Screening for Breast Cancer

Bethany L. Niell, MD, PhD[a,*], Phoebe E. Freer, MD[b], Robert Jared Weinfurtner, MD[a], Elizabeth Kagan Arleo, MD[c], Jennifer S. Drukteinis, MD[a]

KEYWORDS

• Screening • Mammography • Ultrasound • MR imaging • Cancer detection rate

KEY POINTS

- Early detection with screening mammography significantly reduces breast cancer deaths by 20% to 40%.
- Annual screening mammography of women aged 40 to 84 prevents more deaths from breast cancer than biennial screening of women 50 to 74 years old.
- Currently, it is recommended that supplemental screening with ultrasound or MR imaging be performed in addition to mammography.
- The American Cancer Society recommends annual screening mammography and supplemental screening MR imaging for women with an estimated lifetime risk of breast cancer ≥20%, *BRCA* mutation carriers, first-degree relatives of *BRCA* mutation carriers who remain untested, women with a history of mediastinal irradiation between the ages of 10 and 30, and women with certain genetic syndromes.

INTRODUCTION

In the United States in 2017, an estimated 255,180 new breast cancer cases will be diagnosed.[1] In 2013, breast cancer deaths totaled 773,100 person-years of life lost, with each death averaging 19 years of life lost.[2] The goal of screening is to find cancers when still curable (ie, smaller and node-negative) to decrease breast cancer–specific mortality. Since screening mammography became widespread in the United States during the 1980s, age-adjusted breast cancer mortality in women has steadily decreased (**Fig. 1**). This article aims to review the most commonly used breast imaging modalities for screening, discuss how often and when to begin screening with specific imaging modalities, and examine the pros and cons of screening. By the end of this article, the reader will be better equipped to have informed discussions with patients and medical professionals regarding the benefits and disadvantages of breast cancer screening.

SCREENING MAMMOGRAPHY

Early detection of breast cancer with screening mammography significantly reduces the risk of death from the disease.[3,4] The strongest evidence is provided by randomized controlled trials (RCTs), and pooled estimates show that screening mammography can reduce breast cancer mortality by at least 20%.[5] Eight RCTs have been performed and published. The first was initiated in 1963, the Health Insurance Plan (HIP) trial.[6] It recruited 62,000 women ages 40 to 64 from the HIP of greater New York and half were invited to

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[a] Division of Breast Imaging, Department of Diagnostic Imaging, H. Lee Moffitt Cancer Center and Research Institute, 12902 USF Magnolia Drive, Tampa, FL 33612-9416, USA; [b] Division of Breast Imaging, Department of Radiology, University of Utah Hospitals, Huntsman Cancer Institute, 2000 Circle of Hope Drive, Salt Lake City, UT 84112, USA; [c] Division of Breast Imaging, Department of Radiology, Weill Cornell Medical College, Weill Cornell Medicine, 425 East 61st Street, New York, NY 10065, USA
* Corresponding author.
E-mail address: bethany.niell@moffitt.org

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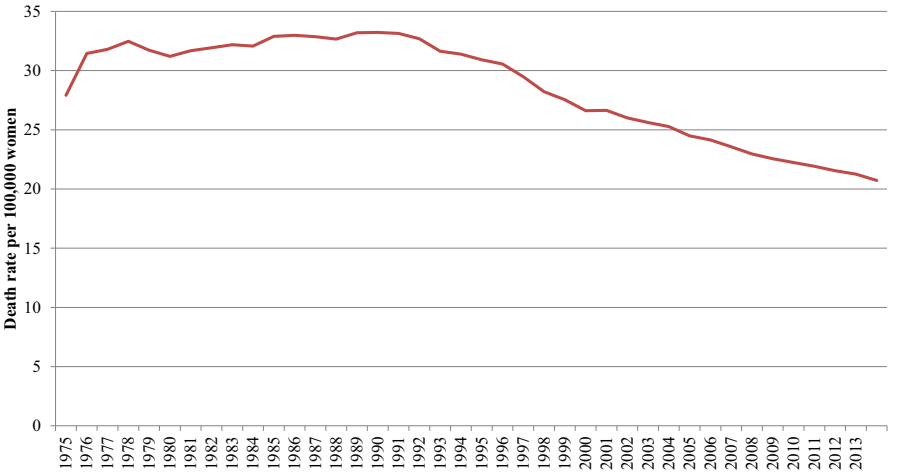

Fig. 1. Age-adjusted breast cancer death rate in American women decreased after the widespread introduction of screening mammography in the 1980s. (*Data from* the Surveillance, epidemiology, and end results [SEER] program from 1975–2013 and US Mortality Files, National Center for Health Statistics, Centers for Disease Control and Prevention. Rates are per 100,000 and are age-adjusted to the 2000 US population (19 age groups - Census P25-1130).)

undergo annual clinical breast examination and screening mammography. Breast cancer mortality was reduced by 22% among those invited to screen (**Table 1**).[3,7,8]

> Pooled estimates from RCTs demonstrate that screening mammography can reduce breast cancer mortality by at least 20%.

In the late 1970s, 2 trials in Sweden, the Swedish Two-County trial and Malmö investigated the effect of screening mammography without physical examination. The Swedish Two-County trial consisted of 133,065 women ages 40 to 74, who were randomized into a group invited to single-view screening mammography and a control group. Screening intervals were 24 months for ages 40 to 49, and 33 months for those 50 to 74.[9] After 3 decades of follow-up, invitation to screening resulted in a 27% to 31% reduction in breast cancer mortality, with only 45% of prevented breast cancer deaths occurring in the first 10 years. At 10 years of follow-up, 1303 women were needed to screen for 7 years to save 1 life. At 20 years, 577 women were needed to screen, and at 29 years, 519 women were needed to screen to save 1 life.[10] The observed number of prevented breast cancer deaths increases with follow-up duration, providing evidence that estimates of absolute benefit and number needed to screen requires trial follow-up intervals exceeding 20 years. Malmö recruited approximately 31,000 to each group, women ages 45 to 70 (MMST1) and ages 43 to 49 (MMST2). Invitation to screening at 18-month to 24-month intervals resulted in a 22% reduction in breast cancer mortality.[11]

The Edinburgh trial evaluated the efficacy of mammography and CBE in 3 cohorts of women recruited between 1978 and 1985. Patients were randomized by clinical practice to biennial single-view mammography (initial screening round was 2-view) plus annual CBE versus CBE alone.[12] With 14 years of follow-up from 28,628 women offered screening and 26,026 controls, invitation to screening decreased breast cancer mortality by 21% to 29%.[13] The Stockholm trial included 40,000 women invited to biennial screening and 20,000 women as controls.[14] The Swedish Two-County trial was already showing significant benefit; the Stockholm trial was terminated after only 2 rounds of screening with single-view mammography and showed no statistically significant mortality reduction (see **Table 1**).

The Canadian National Breast Screening Trials in women ages 40 to 49 (CNBSS-1) and 50 to 59 (CNBSS-2) investigated the efficacy of CBE and screening mammography on breast cancer mortality reduction.[15,16] Women were asked to volunteer to participate, and following CBE, approximately 50,000 volunteers were included in CNBSS-1 and 40,000 in CNBSS-2.[15,16] At 7 years of follow-up in CNBSS-1, women invited to screening had 36% *greater* mortality from breast cancer than control women. At 25 years of follow-up, breast cancer mortality was identical in the mammography and control arms.[17] Flawed study design and suboptimal image quality and interpretation may explain why the Canadian National Breast Screening Trials are outliers compared with other RCTs (see **Table 1**). In the