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Evaluation of a mammography screening program within the population-based Vorarlberg Health Monitoring & Prevention Program (VHM&PP)

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ABSTRACT

Objectives: To describe the mammography screening program from 1989 to 2005 within a population-based prevention program in Austria and to appraise it according to recommended quality indicators.
Material and method: From 01.01.1989 all women aged 40 years or older participating in the Vorarlberg Health Monitoring & Prevention Program (VHM&PP) was offered to undergo additionally a "screening mammography". Passive follow-up has been performed by record linkages with the Vorarlberg cancer registry and mortality statistics for information on outcome variables. Interval cancer rates have been estimated and the survival after breast cancer has been calculated by life table technique by examination period and age groups (40–49 years, 50–69 years).
Results: Between 1989 and 2005 50,100 women aged 40 to 69 years participated in the program, of which 123,652 mammogram results have been collected. In the target population the participation rate was 65.1%. During median follow-up time 13.5 years and 633,342 person-years overall 665 invasive cancer and 87 ductal carcinoma in situ (11.6%) cases have been identified. Between 1996 and 2004 the detection rates were 239.9 per 100.000 among women aged 40–49 years and 543.2 per 100,000 among women aged 50–69 years. The rates for interval cancers were 160.4 and 277.4 per 100 000 negative screens, respectively. During median follow-up of 13.5 years 165 deaths occurred with no difference in survival between patients with interval and screen detected cancers.
Conclusion: A mammography screening program has been performed between 1989 and 2005 in Vorarlberg. Till 2005 most quality indicators improved and met the EU-recommendations suggesting that alternative approaches to organized mammography screening based on routine data should be explored.

1. Introduction

Breast cancer (BC) is the most common cancer diagnosed in women worldwide and the leading cause of cancer death among women, accounting for 23% of the total cancer cases and 14% of cancer deaths [1]. During the following decades increasing breast cancer incidence in Austria is predicted to increase [2]. Therefore, the prevention and management of breast cancer in order to provide high quality health care is an important public health issue.

Mammography is the predominantly applied diagnostic and screening method for breast cancer [3]. Screening aims to achieve early detection of disease in order to change an incurable to a curable status. In the nineties, randomized clinical trials showed that mammography screening can reduce breast cancer mortality [4]. Overall, randomized clinical trials of mammography screening among women aged 50 to 70 years have shown a 15% reduction of breast cancer mortality after 10 years of follow-up [5]. During the past years, the publications of the Cochrane Collaboration fostered discussion about the benefit and harms of mammographic screening [6,7,5]. Mammography screening is also associated with harm, such as false positive results, overdiagnosis and overtreatment [8].

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Recently the Swiss Medical Academy of Medical Sciences decided against the introduction of mammographic screening [9], which has been matter of debate concerning the applied models [10]. However, a small overall advantage in mortality appears for women participating in mammography screening [11].

In Austria, since 1974 mammography is covered by the health insurance and participation in opportunistic screening was high [12]. In 2014, a nationwide quality controlled mammography screening program has been introduced. Data from Tyrol in Austria have shown that opportunistic mammographic screening resulted in a reduction of 26% of BC mortality [13] in women aged 40–79 years. In a pilot project in Tyrol, data of quality indices after introducing organized mammography screening have been reported [14].

In Vorarlberg, mammography screening has been introduced in 1989 as an additional component in the population-wide prevention program. The evaluation of a mammography screening program in a population setting under routine conditions could provide further insight in the value of mammography screening on population level.

Thus, the aim of this study was to describe the mammography screening program from 1989 to 2005 within a community based health prevention program and to appraise it according to recommended quality indicators in order to compare it with those obtained in other studies.

Material and methods

Setting

In Vorarlberg health prevention programs have a long-lasting tradition. In the 70ies, a general health examination as and a gynecological prevention examination have been implemented and documented [15]. The data are electronically available from the 80ies. Organized clinical breast cancer examination (CBE) from the age of 20 years has been performed in the late 70ies and to a minor extent opportunistic mammography screening has been performed, which has not been systematically documented. In 1989 an organized mammography screening program has been implemented. Between 1989 and 2005, 136,488 women participated at least once in the prevention program, of which 69,209 were eligible for the mammographic screening program.

From 01.01.1989 all women aged 40 years or older participating in Vorarlberg health prevention program were invited to undergo additionally a “screening mammography”. The Vorarlberg mammography screening program was organized at that time according to existing standards and quality assurance guidelines such as checks by a health physicist and regular reports for the radiographers.

In 1989, 20,528 women in Vorarlberg were in the age group 40–49 years and 30.573 in the age group 50–69 years. Biennial mammography screening for women from the age of 40 years started on 1 January 1989. Two-view mammography was performed. There were four stationary mammography screening units located in Bregenz, Feldkirch, Dornbirn, and Bludenz. Women were invited to undergo a mammography and data were collected concerning previous mammography, year of last mammography, family history, breast operation, additional examination, height, weight, result of the mammography screening, pill-use, and breastfeeding. Between 01.01.1989 and 31.12.2005 data of 123.652 screening mammograms has been collected. Double reading of the mammograms has been introduced in 2001. From 01.01.2002 information according to the Breast Cancer Imaging Reporting and Data System (BIRADS) classification were collected negative, benign finding, probably benign finding, suspicious finding, highly suggestive for malignancy and known biopsy proven malignancy [16]. For the entire period the information on the outcome of screening mammography was reclassified as unknown, negative, follow-up in a short period of time, and (highly) suspicious. Ethical approval for the evaluation of the VHM&PP data was obtained by the ethics committee of Vorarlberg.

1.2. Outcome data

Data on participation in the mammography prevention program was linked to the Vorarlberg cancer registry data in order to identify incident and prevalent cases of ductal in-situ and invasive carcinoma as well as to the Vorarlberg death index for mortality follow-up. The Vorarlberg cancer registry is an epidemiological cancer registry collecting cancer cases since 1978 and contributing to the WHO publication Cancer Incidence in Five Continents [17]. Breast tumors were coded according the International Classification of Diseases, tenth revision (ICD-10): C 50) and carcinoma in situ cases (DCIS) as D05 without ICDO-M3 = 8520/2, respectively. The censoring date was 31.12.2011. Time under risk following an examination was defined as time to an incident cancer event or to death or to end of study period, whatever was observed first. Prevalent cases with invasive breast cancer ($N = 109$) and prevalent carcinoma in situ ($N = 4$) have been excluded. Tumor stage was classified according to the TNM classification of malignant tumors [18] and summarized according to the Union for International Cancer Control (UICC) classification in (UICC I-IV) to categorize tumor spread [19]. Any tumor stage with positive regional lymph nodes was classified as UICC stage II+. Coverage was defined as percentage of eligible women attending an examination per two years. Screen detected cancers were defined as registered cancer after suspicious finding or recall.

1.3. Interval carcinoma

Invasive or in-situ carcinoma registered within two year follow-up of mammographic screening round after negative screening round (without pathological finding or recall) were defined as interval invasive or in-situ carcinoma, respectively. Tumors with lag time of 2 months after the mammography were considered. The occurrence of interval tumors was evaluated separately up to 1 year (2–12 months) and between first and second year (12–24 months) after the screening mammography. Rates for interval carcinoma were calculated per women screened negative.

1.4. Statistical analysis

We calculated rates by age strata of 40–49 years and 50–69 years at the first mammographic examination by year of examination (1989–1995 and 1996–2005). Coverage rate has been calculated by counting the screening examinations (N_{Screens}) in women aged 40–49 years and 50–69 years in relation to the female Vorarlberg population in these age groups in 1989–1995 and 1996–2005 (population in person years), assuming biannual attendance.

$$\text{Coverage} = \left(N_{\text{Screens}} \times \frac{2}{\text{Population}} \right) \times 100$$

Participation rate has been calculated by counting each woman once during the observation period in the health prevention program. Life table techniques were applied to calculate survival after invasive breast cancer and interval cancer. The results were illustrated by Kaplan–Meier-plot and compared using log-rank test. In addition, we calculated population-based rates for incident in-situ and invasive carcinoma, for which we used the official data on population, by sex and 5 year age classes as supplied by statistics Austria. All statistical analyses were performed using SAS 9.3 (SAS Institute Inc., Cary, NC, USA.).