-skilled individual providing inter-disciplinary crossover may be of benefit to other specialities.

41 Comments from radiologists

JA Fielding

Department of Radiology, Royal Shrewsbury Hospital, Shrewsbury, UK

Above all, quality standards must be maintained. This is a view upheld by the CMO's Committee looking at skill mix in the NHSBSP. How are these standards to be maintained and our targets achieved, against a background of possible Government intention to expand the target population, by increasing the screening age limit up to 70 years and a yearly population increase?

The situation in the UKBSP was crystallised by a survey sent to the 95 Breast Screening Units. Seventy-eight were completed and returned (82%).

These are some of the most significant results: (1) average UK round length: 73% screened within 36 months (minimum

NHSBSP standard, 90%); (2) double reading: 68%; (3) unfilled sessions: 81 from 78 units; (4) unfunded, but worked sessions: on average, one session per week per unit; and (5) average reporting rate: 115 films per hour (ie 57.5 women with single views).

Radiologists are performing a sterling task given the present set-up. However, the conclusion was reached that, due to lack of resources and personnel, there is suboptimal delivery of the UK breast screening programme, according to current ideals. Radiologists' comments both for and against the new tiered workforce structure are discussed. Alternative solutions are in short supply.

42 Assessing an individual's film reading ability

A Gale

Institute of Behavioural Sciences, University of Derby, Derby, UK

Reading a breast screening case is a complex skill that experienced consultant radiologists regularly accomplish within seconds. What constitutes such skill, how is it learnt and is it a skill restricted to radiologists? Case classification, mammo-

graphic feature identification, sensitivity, specificity and ROC analysis have all been measured to gain insight into the film reading skill of individual radiologists, breast physicians and radiographers as they undertake a film reading task. Data

evidence that these groups can perform almost equally well potentially indicates that, within some constraints, film reading could be undertaken by non-radiologists. However, film reading

is subject to wide inter- and intra-individual variability and this has to be borne in mind when considering any individual's potential for film reading.

43 Characterising breast tissue for the development of a tissue-equivalent phantom

MJ Farquharson

Department of Radiography, City University, London, UK

This paper will present progress being made with the development of a radiologically tissue-equivalent phantom constructed from hydrophilic materials. These materials have the ability to absorb water without being dissolved in it. The quantity of water uptake can be accurately controlled in the manufacturing process. We have been working on characterising the radio-

logical properties of normal and diseased breast tissue and, to date, we have concentrated on linear attenuation measurements, scattering properties and elemental analysis. Preliminary results will be presented including recent trace element analysis carried out at the European Synchrotron Radiation Facility (ESRF).

44 Prediction of the underlying histology from the mammogram: mammographic-large section histologic correlation of >1000 open surgical biopsies

L Tabár

Department of Mammography, Central Hospital, Falun, Sweden

The radiologist greatly enhances her or his skills by regular review of the preoperative mammograms once the histologic diagnosis became available.

Most breast cancers are invasive at diagnosis, even when they are detected at mammographic screening. The invasive cancers must be found in their preclinical stage to prevent the development of advanced breast cancer, a prerequisite for decreasing mortality. The majority of the mortality benefit in the Two-County Swedish Trial was achieved by shifting Stage II and more advanced cancers to Stage I, ie detecting invasive tumors at an early stage, rather than by shifting invasive tumors to *in situ*. Although 39% of all malignancies did contain calcifications in a mammographic-large section histologic correlation of > 1000 consecutive open surgical biopsies, a minority of the malignant breast tumors had calcifications as the only mammographic sign of malignancy. Detecting subtle spiculated and

circular or oval lesions should be a priority. Most of the breast cancers, 80%, depicted spiculated or circular/oval breast masses, of which three-quarters were without associated calcifications. Two thirds of the breast cancers were spiculated; finding them when still small is the major challenge for the radiologist. Once a spiculated lesion has been found, the probability that it is a cancer is 92%.

Only one-third of the malignant tumors were circular/oval on the mammogram. The malignancy ratio of the circular/oval lesions undergoing open biopsy is lower than for the spiculated lesions.

The three main malignant types of calcifications were predictive of cancers in a varying way. Correlating the mammographic findings with underlying histology will help the radiologist find the tumors which would become fatal without early detection.

45 Implanted markers prior to neoadjuvant chemotherapy: preliminary report

DM Allan for The Dartford Breast Care Team

Dartford & Gravesham NHS Trust, Joyce Green Hospital, Dartford, UK

In our experience, some women with a large breast carcinoma have responded so well to neoadjuvant chemotherapy that the tumour has been difficult to locate at surgery. We have started placing metallic markers in such tumours before, or in the early stages of, chemotherapy with a view to ensuring that the lesion can be localised if necessary. This presentation reports the results of the first six patients treated in this way.

Tumour size was estimated by ultrasound examination at the time of implantation, half way through chemotherapy and prior

to surgery. One did not respond to neoadjuvant therapy and had a mastectomy. The other five had varying degrees of response, with one becoming impalpable and having conservation surgery. In three cases the implanted marker was used for mammography-guided localisation prior to surgery. The marker was within the tumour on histological examination in all cases.

A larger study is under way to determine by how much an implanted marker can move within the breast.

46 Up the creek without a paddle

G Baxter

Warwickshire, Solihull & Coventry Breast Screening Unit, Coventry & Warwickshire Hospital, Coventry, UK

In mammography compression is essential for various reasons: (1) scatter reduction; (2) dose reduction (3) improved image sharpness; (4) to maintain a uniform film density; and (5) to improve the separation of the breast tissue structures.

Localised compression or "paddle views" are used to demonstrate whether a lesion has ill-defined or well-defined borders, and also to demonstrate whether a lesion represents significant architectural distortion or is a superimposition of normal breast tissue.

With compression, the whole breast will be compressed only as much as its least compressible part but, by substituting a smaller compression plate, pressure can then be applied to a smaller volume.

How many times has a radiographer been told to see if they can "lose" or "squash" a lesion out? However, can you "lose" a lesion under spot compression that is really there? This radiographer believes "yes" and will demonstrate that certain lesions can be compressed and appear to disappear.

47 Techniques and equipment in mammography – an aid to diagnosis

J Berry-Smith and L Gustard

North Yorkshire Breast Screening Service, York District Hospital, York, UK

This presentation will illustrate how the mammographer can, by using well established techniques, new techniques and optimising the use of new generation equipment, assist in the diagnosis of small breast cancers.

The mediolateral oblique (mlo) is recognised as the view that images the maximum amount of breast tissue. The execution of this view is open to variation in personal preference and expertise. In our unit, clients brought back for assessment following routine screening mammography will sometimes have a repeat oblique film taken. We intend to show how this view is worth

considering, early in the diagnostic process, when the abnormality is not seen in the craniocaudal view.

The surgically altered breast can be difficult to diagnose. We will demonstrate a simple technique to identify the surgical scar on the mammogram that then helps to differentiate between scar tissue and a recurring lesion.

We also intend to demonstrate how the use of a high-contrast film and appropriate use of different targets and filters on the newer equipment maximises the amount of diagnostic information on the resulting mammogram.

48 Image blur: back to basics

J Berry-Smith and C Lonsdale

North Yorkshire Breast Screening Service, York District Hospital, York, UK

A survey of films repeated for technical reasons in the NHSBSP has recently been carried out. In particular, the number of films repeated for blurring was of interest. The data did not indicate a problem with any specific X-ray equipment and it was suggested that the change in technology and design of compression mechanisms on the newer X-ray machines may necessitate a change in radiographic technique to achieve optimum breast images.

We have undertaken a study of our own technical recall rates looking at the many different reasons why blurring occurs.

We will suggest that the mammographer can minimise image blurring by applying some basic radiographic principles, often forgotten as we strive to perfect this challenging technique.

49 Between four walls: what level of privacy do women want?

M Brown, B Caswell and M Heath

Warwickshire, Solihull & Coventry Breast Screening Unit, Coventry & Warwickshire Hospital, Coventry, UK

Privacy for the woman attending breast screening is a sensitive and subjective issue. Results from our regular customer satisfaction surveys indicate that a small percentage (3%) of women are dissatisfied with privacy arrangements in our screening units. Those who said there was only just enough privacy varied between 7% and 25% depending upon the

area screened. To investigate what privacy means to the woman attending breast screening, 158 women were interviewed in both static and mobile screening units to identify the most vulnerable areas. Results suggested that women were concerned with: (1) giving personal details at reception, eg full address, telephone number, date of birth; (2) changing

prior to the mammogram; and (3) location of the mobile screening unit.

To evaluate this initial study and obtain specific qualitative information, a detailed semi-structured interview was developed.

The information obtained from this evaluation study will be used: (1) to improve the service where possible and appropriate; and (2) if appropriate, to develop a quantitative tool to monitor the sensitive and subjective issues surrounding what 'privacy' means to the woman.

50 Technical recalls (TC): a lesser service?

B Caswell and V Gilks

Warwickshire, Solihull and Coventry Breast Screening Unit, Coventry and Warwickshire Hospital, Coventry, UK

The aim of this pilot study was to provide qualitative and quantitative evidence on the level of satisfaction of the breast screening service provided for women who re-attend for technical recall (TC). The information obtained was used to improve the service where possible and appropriate. A specific questionnaire was developed which concentrated on the acceptability of: (1) the location; (2) the appointment time; (3) the mammogram; (4) the information sent with the appointment; and (5) the length of time between screening and results received.

Fifty women were given questionnaires to complete and post back to the unit; 50% replied. Although some women had

waited 3 weeks for their recall appointment (screening to TC) and then a further 3–11 days for the results, the majority of those who replied (75%) were satisfied with the service provided. It should be noted, however, that this study period included Easter and May bank holidays and some of the women sampled were on holiday at their first offered appointment.

The outcome of this study has resulted in a formal procedure for technical recalls which includes: (1) specific clinics for technical recalls; (2) prioritisation film reading; and (3) further monitoring to ensure that results are received where possible within 3 weeks of initial attendance for breast screening.

51 A trial of duplicating film for mammography

GR Clough

Breast Imaging Department, Breast Care Unit, St James's University Hospital, Leeds, UK

When reporting mammograms it is essential that comparisons, where possible, are made with the patient's previous examinations. NHS breast screening units do not routinely release original mammograms to other sources for reporting comparisons. The quality of duplicate mammograms varies enormously. One of the factors associated with this variation is the type of duplicating film used. A trial of five leading film manufacturers duplicating film (Agfa, Fuji, Kodak, Konica and Sterling) was undertaken. Sensitometry tests were carried out and duplicates of Tor Mas, Tor Mam and mammograms of different breast types were produced and scored. The results from the

Tor Mam test were inconclusive, while the scores from the Tor Mas and mammograms showed marked differences between the makes of duplicating film. Characteristic curves for all duplicates and the original film were drawn. The gamma of each film was calculated and ranged from 3.25 to 5.07. A one-sample *t*-test was carried out on the data from the characteristic curves to look for a statistical difference between the duplicate films and the original. *P* values ranged from 0.27 to 0.0005 with *P* < 0.01 being statistically significant. Kodak duplicating film performed well in all tests, Fuji and Sterling scored poorly.

52 Latent image fade and Kodak MinR2000 film

A Cowley and V Gilks

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In the NHSBSP, most screening centres use mobile screening units where the films may be processed after some time has elapsed (between 7 to 24 h under normal circumstances, but occasionally up to 72 h after the films have been exposed). Latent image fade using Kodak MinR-E film has been studied before (Robson *et al* 1992). The aim of this study is to determine the percentage fall in optical density from the target density using Kodak MinR2000 film with 4 cm perspex. The films were processed (see Table).

A Kodak ML300 processor was used with a 150-s cycle at 34.2°C using Kodak RP LO chemistry. Optical density measurements were taken with an X-rite densitometer (334

model). Sensitometric measurement was checked using an X-rite sensitometer (393 model).

| When processed | Optimal density | % Fall |
|----------------|-----------------|--------|
| Immediately | 1.65 | 0% |
| After 7 h | 1.61 | 2.4% |
| After 24 h | 1.64 | 0.6% |
| After 48 h | 1.58 | 4.2% |
| After 72 h | 1.52 | 7.9% |

The results obtained show that, generally, processing films at the earliest opportunity, ie on the same day, is preferable to longer time delays although the differences are minimal.

53 Galactocele in a postmenopausal woman: a case report

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Galactocele is a rare cause of benign breast mass in postmenopausal women. It occurs during pregnancy or lactation. A 54-year-old female, 4 years after the menopause, presented with a complaint of gradually increasing size of right breast over 2 years. On examination, the entire right breast was grossly enlarged with normal skin, nipple and axilla. Mammogram of the right breast revealed homogenous opacity occupying the entire breast with smooth margins and no retraction of tissue or calcification. The appearance suggested a benign lesion-like cyst. Sonography confirmed the presence of a large unilocular cyst with some internal echoes within it and less through transmission. About 2.5 l milkish fluid was aspirated.

Biochemical and cytology confirmed the nature of the fluid as milk. Her routine blood, biochemical and endocrinal parameters and other radiological work-up were within normal limits. She has been asymptomatic for the last 4 years. The cause of the lesion remains unknown. This case is being documented in view of an unusual presentation.

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54 Flexible screening clinics: future options

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Objectives: To explore the desirability and practicality of establishing more flexible breast screening clinics. We canvassed NHSBSP units to establish whether more flexible scheduling was being undertaken, how, and with what success? We enquired about local aims and procedures.

Methods: We telephoned all breast screening units in the country. This indicated strong interest in the subject. Accordingly, we followed up with a questionnaire. Our survey response rate was 67%. We also researched the literature for data on the success of flexible screening.

Findings: Overall 58% of units were either currently employing more flexible procedures or they had previously done so. Relatively few such units were in inner-city areas. We found that clinics involved in flexible screening had uptake rates greater or equal to their normal clinics. Additionally, we examined the characteristics of more effective clinics.

Conclusions: Data suggest that flexible approaches are an important component in screening and could well influence overall compliance. Units generally applied such approaches because of slippage. However, we contend that flexible screening could be a useful tool for two reasons. First, to increase capacity (both clinic time and staffing) and, second, to form part of an agenda focusing on low uptake.

55 Decubitus positioning for stereotactic core biopsy

CE Ingram, S Nutton and S Dunhill

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Digital stereotaxis has made biopsy of microcalcifications more effective. Results with the upright units mainly available in the UK have been shown to be comparable with those obtained on dedicated prone biopsy tables. Some women suffer vasovagal attacks while in the sitting position and this complication led us to develop the decubitus method, in which the woman lies on her side on a trolley. The breast to be biopsied is positioned uppermost and entered from a lateromedial approach. The woman can be rolled towards the prone position until the sternum touches the edge of the grid. This posi-

tion has been found to be stable and comfortable for the patient. It allows easy access to the breast and allows posterior lesions to be reached. An alternative mediolateral approach is possible with the affected breast inferior and the upper breast taped back, with the patient in an anterior oblique position. These methods have proved valuable for "fainters" and for disabled women, including those with severe shoulder and neck arthritis. Because of the increased operator and patient comfort, we are tending to adopt this method for all stereotactic core biopsies.

56 Imaging methods to screen women with breast implants

M Morrow

West of Scotland Breast Screening Service, Glasgow, UK

Method: Literature search of three modalities to include mammography, ultrasound and magnetic resonance imaging (MRI).

Following the report of the Independent Review Group in 1998, in Britain silicone gel breast implants have not been proven unsafe. There are currently 100 000 women in the UK with implants (Park *et al.* 1998). Women aged 50–64 years who fall into this category are invited for routine mammographic screening, thereby presenting a technical challenge to the screening mammographer who often has no information about the surgical placing of the implant or the degree of capsular contracture (if present). In this paper, an evaluation was made, comparing mammography, ultrasound and MRI, to screen such women. Each modality was studied in turn and benefits and disadvantages noted.

Conclusion: To screen well women, mammography was found to be the optimum basic imaging method to visualise breast parenchyma. However, this must be performed by a skilled mammographer who can tailor the examination accordingly and use the appropriate technique (eg Eklund views).

Ultrasound proved a useful addition to mammography in evaluating asymmetric densities following augmentation, but the sensitivity was lower than mammography (Azavedo and Bone 1999). The role of MRI in breast cancer diagnosis remains investigational, requiring an intravenous contrast to show tumour enhancement. MRI is, however, an excellent tool to question implant integrity.

Paper submitted for Post Graduate Certificate in Mammography.

57 Audit rules OK! The benefits of an internal quality audit programme in the breast screening service

S Munslow and MG Wallis

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The Warwickshire, Solihull and Coventry Breast Screening Service's success in achieving ISO 9002 certification is endorsed by its continuous programme of internal quality audits. The objective of this study is to accentuate the key reasons why internal quality audits should be performed within breast screening and to outline some of the benefits realised within our own service.

Key reasons why internal quality audits should be performed:

1. To obtain *accurate* input for management decisions

2. To obtain *impartial* management information
3. To know *factually* if the service is at risk
4. To find *opportunities* for continuous improvement
5. To *improve* communications and motivation
6. To assist with training of staff
7. To assess the status and capability of equipment
8. To *prevent* management and business problems

If you believe knowledge is expensive, try ignorance!

58 Pictorial essay of fat necrosis

A Murphy and JR Smales

North Yorkshire Breast Screening Service, York District Hospital, York, UK

The objective of this presentation is to review the importance of triple assessment in fat necrosis. At least six confirmed cases will be presented demonstrating the importance of an accurate clinical history/examination, high quality imaging and pathological correlation. The ultrasound findings demonstrate a common theme of

irregular fluid collections extending across tissue planes. In particular this presentation: (1) highlights the ultrasound features which should alert the sonographer to a diagnosis of fat necrosis which may otherwise be obscure; and (2) demonstrates how these features are part of the triple assessment process.

59 Galactoductography

MN Mwangi

X-Ray Department, Kenyatta National Hospital, Nairobi, Kenya

Galactoductography was performed on 42 female clients and one male client who presented with nipple discharge.

Nipple discharge that was described as either bloody, brownish, clear or darkish was considered pathological. The majority of the clients who presented to our department were referred from sur-

gical, medical and endocrinology clinics within our referral hospital, Kenyatta National Hospital, and from private hospitals in Nairobi. A few were referred from district and provincial hospitals.

The discharging breast was examined by the radiologist and the discharging duct cannulised under aseptic technique. Approxi-

mately 2 ml non-ionic water soluble contrast media was injected with patient pain appreciation as a guideline on the amount of contrast. A series of films in craniocaudal, oblique and magnified views were taken with the cannula *in situ*. Mammograms and galactoductography were performed on 43 clients. The age range was from 25 to 60 years. The average age group was 30 to 40 years. The average parity was between 0–4 children.

There was no significant right to left breast preference: left, 24; right, 19. Bloody nipple discharge was seen in 53.4% of the clients. Seventy-nine per cent of mammograms were reported normal despite discharging nipples. Galactoductography revealed an existing pathology. Galactoductography was normal in 16.2%. Galactoductography was found to be more sensitive in ductal pathology than mammography.

60 Routine mammography for women aged 40–49 years: should mammography screening guidelines be changed in view of current research?

L Nimmo

Breast Screening, North West Glasgow Breast Screening Centre, Glasgow, UK

The objective of this study was to establish that current guidelines excluding women aged 40–49 years from the National Breast Screening Programme (NBSP) are justified. Since the conception of the NBSP many articles have been published to fuel the debate on routine mammography for women aged 40–49 years. This study evaluates some of the relevant issues to facilitate making an informed decision on the minimum age for routine screening.

The relevant issues chosen were: reduction in mortality, screening interval related to tumour growth, ductal carcinoma *in situ* (DCIS), density of breast parenchyma, false-positive mammograms, cost-effectiveness and radiation-induced breast cancer. A

collation of the issue summaries identifies that screening women from the age of 40 years does reduce mortality. However, this has to be balanced against: (1) the possibility of overtreatment from an increase in both detection of DCIS and false-positive mammograms and (2) radiation-induced cancers. The study concludes that at present there is insufficient evidence to reduce the age of inclusion in the NBSP. Any new research has to be kept under review and changes implemented as necessary.

Three areas were highlighted as the main influences for future changes: (1) research focused for this age group; (2) research distinguishing invasive from non-invasive DCIS; and (3) changes in equipment and technique.

61 A radiographer's perspective of sentinel lymph node biopsy

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Axillary lymph node clearance during surgery for breast cancer provides control of local disease within the axilla and staging of axillary lymph nodes. However, the procedure carries a significant morbidity such as seroma formation, infection, parathesia-reduced shoulder movements, lymphoedema and longer in-patient stay. As there are a significant number of patients presenting with early stage breast cancer (60% of patients have disease free axillary nodes), routine axillary lymph node clearance exposes many patients to unnecessary surgery.

Sentinel lymph node biopsy has evolved as a technique to successfully identify the first draining lymph node to accurately predict axillary lymph node status. It is a minimally invasive procedure which, after an initial learning curve, is quick and easy to perform. At the University Hospital Birmingham NHS Trust, we are now involved in a national trial for this procedure. This is a review of the technique and imaging modalities involved. If shown to be a successful and reliable technique, sentinel lymph node biopsy will contribute significantly to the management of breast cancer patients.

62 What is the predictive value for malignancy of radiological classification for indeterminate microcalcification seen on mammography?

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Objective: The aim of this study is to measure the predictive value for invasive/non-invasive cancer for indeterminate microcalcification (M2, M3 and M4) seen on mammography.

Methods: Four-hundred and thirteen cases of indeterminate calcification were prospectively classified as M2 (benign), M3 (probably benign) or M4 (suspicious for malignancy) and underwent prone 14G stereotactic biopsy. The predictive value

for each category was measured by recording the outcome for all cases (no surgery, surgery benign, DCIS, invasive cancer).

Results: Of 41 cases classified as M2, one case had a final outcome of DCIS and none had an outcome of invasive cancer (positive predictive value = 2.4%). Of 184 cases classified as M3 there were 10 cases of invasive cancer and 28 cases of DCIS (positive predictive value of 20.6% overall for malignancy).

nancy). Of 188 cases classified as M4 there were 70 cases of DCIS, three cases of LCIS and 12 cases of invasive cancer (positive predictive value overall of 45.2% for malignancy).

Conclusion: Sub-classification of microcalcification based on a full radiological work-up including magnification views is useful prior to stereotactic biopsy.

Examples illustrating radiological and pathological correlation will be used.

63 Scenic screening sites of Sussex

V Repose

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This presentation demonstrates a series of paintings by myself, a senior radiographer. It shows views close to the various sites visited by the East Sussex, Brighton and Hove Breast Screening Service's mobile clinics.

At each site the corresponding local picture is mounted behind the reception desk and this has proved to be a talking point amongst the sometimes anxious women. It has been especially pleasing for the radiographers on each caravan when these women express their delight at seeing some part of their town displayed on the mobile unit.

64 Investigation into possible causes of blurring in mammograms

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Technical recalls cause unnecessary anxiety to the women concerned and an increased workload for the screening unit. A review of technical recalls at Bolton Breast Unit found that over 90% were due to blurred images. This study aimed to identify causes of blurring and to reduce the number of technically inadequate films. X-rays were taken using static IGE DMR & 800T units and Kodak Min-R 2000 film/screen combination. Exposure factors (kVp, mAs, target & filter) were selected automatically, using 'Standard' mode. Two groups of films were examined; group 1 ($n = 45$) were identified as blurred at reporting stage and group 2 ($n = 45$) were technically adequate films selected randomly.

Analysis showed that the mean compression force applied was 10 dN and 13 dN for the blurred and adequate films, respectively, which is a significant difference ($P < 0.01$). The breast thickness and mAs were significantly higher in the blurred group ($P < 0.01$). With the 800T unit, the rhodium filter was selected for 90% of blurred films compared to 36% of adequate films. Inadequate compression in the blurred group (which would result in greater breast thickness, longer exposures and earlier selection of rhodium target/filter) is suspected. A minimum compression force has been recommended at the unit.

65 An evaluation of the relationship between compressed breast thickness and glandular dose, within the breast screening service

S Simpson

Scottish Mammography Education Centre, SESBS Centre, Edinburgh, UK

This project aims to investigate the relationship between compressed breast thickness (CBT) in mm and mean glandular dose (MGD) in mGy for two differing mammography units. The units are a 28 Kvp fixed molybdenum filter and target mammomat (Siemens 300) (Young *et al* 1996) and an Automatic Quality Beam System unit, which alters Kvp, filter and target material (Siemens 3000) (Young *et al* 1996), both units being commonly used in the NHSBSP. The outcome revealed that using a fixed 28 Kvp molybdenum filter and target, the CBT and MGD relationship exists exponentially. Breasts with a CBT of

greater than 60 mm were at risk of receiving a MGD greater than recommended by NHSBSP Publication 37 1998, of 2 mGy. The Automatic Quality Beam System demonstrated overall a more erratic relationship between CBT and MGD, mainly due to target and filter material changing. However, it allowed the MGD at greater values of CBT to be reduced, with 2 mGy not exceeded up to 70 mm CBT. The use of Automatic Quality Beam System mammomats is highly recommended within the NHSBSP to maximise image quality while maintaining low glandular dose.

66 Radial scars and stellate lesions as imaging abnormalities: a comparative study

A Stewart

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The aim of this study is to compare the imaging appearances of radial scars (RS), thought to be of questionable significance, to stellate lesions (SL), indicative of malignancy in up to 94% of cases (Burrell *et al* 1996). Mammographic appearances of RS may change depending on which projection is being viewed but may not for stellate lesions. RS are represented by an area of architectural distortion and exhibit a radiolucent core, long spicules and no calcifications. However, calcifications have been shown to be present in up to 45% of RS (Cardenosa *et al* 1991). SL comprise a dense core, short spicules and polymorphic calcifications. Mammographically, the two may be

indeterminate. Ultrasound of both RS and SL may show similar traits: irregular outline, posterior shadowing and enhanced vascularity. Studies of contrast-enhanced MRI images show tumours to have rapid uptake with steady wash-out of gadolinium. However, this pattern can also be attributed to RS and there may be no significant enhancement differences between benign and malignant lesions (Stomper *et al* 1995). The specificity of MRI remains low.

In conclusion, imaging has very definite limitations and cannot readily or unequivocally differentiate between RS and SL.

67 Comparison of four methods of presentation of breast specimens

PA Thompson

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The objective of this presentation is to demonstrate and compare four methods of presentation of specimens of breast tissue, which have been surgically removed and sent to the Breast Screening Department for X-ray. These four methods are all used at the Princess Alexandra Hospital and the presentation sets out the advantages and disadvantages of each method to the surgeon, the radiographer and the pathologist.

A brief description of the pre-operative localisation procedure is followed by a description of the three methods of marking the specimen, each accompanied by a colour photograph and a radiographic image. The fourth method, which is an unmarked specimen, does not warrant an illustration.

The presentation aims to show that, whichever method is used, the marking and orientation of the specimen should be clear.

68 'To failsafe' or 'not to failsafe', that is the question?

M Wheaton and M Gray

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Ever since the beginning of the NHS Breast Screening Programme, the effectiveness of failsafe batch procedures has been questioned. These procedures ensure that all women are given the opportunity to attend for breast screening. Women may: (1) move home; (2) amend incorrect data; (3) register with a GP for the first time etc.

It is imperative that these women do not miss out on their routine screening invitation. All services are aware of this problem, but many have devised alternative mechanisms to failsafe. Reasons for this include:

1. Not trusting the HA computer system to 'pick up' the correct women leading to inappropriate invitations being sent.

2. The availability of alternative information about 'missed' women from HAs allowing manual invitations to be initiated.
3. Services covering large geographical areas not having an appropriately located unit at the time women are picked up in a failsafe batch.

We have been working together to develop new NHSBSP failsafe guidelines for screening services, not only to promote a standardised failsafe procedure across the NHSBSP, but also to enable services to maximise the undoubted benefits of running failsafe batches on a 3-monthly basis or less.

69 Quality management systems: the benefits of achieving ISO 9002

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Since taking part as a pilot in the NHSBSP 'Systematic Management of Quality for Breast Screening Services' exercise, we

have obtained ISO 9002 certification. By taking this additional step we believe we have gained considerable benefits over a

non-certificated quality management system. The seven principles of quality management are: (1) get organised; (2) have written procedures; (3) control key documents; (4) keep records; (5) carry out regular checks; (6) identify faults and correct them; and (7) communicate well.

For each of the above principles we list just one benefit of ISO 9002 over QMS: (1) well planned service with mechanisms for the management of change in all circumstances; (2) greatly

reduced level of documentation with a minimal number of work instructions; (3) smaller number of documents to control, with a requirement to update, not left on the shelf; (4) requirement to document and control key areas, eg Screening Round Plan, thereby avoiding round length slippage; (5) annual schedule of audits ensuring the quality system is updated with changes in practice, ie a living system that evolves with the service; (6) requirement to action the outcome of audits as we are audited twice a year by an external body; and (7) reporting mechanisms to all staff.

70 Responsibility versus residence: how will this change in Department of Health policy affect you and your breast screening service?

M Wheaton and MG Wallis

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Call and recall mechanisms for women in many areas of the NHSBSP are based on GP practice within the HA of residence. Women are invited to the breast screening service purchased by the HA in which they reside, regardless of responsibility status of their registered GP. With the advent of Primary Care Groups and Primary Care Trusts, the Department of Health is to issue a policy statement from April 1, 2001, requiring all breast screening services to call and recall women registered with GPs responsible to that HA. Our service will lose 4712 and gain 4920 women, a net gain of 208 women. However small the gain, 9632 women will change their screening service causing significant disruption to all concerned.

The following implications can be defined: (1) a significant increase in the number of administrative processes performed; (2) communication with a larger number of HAs; (3) re-evaluation of mobile breast screening sites to ensure appropriate accessibility to screening; (4) clear communication and documentation with neighbouring screening services to ensure women are not missed; (5) re-negotiation of service level agreements and/or contracts; and (6) careful screening round planning from April 1, 2001, ensuring every woman continues to achieve the 36-month round length target.