

# Screening for Cancer with MRI and Conventional Imaging

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## Synopsis

In the field of oncology, screening tests target at identifying cancers in asymptomatic, presumably healthy individuals. The aim is to detect cancer in its pre-clinical stage in order to improve prognosis and avoid disease-specific complications. The only cancer type for which imaging studies are used for mass screening is breast cancer. At the same time, this is the only cancer for which experiences exist regarding the use of MRI for screening. This lecture serves to provide an overview on the effectiveness of breast cancer screening methods by conventional methods (mammography, clinical breast examination) compared to MR imaging.

In the field of oncology, screening tests target at identifying cancers in asymptomatic individuals, i.e. in a pre-clinical stage. The underlying concept is that early diagnosis of a cancer improves the prognosis of the affected individual (i.e., reduce mortality), and avoids disease-specific complications. The only cancer type for which screening with imaging studies has been established is breast cancer. At the same time, this is the only cancer for which experiences exist regarding the use of MRI for screening.

In spite of increasing incidence rates, there has even been a gradual decline of breast cancer mortality rates during the last 10 years. One major reason for the reduced mortality is the advent of mammographic screening. The reduction of rate of death that is achieved with systematic mammographic mass screening is in the order of 30%.<sup>2-4</sup> Although this sounds splendid, there remains substantial room for improvement. The sensitivity and positive predictive value (PPV, i.e. cancer yield per number of recommended biopsies) of mammography depends heavily on breast parenchymal density.<sup>5-7</sup> With increasing breast density, and particularly in young patients or in the presence of benign fibrocystic disease, postoperative scars and post-radiotherapy parenchymal fibrosis, sensitivity and specificity can be substantially reduced. In turn, many of the mammographically suspicious lesions turn out to be benign upon histology; the average PPV of mammography is about 35% (only 35 out of 100 biopsies that are recommended for a suspicious mammographic finding turn out to be cancer). Breast ultrasound (US) can help compensate for some of the weaknesses in the mammographic exam, particularly in young patients, and it has a well-defined role in the primary work-up of the symptomatic patient. However, ultrasound still contends with some important disadvantages, the most important being its very low PPV.

There is convincing evidence to suggest that magnetic resonance imaging (MRI) of the breast is the imaging technique that offers the highest sensitivity for diagnosing primary and recurrent breast cancer. Currently, breast MRI is mostly used as a 'second line' imaging modality, i.e. only after a suspicious or equivocal finding was made on a mammogram or breast ultrasound<sup>10-17</sup>, in particular for local staging. With increasing evidence of the superior diagnostic accuracy of MRI compared with conventional imaging methods, MRI is increasingly evaluated as a first-line imaging modality, i.e. for screening. This is in concordance with the concept to individualize screening efforts so that not all women are subjected to the same protocol (yearly mammographic screening starting age 40 years), but to tailor screening efforts to the individual risk profile, i.e. offering intensified screening protocols to women who carry an increased risk. An increased risk of breast cancer includes women who were already diagnosed with breast cancer (high risk of recurrent ipsilateral, synchronous or metachronous contralateral breast cancer), women with a history of borderline tissue diagnosis [lobular carcinoma in situ (LCIS), atypical ductal hyperplasia (ADH) or radial scars], women with a strong family history for breast cancer (in particular early-onset breast cancer) and women with presumed or proven mutation in one of the breast-cancer susceptibility genes BRCA1 or BRCA2 (resulting in a condition called hereditary or familial breast cancer). For carriers of BRCA gene mutations, the individual lifetime risk is as high as 85–90%. The first trial on using MRI screening in women at high risk suggests that MRI helps to double the number of detected cancers compared with conventional breast imaging (sensitivity 100% by MRI vs 44% for mammography and breast ultrasound) and similarly increase PPV (64% vs 34%, respectively). Further trials<sup>18-22</sup> have confirmed these encouraging results, consolidating MRI as the new 'gold standard' for breast imaging.

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