Breast cancer is the commonest cancer in women in the UK, accounting for 31% of all cancer cases in women. The estimated lifetime risk of developing breast cancer in 2008 is one in eight for women in the UK.¹ Mammography has always been presented in terms of benefit to reduce mortality. Recently there have been number of high profile testimonials from women with negative experiences of mammography and breast screening. This has been compounded by inconsistent data on the benefits and risks of screening mammography and the radiation dose of a mammogram to an individual woman. Now women are asking, “how safe is a mammogram?” and “will breast screening be good for me?”

This article will lay out the history of mammography to the present day with emphasis on the current literature on benefits and harms of mammography. The aim of this article is to give a balanced view so the reader can make their own conclusions on this currently controversial subject (figure 1).

The early mammogram

The idea of imaging the breasts originated from German surgeon A Salomon. He correlated the anatomy and pathology of 3,000 mastectomy specimens with basic x-rays of the time. Although early work continued, it was not until 1965 when the Belgian radiologist and physicist Charles Gros invented an apparatus designed to specifically image the breast. Equipped with a special molybdenum anode that has a spectrum tailored to soft tissue radiographs this transformed the imaging technique called the Senographe. By 1970 Gros and his company had sold around 2,000 CRG Senographe throughout the world and was the founder of the mammogram as we know it today.

At the same time interest was growing to see if screening a population of women would reduce mortality using the Senographe. From 1963 to 1966, Philip Strax, Louis Venet, and Sam Shapiro, under the auspices of the Health Insurance Plan (HIP) of New York, organised the first randomised, controlled trial of periodic screening with physical examination and mammography. The HIP trial and the subsequent Swedish two counties trial² provided the foundation and scientific basis for the subsequent worldwide screening programmes.

The digital mammogram

Today, digital mammography is replacing screen-film mammography as it has been shown to be more accurate, especially in pre-menopausal women and women with dense breasts.³ The ability to alter contrast and brightness or to correct an exposure aids diagnosis. Digital imaging also produces faster image acquisition, reduces examination time and improves electronic transmission, data storage and retrieval.

Digital mammography has a dose of approximately 0.09 millisievert (mSv) [1.7 mGy] per view (22% lower dose than screen film mammography).⁴ The worldwide average background dose for a human is approximately 2.4 mSv per year.⁵ This exposure is mostly from cosmic radiation and natural radionuclides in the environment. The increased risk of cancer mortality from an effective dose of 0.09 mSv is approximately 4.5 in 1 million over one’s lifetime. Although multiple doses from several mammography examinations will increase this risk, it is still considered negligible relative to the medical benefits.⁶

Mammography is still the most important imaging modality in diagnosing breast diseases. Although its sensitivity for cancer detection varies widely, 83-92% in women >50 years with fatty breasts to 35% in women with glandular breasts, it can potentially identify all signs of breast malignancy (mass lesion, distortion, asymmetry and calcification) which currently no other imaging modality can do.⁷ Mammography forms one of the main components of the Triple Assessment (clinical assessment, mammography +/- ultrasound and tissue biopsy) — which is the standard of practice all breast units conform to today, although it is usually reserved for women over the age of 35 as sensitivity is relatively limited in younger women’s glandular dense breasts.

Mammography as a population screening tool

The premise behind screening for breast cancer is that if a cancer was detected and treated before it became evident to the patient in the form of symptoms, the woman would benefit from this early diagnosis by a reduced mortality (figure 2). Any benefits from screening can only be helpful if it results in earlier diagnosis and earlier institution of treatment which would affect mortality.

Screening for breast cancer was introduced in the UK in 1986 following recommendations of the Forrest Report.⁸ The report concluded “screening by mammography can lead to the prolongation of lives of women aged 50 years and over with breast cancer.” The evidence base for this report was from a series of randomised controlled trials (figure 3) that identified a reduction in mortality up to 30%. Women today screened as part of the NHS Breast Screening Programme UK (NHSBSP UK) have two views (medio-lateral and cranio-caudal) to reduce the false positive rate and increase the true positive rate, with a three yearly interval between screens.

Mammography screening programmes are now under scrutiny. Opponents of screening are questioning the validity of mortality data, ‘overdiagnosis’ and the psychological and physical stress of false positive recall examinations.

Screening opponents such as Jorgensen and Gotzsche (2010)⁹ reviewed the NHSBSP data and concluded the better survival data in the last decade may be due to improved treatments, especially in chemotherapy, radiotherapy and hormonal therapy. This proposal was based on the observed drop in breast cancer mortality in the relevant age group which began before the screening programme started and was largest in the age group too young to be screened (age 40-49). Other factors, such as increased ‘breast awareness’, may also have contributed by encouraging early presentation regardless of screening.
Recently, the most robust mortality data has been published by Tabar et al. (2011) They reviewed the last 29 years of the Swedish Two-County Trial. The conclusions were that screening results in a highly significant decrease in breast cancer specific mortality with screening 300 women for 10 years preventing one death from breast cancer. This decreased mortality data is concluded to be over and above the changes in treatment practices over the last 29 years.

‘Overdiagnosis’ refers to the possible detection of cancers that would never have clinically surfaced without screening. Overdiagnosis can result from either the detection of non-progressive cancers or in the scenario where a woman may die from another cause before her cancer would have become symptomatic. As it is not currently possible to distinguish between progressive and non-progressive cancers, doctors treat all detected breast cancers, making overtreatment inevitable.

Those that consider screening results in overdiagnosis estimate from the well-designed randomised controlled trials that one in four screen detected cancers are unnecessary diagnoses. This leads to inappropriate anxiety, biopsies and treatment. They argue that, as screening has detected an increasing amount of breast cancer, these additional breast cancer cases would sharply decline when the women pass the age limit for invitation. This data has been refuted by many, including Zahl et al. Although the concept of overdiagnosis is accepted by many, the question is no longer whether overdiagnosis occurs, but how often it occurs. This is almost impossible to calculate and viewpoints will differ greatly.

False positive screens occur when a woman is recalled for an abnormality on the mammogram but after investigation it is normal or benign, such as a simple cyst. NHSBSP statistics for 2007 show that although 14,753 breast cancer cases would sharply decline when the women pass the age limit for invitation. This data has been refuted by many, including Zahl et al. Although the concept of overdiagnosis is accepted by many, the question is no longer whether overdiagnosis occurs, but how often it occurs. This is almost impossible to calculate and viewpoints will differ greatly.

False positive screens occur when a woman is recalled for an abnormality on the mammogram but after investigation it is normal or benign, such as a simple cyst. NHSBSP statistics for 2007 show that although 14,753 breast cancer cases were detected, 83,728 women were recalled for assessment which equates to approximately 70,000 women being recalled for benign/normal disease. Although many women accept this as an inevitability of screening, increasing cohorts have voiced their concerns, citing psychological and physical stress at these apparent needless recalls.

**Conclusion**

UK breast cancer screening is now in its 24th year. The concept of “breast awareness” and the symbol of the pink ribbon is very much part of our culture. Many women work tirelessly campaigning and raising money for research into breast cancer, with many high profile events and celebrity endorsements. Most women find screening a valuable part of their yearly routine. However, many women have lost a friend or family member to breast cancer and screening helps them with their personal anxiety of an often dreaded disease. There are always those who will oppose the view of national screening due to conflicting evidence, overdiagnosis and false positive fears.

Overall, the literature still can provide evidence that organised breast cancer screening, performed by well-trained and dedicated medical professionals, can prevent about one-half of breast cancer deaths if it is repeated at regular and appropriate intervals. Earlier detection leads to fewer advanced cancers and consequently to fewer deaths and to a reduced need for the more aggressive forms of therapy.

Women should have the information for an informed choice and the decision of women who decline to participate must be respected.

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**References**

Mammographic screening is a public health intervention with benefits, harms and consequences.

The theory of screening breast cancer. The bottom triangle is the screened population. The breast cancer gradually grows (blue triangle) but the breast cancer is diagnosed (D) with screening, treated and the patient is potentially cured. Without screening the breast cancer presents later (P) therefore increased risk of death (cross). The lead time is the difference in time between screening and the cancer naturally presenting.

Randomised control trials of breast cancer screening with mammography.

The pink ribbon is very much a symbol of the 21st century and there are many fund-raising events to support breast cancer charities.