10.1 Introduction: Epidemiology

Breast cancer is the most frequent malignant disease in women worldwide and the second leading cause of cancer death in Western countries. In Germany, 46,000 women per year suffer from breast cancer. Of these women, 18,000 died from it [1]. In the USA, 211,240 new cases of breast cancer were diagnosed in women in 2004 and 40,410 died from it. The incidence has been increasing from 1940 until the present, to 110 per 100,000 women annually, and is higher in white women than in African-Americans. Statistics indicate that one in nine women will develop breast cancer during her lifetime [2].

In the last decade, there has been progress in understanding risk factors for breast cancer. Female breast cancer is a complex multifactorial disease, the etiology of which involves a strong interplay between environmental and genetic factors. The highest risk factor is age. The relative risk (RR) increases from 1 to 56 from the age of 25 to 74. The incidence rises from 1.9 in the 20-24 age group to 387.2 in the 80-84 age group per 100,000 white women in the USA. The probability is also higher in Western countries (RR 5), if relatives have had breast cancer (RR 1, 4–6), in case of contralateral breast cancer (RR 5), and if breast parenchyma is dense in mammography (RR up to 4.3) [3]. Even though breast cancer is uncommon in women younger than 30 years, women with inherited specific genetic abnormalities such as the BRCA gene have a high risk of developing breast cancer at young ages.

Approximately 60%-80% of invasive breast cancers are ductal carcinomas. These often present as a firm to hard lump. Invasive lobular carcinomas account for approximately 10%-20% and are more difficult to detect due to diffuse infiltration of the surrounding tissue and a multicentric appearance. Five percent are medullary carcinomas; the remaining tumors comprise a variety of histological types. However, most patients initially present with a breast lump. In all patients with a lump, a definite diagnosis should be made.

10.2 Conventional Imaging

10.2.1 Mammography

Mammography is indicated in clinically symptomatic women and for screening for breast cancer in asymptomatic women. After clinical examination and palpation, mammography is useful to improve the diagnosis in cases of a breast lump, asymmetry of breast contour, protrusion, or dimpling of the skin. Two or three views of each breast are obtained – mediolateral, oblique, and craniocaudal – during which the breast is compressed between two plates.

Breast cancer often shows distinct, irregular, sometimes crab-like densities and clusters of microcalcifications (Fig. 10.1). Ninety percent of all diagnosed in-situ breast cancers
and 60% of all invasive cancers show microcalcifications. Lobular carcinomas are harder to detect than ductal carcinomas because microcalcifications are rare (roughly 5%) and the diffuse infiltration of the surrounding tissue with no change in tissue density. Carcinomas can be diagnosed more easily in fatty transformed breasts than in mastopathically changed breasts because of the higher density of the breast tissue and the lower normal tissue-to-tumor contrast. Approximately 10% of carcinomas cannot be detected by mammography even when they are palpable.

Mammography has a high sensitivity of 69%–90% in detecting breast cancer [4–9]. However, approximately 80% of suspicious microcalcifications are benign, resulting in a high number of false-positive diagnoses and a low specificity. Consequentially, only approximately 30% of all women with suspicious mammography who undergo surgery turn out to have breast cancer in histology.

Nevertheless, mammography is at the moment the best modality for screening asymptomatic women for breast cancer and for follow-up after breast cancer. Because screening has now been implemented, mortality in women aged 50 and over has decreased by more than 30% [10]. The age the screening should be started and the frequency remains controversial and differs from country to country.

10.2.2 Sonography

Indications for sonography are a palpable lump in women younger than 30 years, especially when presenting dense breast tissue, or older than 30 with an unsuspicious mammography and to differentiate between solid and cystic lesions diagnosed in mammography. Signs of malignancy are irregularly shaped hypoechoic masses and ill-defined demarcation against surrounding tissue. Microcalcifications, as the most common sign of malignancy, are not detectable by sonography. The quality of sonography depends greatly on the experience of the physician. For these reasons, it is difficult to discriminate between benign and malignant tumors with the necessary investigator-independent certainty. The sensitivity is high, but because of many false-positive diagnoses specificity is low. Sonography as a single examination for screening is not recommended, but is useful in combination with mammography to increase sensitivity [11].

10.2.3 Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) is a modern breast imaging technique that is gaining popularity. Breast MRI has been shown to have sensitivities between 95% and 100% in detecting early breast cancer [12, 13]. Especially in young women with dense breast tissue, the sensitivity of MRI is higher than mammography [14]. Enhancement of the contrast agent (mostly chelates of gadolinium) and dynamic contrast-enhanced examination of the lesions reflects local tissue changes in blood flow, capillary permeability, and extracellular volume due to angiogenesis, a hallmark of cancer. The reported specificity of MRI ranges between 37% and 97% [15–18]. A high rate of false-positive findings results in many unnecessary biopsies and undue anxiety for patients [19]. Mostly benign tumors (e.g., fibroadenoma and severe fibrocystic disease) are responsible for false-positive findings.