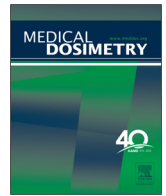




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Heart-sparing radiotherapy in patients with breast cancer: What are the techniques used in the clinical routine? A pattern of practice survey in the German-speaking countries

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ABSTRACT

The aim of this study was to understand the practice of care in German-speaking countries with regard to heart-sparing radiotherapy techniques. Between August 2015 and September 2015, an e-mail/fax-based survey was sent to radiation oncology departments in Germany, Austria, and the German-speaking Switzerland. The questionnaire was divided into 3 chapters: a general chapter on the department, a chapter specific for heart-sparing techniques in patients with breast cancer, and a third chapter on personal beliefs on the topic of heart sparing in patients with breast cancer. A total of 82 radiation oncology departments answered the questionnaire: 16 university clinics and 66 other departments. In general, heart-sparing techniques are being offered by 90.2% of departments for radiation oncology in the German-speaking countries. However, in the clinical routine, 87.7% of institutions use heart-sparing techniques in less than 50% of patients with breast cancer. Heart-sparing techniques are especially provided for patients with left-sided breast cancer (80%), patients after mastectomy (52.5%), and when the mamma interna lymph drainage vessels are irradiated (41.3%). In 46.3% of departments, there are written internal guidelines for heart sparing in patients with breast cancer. Breathing-adapted radiotherapy is used as the most frequent heart-sparing technique in 64.7% of the institutions, followed by intensity-modulated radiation therapy, which is most frequently used by 22.1%. The only significant difference between university hospitals and other departments was seen for the offering of partial breast irradiation. The most commonly used heart-sparing technique is breathing-adapted radiotherapy, but there is no coherent approach for heart sparing in patients with breast cancer in the German-speaking countries. Overall, all options for cardiac protection/cardiac avoidance have their advantages and disadvantages, with deep inspiration breath-hold radiotherapy

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having the most clear data, which should be the preferred choice when using heart-sparing techniques.

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Introduction

In patients with breast cancer, adjuvant radiotherapy can reduce the risk of local recurrence and is recommended for all patients undergoing breast-conserving surgery.¹ Because of the good prognosis with a 5-year survival rate of 90%,² long-time toxicities become more and more important. Studies on long-term survivors demonstrated an increased cardiac mortality and cardiac morbidity after radiotherapy for breast cancer.³⁻⁷ In 2 studies by Darby *et al.*⁸ and Sardaro *et al.*,⁹ the risk of cardiac diseases was described to increase by 7.4% and 4% for each gray in the mean heart dose, respectively. Therefore, it is necessary to minimize cardiac dose when treating patients with breast cancer.

In recent years, different concepts for reducing the heart dose in patients with breast cancer were described. One would be to displace the heart out of the radiation field. This can be achieved by a modified patient setup like prone position^{10,11} or specific breathing techniques like deep inspiration breath-hold (DIBH) and gating techniques.¹²⁻¹⁶ Another idea is to solely irradiate a small volume around the lumpectomy cavity.^{17,18} A third approach that can be pursued if heart sparing is intended is to reduce the heart dose by modern radiation techniques like intensity-modulated radiation therapy (IMRT) or volumetric-modulated arc therapy (VMAT).¹⁹⁻²¹

Despite the relation between heart dose and cardiac events, until today, there are no definite recommendations concerning the use of heart-sparing techniques in patients with breast cancer. Little is known about when and if heart-sparing techniques are used on a large basis in clinical practice. In this paper, we present the results of a survey in German-speaking countries on the heart-sparing techniques used in patients with breast cancer and discuss the available evidence.

Methods

Between August 2015 and September 2015, a short cover letter and a link to an online survey was sent to radiation oncology departments in Germany, Austria, and the German-speaking Switzerland via the mailing list of the German Society of Radiation Oncology (“*Deutsche Gesellschaft für Radioonkologie*”—DEGRO). If technical or other problems prevented the participation at the online survey, the questionnaire was sent via fax.

A total of 82 radiation oncology departments answered the questionnaire. Of the 82 departments, there were 16 university departments and 66 other departments (like medical care centers, urban/city hospitals, or radiation oncology doctors’ practice). Most of the participants (87.2%) had > 10 years of experience in radiation oncology. The median radiotherapy experience of the participants was 20 years (range 4 years to 35 years).

The distribution of qualitative data is presented by absolute and relative frequencies. Corresponding statistical hypothesis testing is performed through Fisher exact test. All statistical testing was conducted in an exploratory manner on 2-sided 5% significance levels using the software *PASW Statistics 18 version 18.0.0* (available at <https://www.ibm.com/de-de/marketplace/statistical-analysis-and-reporting>).

Results

Of the institutions that answered the questionnaire, 95.1% ($n = 78$) were from Germany, 3 were from Austria, and 1 was from Switzerland. With a total absolute number of 16, 19.5% were university hospitals. The number of patients treated per year (ppy) was more than 1000 in 82.5% of the departments (1000 to 1499 ppy in 42.5% and >1500 ppy in 40%). More than 86% of the departments irradiate more than 100 patients with breast cancer per year.

In general, heart-sparing techniques are offered by 90.2% of the departments. However, in slightly more than half of the institutions (53.7%), there are no written institutional internal guidelines for which patients’ heart-sparing techniques should be performed.

Figure 1 shows the percentage of departments offering heart-sparing radiotherapy for patients with breast cancer.

Figure 2 depicts the recommendation for heart-sparing techniques.

Figure 3 depicts the used techniques.

Regarding breathing-adapted radiotherapy, a respiratory gating system is used in 52.8% of the departments, whereas voluntary breath-hold and spirometric techniques are provided in 32% and 15.2%, respectively.

Most of the departments use 2-dimensional imaging (54.3%) or controlling of the skin marks (46.9%) to verify positioning during breathing-adapted radiotherapy. Imaging with computed tomography is performed by 24.7% of departments and 29.6% are verifying positioning with light fields.

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