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LYMPHEDEMA OF THE OPERATED AND IRRADIATED BREAST IN BREAST CANCER PATIENTS FOLLOWING BREAST CONSERVING SURGERY AND RADIOTHERAPY

N. Adriaenssens, H. Verbelen, P. Lievens, J. Lamote

UZ Brussel, Breast Clinic, Department of Physical Therapy (NA); UZ Brussel, Breast Clinic, Oncological Surgery (JL); and Vrije Universiteit Brussel, Physical Therapy Department (HV,PL), Brussel, Belgium

ABSTRACT

The National Institutes of Health Consensus Development Conference on Treatment of Early Stage Breast Cancer in 1990 indicated that breast conserving surgery with radiotherapy is the primary therapy for the majority of women with early stage breast cancer. Despite good aesthetic results, a remarkable number of patients suffer from lymphedema of the operated and irradiated breast.

131 study participants scored 8 subjective symptoms of breast edema on a scale from 0 to 10 and completed the EORTC QLQ-BR23 questionnaire to assess the health related quality of life among breast cancer patients.

Incidence of breast edema, up to 5 years following surgery, was 75.5%. There was a significant positive correlation between breast edema and body mass index. Breast edema also correlated significantly with chemo-therapy treatment, anti-hormone therapy, age, and all aspects of quality of life, except sexual functioning, sexual enjoyment, and upset by hair loss. There were no significant differences in breast edema related to the post- operative period, the level of nodal dissection, pre-operative bra cup size, tumor location and whether the surgery was performed on the dominant side.

Despite the benefits of breast conserving surgery and radiotherapy, breast edema is a common complication that lowers quality of life significantly.

Keywords: lymphedema of the breast, breast edema, breast conserving surgery, incidence, risk factors, quality of life, irradiated breast, radiotherapy

Breast cancer is the most common malignancy in women in the Western World and although mortality is decreasing, the incidence of breast cancer has increased. With introduction of breast cancer screening and self-awareness programs, breast cancers are often diagnosed at an earlier stage. Together with the evolution of surgical techniques, an increasing number of breast cancers fit the criteria for breast conserving surgery (BCS) (1). The National Institutes of Health Consensus Development Conference on Treatment of Early Stage Breast Cancer in 1990 indicated that BCS with radiotherapy is the primary therapy for the majority of women with early stage breast cancer. Despite good aesthetic results, a remarkable number of patients suffer from breast cancer related lymphedema of the operated and irradiated breast (2).

Breast edema is a complication of BCS

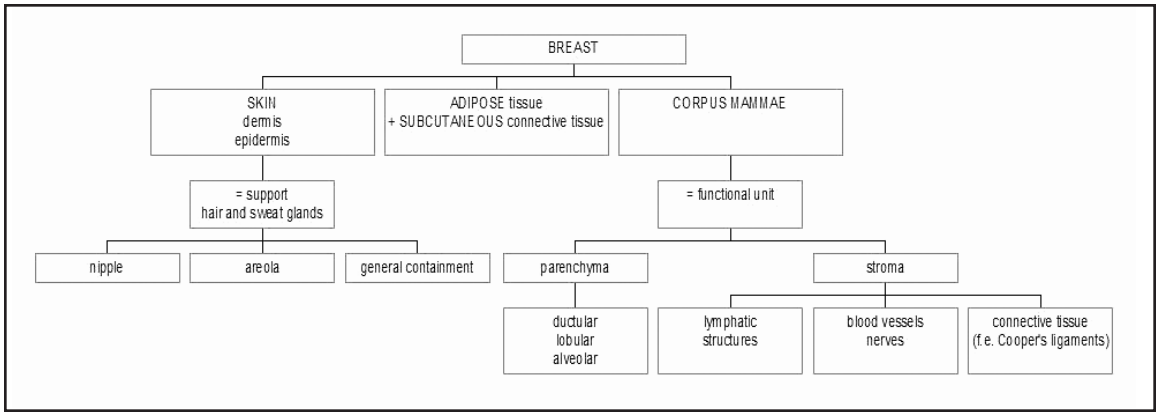

Fig. 1. Schematic presentation of the anatomical composition of a breast.

and radiotherapy that is sparsely described in the literature. Incidences of breast edema vary widely because there are no standard diagnostic criteria for breast edema and there is no consensus on the definition. Most researchers use clinical examination with observation and palpation of the breast, and patient reported subjective symptoms to assess breast edema. Common diagnostic symptoms of breast edema described in the literature are peau d'orange, swelling, heaviness, redness, and pain in the operated breast (3-7).

Breast edema comprises two components. Parenchymal breast edema is characterized by swelling or enlargement of the parenchyma of the breast, and cutaneous breast edema is caused by edematous changes in the epidermis and dermis of the breast (7) (*Fig. 1*).

Risk factors for the development of breast edema have been the focus of a few studies. Incidence and degree of breast edema appear to be negatively influenced following more extensive axillary surgery (5-7), with large pre-operative cup size (5), with overweight (4), if the tumor is located in the superior external quadrant (SEQ) (4), following axillary nodal irradiation, and with post-operative wound infection (7). Despite benefits of BCS, breast edema may cause an unsatisfactory aesthetic and psychosocial outcome, influencing activities in daily living and the quality of life (QOL) of breast cancer survivors (2).

The main aim of this study was to analyze incidence and degree of breast edema, in correlation with the 60 months post- operative period, in a cohort of female breast cancer patients following BCS and radiotherapy.

A secondary aim of this study was to analyze the correlation between degree of breast edema and QOL. Influence of risk factors proposed in the literature such as axillary lymph node dissection, pre-operative bra cup size, body mass index (BMI), and location of the tumor, but also influence of possible unknown risk factors, like chemotherapy, anti-hormone therapy, whether the surgery was performed on the dominant side, and age, were studied.

MATERIALS AND METHODS

Patient Recruitment

Breast cancer patients treated with BCS and radiotherapy at the Universitair Ziekenhuis Brussel (UZB) in the last 5 years were invited to participate in the study during a follow-up appointment at the Breast Clinic of the UZB. Study eligibility criteria

for the entire sample included female gender, treated with unilateral or bilateral BCS and radiotherapy, and aged over 18 years. All ductal carcinoma in situ, stages of cancer, and systemic therapies were included in the study. Exclusion criteria were BCS over 5 years ago and comorbidities associated with breast edema, for example angiosarcoma, heart conditions, and lung conditions. Patients with surgical breast reconstruction and patients not understanding French or Dutch were also excluded. All women in the study gave informed consent and the trial was approved by the UZB Ethics Board.

Surgery

BCS was performed between August 3, 2005, and September 24, 2010. Surgery encompassed local excision of the tumor aiming at free tissue margins. The sentinel lymph node technique was used during surgery to detect positive lymph nodes and perform extensive axillary lymph node dissection (6,8). In some cases, axillary nodal status was determined pre-operatively using axillary ultrasound and fine needle aspiration cytology (9).

Radiotherapy Treatment Protocol

Patients received conventional post-operative radiotherapy to the breast area using two opposing tangential fields with 25 fractions of 2 Gy, 5 days a week, during 5 weeks. An electron boost of 16 Gy in 8 fractions was delivered to the tumor site for patients under the age of 70 years, resulting in a total dose of 66 Gy in 7 weeks. Patients with axillary metastases also received radiotherapy to the axillary, infra- and supraclavicular fields at the same dose and fractionation (10-11). At the UZB, radiotherapy starts approximately 6 weeks after BCS.

Main Outcome Measures and Measurement Instruments

Study participants rated current subjective symptoms of breast edema in the operated and irradiated breast through a self-devised questionnaire. Heaviness, swelling, redness, peau d'orange, numbness, tingling, stabbing pain, and skin twitching of the breast were rated on a scale from 0 to 10. A score of 0 was given when the subjective symptom was currently not present in the operated breast. A score of 10 was given when the subjective symptom was currently unbearable in the operated breast. Sum of scores was calculated on a total score of 80. Total symptom score was divided into categories to describe degree of breast edema. A score of 0 on 80 represented no breast edema, a score between 1 and 25 – mild breast edema, a score between 26 and 50 – moderate breast edema and a score between 51 and 80 – severe breast edema. Information on BMI and breast size, quantified by the pre-operative bra cup size, was also collected through this questionnaire. Two BMI categories were used to describe the weight of the patient: BMI lower than 25 kg/m^2 were referred to as not overweight and BMI equal to and higher than 25 kg/m^2 were referred to as overweight (13,14).

Medical and sociodemographic data were collected through the electronic medical database (EMD) of the UZB, for example degree of nodal dissection, location of the tumor, systemic therapies, and date of the operation. Patients were divided into 5 time intervals according to their post-operative period: from 0 to 3 months, 3.1 to 6 months, 6.1 to 12 months, 12.1 to 24 months and 24.1 to 60 months after surgery.

Study participants also completed the EORTC QLQ-BR23 questionnaire. This is a validated questionnaire used for assessment of health related QOL among breast cancer patients developed by the EORTC Quality of Life Study Group. The EORTC QLQ-BR23 consists of 23 questions divided into 4 functional scales and 4 symptom scales related to breast cancer. Functional scales are body image, sexual functioning, sexual

enjoyment, and future perspective and symptom scales are side effects of systemic therapies, breast symptoms, arm symptoms, and upset by hair loss. All scales range in score between 0 and 100. A high score on a functional scale represents high and healthy level of functioning. A high score on a symptom scale represents more severe symptoms (14,15).

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) version 19.0 was used to analyze results. Descriptive statistics as frequencies, means, standard deviations, and percentages were used to describe clinical characteristics of study participants and incidence of breast edema.

Pearson-Chi Square, two-sided tests, were used to assess whether degree and incidence of breast edema varied according to the post-operative time intervals.

Correlation between degree of breast edema and QOL, BMI, and age were assessed using Pearson's correlation coefficients, one-sided tests.

Influence of level of nodal dissection, pre-operative bra cup size, location of the tumor, chemotherapy, anti-hormone therapy, and whether the operation was performed at the dominant side, on degree of breast edema was assessed using one-way analyses of variance (ANOVA) and independent sample t-test.

In all tests, p-values of less than .05 were considered to be statistically significant.

RESULTS

Respondents

187 patients were recruited to participate in the study of which 168 patients completed and returned the questionnaires. Reasons for not returning questionnaires were not registered. These participants were not contacted to inquire about their reason for not returning the questionnaire. Based on the inclusion and exclusion criteria, 37 of the 168 patients who filled out the questionnaires were not eligible for the study. The majority of these patients were excluded because BCS was over 5 years ago (n=28), and 9 patients were excluded because after- treatment did not include radiotherapy. A total of 131 women were enrolled in this prospective cross-sectional study.

Clinical Characteristics

Characteristics of the study population are shown in *Table 1*. Mean age of the patients was 60.2 years (SD ± 10.4). 21.1% of the patients had complete axillary lymph node dissection, 57.9% had pre-operative bra cup size bigger than or equal to C cup, 50.1% had BMI greater than or equal to 25 kg/m^2 and in 49.2%, the tumor was located in the superior external quadrant (SEQ). 20.6% received chemotherapy, 71.8% received anti-hormone therapy after initial treatment and 52.8% were operated at the hand dominant side.

The mean time interval between operation and data collection was 694.2 days (SD ± 502.6). According to post-operative time intervals, 11.5% were operated on between 0 and 3 months at the time of measurement, 11.5% between 3.1 and 6 months, 13.1% between 6.1 and 12 months, 23.8% between 12.1 and 24 months and 40.0% between 24.1 and 60 months.

Incidence and Degree of Breast Edema

Incidence of breast edema in breast cancer patients who had BCS and radiotherapy in a cohort up to 5 years following surgery was 75.5%. The mean degree of breast edema, expressed as total score on 80 for the symptom scale was 14.4 (SD ± 14.0). According to categories of degree of breast edema, 81.8% of the patients had mild breast edema, 16.2% of the patients had moderate breast edema and 2.0% of the patients had severe breast edema.

TABLE 1
Characteristics of Breast Cancer Patients Following Breast Conserving Surgery with Radiotherapy (n = 131)

Possible risk factors	
Age (years)	60.2 (SD±10.4)
ALND	21.1 %
Pre-operative bra cup size ≥ C	57.9 %
Body mass index ≥ 25 kg/m^2	50.1 %
Tumor location in the SEQ	49.2 %
Chemotherapy	20.6 %
Anti-hormone therapy	71.8 %
Surgery on dominant side	52.8 %

ALND = Axillary Lymph Node Dissection;
SEQ = Superior External Quadrant

Incidence of breast edema in patients who had BCS less than or 3 months ago was 93.3%. 78.6% of the patients with breast edema had mild breast edema and 21.4% of the patients with breast edema had moderate breast edema. Mean score on the symptom scale in the post-operative time interval between 0 and 3 months was 16.4 (SD ± 13.4).

Incidence of breast edema in patients who had BCS between 3.1 and 6 months ago was 73.3%. 72.7% of the patients with breast edema had mild breast edema, 18.2% had moderate breast edema and 9.1% had severe breast edema. Mean score on the symptom scale in the post-operative time interval between 3.1 and 6 months was 18.5 (SD ± 23.6).

Incidence of breast edema in patients who had BCS between 6.1 and 12 months ago was 82.4%. 85.7% of the patients with breast edema had mild breast edema and 14.3% had moderate breast edema. Mean score on the symptom scale in the post-operative time interval between 6.1 and 12 months was 13.2 (SD ± 11.2).

Incidence of breast edema in patients who had BCS between 12.1 and 24 months ago was 80.6%. 88.0% of the patients with breast edema had mild breast edema, 8.0% had moderate breast edema and 4.0% had severe breast edema. Mean score on the symptom scale in the post-operative time interval between 12.1 and 24 months was 14.2 (SD ± 11.9).

Incidence of breast edema in patients who had BCS between 24.1 and 60 months ago was 65.4%. 79.4% of the patients with breast edema had mild breast edema and 20.6% had moderate breast edema. Mean score on the symptom scale in the post-operative time interval between 24.1 and 60 months was 13.3 (SD ± 13.3).

There were no significant differences between post-operative time intervals in terms of degree and incidence of breast edema (*Table 2*).

Breast Edema and Possible Risk Factors

No significant correlations were found between degree of breast edema and level of axillary lymph node dissection, pre- operative bra cup size, location of the tumor, and whether surgery was performed on the dominant side.

TABLE 2
Incidence and Degree of Breast Edema in a Cohort of Breast Cancer Patients Following Breast Conserving Surgery with Radiotherapy (n = 131)

post operative time interval	incidence (%)	degree in category (%) in a patient group with at least mild breast edema			degree in score (*SD*)
		Mild	Moderate	Severe	/80
0 - 60 months	75.5	81.8	16.2	2.0	11.0 *(±13.6)*
0 - 3 months	93.3	78.6	21.4	0	16.4 *(±13.4)*
3.1 - 6 months	73.3	72.7	18.2	9.1	18.5 *(±23.6)*
6.1 - 12 months	82.4	85.7	14.3	0	13.2 *(±11.2)*
12.1 - 24 months	80.6	88.0	8.0	4.0	14.2 *(±11.9)*
24.1 - 60 months	65.4	79.4	20.6	0	13.3 *(±13.3)*

A significantly positive correlation was found between degree of breast edema and BMI of patients with breast edema ($p = .046$, $r = .171$). Patients who received chemotherapy had a significantly higher degree of breast edema ($p = .005$) and patients with anti-hormone therapy had a significantly lower degree of breast edema ($p = .024$).

There was a significantly negative correlation between degree of breast edema and age of patients with breast edema ($p = .000$, $r = -.364$).

Breast Edema and QOL

There was a significantly negative correlation between degree of breast edema and body image ($p < .001$, $r = -.443$) and between degree of breast edema and future perspective ($p < .001$, $r = -.476$) of patients with breast edema. There was a significantly positive correlation between degree of breast edema and side effects of systemic therapy ($p < .001$, $r = .264$), breast symptoms ($p < .001$, $r = .693$) and arm symptoms ($p < .001$, $r = .571$) in patients with breast edema.

Degree of breast edema was not significantly correlated with sexual functioning, sexual enjoyment and upset by hair loss in patients with breast edema (*Table 3*).

QOL of the patient group without breast edema (n = 32) and the patient group with at least mild breast edema (n = 99) was significantly different for body image ($p = .001$), future perspective ($p = .048$), systemic therapy ($p = .000$), breast symptoms ($p = .000$) and arm symptoms ($p = .003$). There was no significant difference in sexual functioning, sexual enjoyment, and upset by hair loss between both groups. When comparing QOL of the patient group with at least mild breast edema with the EORTC QLQ-BR23 reference values for breast cancer patients with all stages of breast cancer, the breast edema group scored worse than the reference group, except for sexual functioning. When comparing with the EORTC QLQ-BR23 reference values for breast cancer patients between 60 and 69 years, the breast edema group scored also worse than the reference group, except for sexual functioning, and sexual enjoyment (*Table 3*).

DISCUSSION

Incidence and Degree of Breast Edema

Following BCS and radiotherapy, three out of four patients, in a cohort up to 5 years post-surgery, developed breast cancer related lymphedema of the operated and irradiated

TABLE 3
EORTC QLQ-BR23 Scale Scores of a Cohort of Breast Cancer Patients Following Breast Conserving Surgery with Radiotherapy (n = 131) and EORTC QLQ-BR23 Reference Values of a Group of Breast Cancer Patients with All Stages of Cancer and a Group Between 60 and 69 Years

Scale	Group with no breast edema (n = 32) *(SD)*	Group with breast edema (n = 99) *(SD)*	Reference value 'all stages of cancer' *(SD)*	Reference value '60 - 69 years' *(SD)*
Body image (*)	91.4 *(13.3)*	70.8 *(31.1)*	82.7 *(22.9)*	85.0 *(21.7)*
Sexual functioning	22.7 *(25.4)*	21.9 *(21.9)*	19.5 *(22.8)*	11.3 *(17.8)*
Sexual enjoyment	36.1 *(26.4)*	52.7 *(29.5)*	53.1 *(27.1)*	49.1 *(25.8)*
Future perspective (*)	59.2 *(29.4)*	46.2 *(30.7)*	47.3 *(33.7)*	52.4 *(34.3)*
Systemic therapy (*)	12.3 *(14.7)*	25.0 *(20.8)*	15.5 *(13.5)*	16.0 *(14.6)*
Breast symptoms (*)	7.1 *(10.5)*	28.5 *(23.5)*	16.2 *(16.8)*	16.2 *(16.9)*
Arm symptoms (*)	7.1 *(11.4)*	30.8 *(24.2)*	18.7 *(20.5)*	20.8 *(21.9)*
Hair loss	33.3 *(51.6)*	43.8 *(38.6)*	5.0 *(18.2)*	7.3 *(21.6)*

(*) significant difference between the patient group with and without breast edema, respectively .001, .048, .000, .000, .003

breast. The majority of patients suffered from mild breast edema but almost one out of five patients had moderate or severe breast edema.

Highest incidence of breast edema was within the first 3 months following surgery, but highest degree of breast edema and highest incidence of moderate to severe breast edema were between 3.1 and 6 months. In this time interval, in general, patients have finished radiotherapy. Between six months and two years, incidence increased again, but the degree of breast edema decreased. This evolution of incidence of breast edema is also described by Wratten et al (7). They quantified cutaneous breast edema by measuring epidermal thickness. Epidermal thickness starts to increase during radiotherapy and thickness measures peak between four and six months after finishing radiotherapy. This is equivalent to our time interval between 6.1 and 12 months. Unlike the results of Wratten et al that, in most cases, symptoms return to baseline 12 months post-surgery, our results showed high incidences until 24 months following surgery (7). Two years after surgery, incidence dropped to 65%, but still one out of five patients had moderate breast edema.

Breast Edema and Possible Risk Factors

Degree of breast edema was greater in patients with axillary lymph node dissection (mean total subjective symptom score of 13.37/80) than with sentinel lymph node biopsy (mean total subjective symptom score of 10.52/80), although this was not statistically significant. Pezner et al also found a higher incidence of breast edema following axillary lymph node dissection compared to sentinel lymph node biopsy, without statistical significance (5). Other researchers did find a significant increase of the risk of breast edema with more extensive axillary clearance (6,7). A possible explanation for the correlation between breast edema and axillary lymph node dissection could be the anatomy

of the lymphatic pathways of the breast that drain the majority of the breast towards the ipsilateral axilla (17). When lymphedema of the breast is drained towards the ipsilateral axilla and axillary lymph nodes are dissected, lymph fluid cannot be drained and accumulates in the breast. Patients with axillary lymph node dissection are also in a further stage of breast cancer and need additional after- treatment, for example chemotherapy. Patients who received chemotherapy had a significantly higher degree of breast edema. Depending on the type of chemotherapy, capillary leakage of proteins and fluid in the extracellular space is a well-known side effect, first described by Semb Karin et al (18). Patients with positive lymph nodes also received radiotherapy to the axillary, infra- and supraclavicular fields (10,11). Radiotherapy may not cause direct damage to the lymph vessels or lymph nodes on a short-term period, but it does cause sclerosis of the skin, which may obstruct lymph flow and slow down regeneration and neoformation of lymph vessels (19-23). It is possible that these additional therapies can aggravate the degree of breast edema.

Patients with smaller bra cup size had a lesser degree of breast edema than women with larger breast size, but this difference was not statistically significant. Pezner et al found that patients with bra cup size C or larger were at statistically significant greater risk for developing breast edema than patients with smaller cup sizes (5).

The risk of post-operative breast edema seemed to be significantly increased in patients who are overweight. BMI equal to and higher than 25 kg/m^2 is an important risk factor for the development of breast cancer related lymphedema (13,14). These results are consistent with previous data from the literature (4,6).

Patients who had a tumor in the SEQ had the highest degree of breast edema, but this was not statistically significant. Although a significant correlation between breast edema and location of the tumor has been observed by others (4). Breast cancer is most commonly located in the SEQ at significantly younger age, compared with cancers located at the nipple or inner quadrants (24). We also found that younger patients had significantly higher degrees of breast edema. The patient group with breast edema was 4.5 years younger, which is a risk factor for the development of breast edema. Another possible explanation for the higher degree of breast edema in younger women, could be more developed corpus mammae than in older women (*Fig. 1*). Damage to a highly developed functional unit has more side effects than surgery of a breast with a high ratio of fat tissue.

Besides risk factors described in the literature, this study also focused on possible risk factors that have not previously been studied. As mentioned above, chemotherapy and younger age were significantly correlated with greater degree of breast edema in patients. Patients with anti-hormone therapy had a significantly lower degree of breast edema. The correlation between low degree of breast edema and hormone dependent tumors, treated with anti-hormone therapy, has not been reported previously. Further research is necessary to exclude anti-hormone therapy as a possible risk factor for the development of breast edema.

Whether surgery was performed on the dominant side did not affect the degree of breast edema.

Breast Edema and QOL

Breast cancer patients with breast edema had worse body image and future perspective than breast cancer patients without breast edema. This negative influence of breast edema on body image could be a poor aesthetic result of the operated and irradiated breast with edema. Breast edema delays the healing process, which may cause negative future perspective. Patients with breast edema also had more side effects of systemic therapies, breast symptoms, and arm

symptoms. Lymphatic disorders can decrease immune function of the body, which could be related to increased side effects of systemic therapies. The breast edema group had significantly ($p = .003$) more breast cancer related lymphedema of the arm, which could explain the higher incidence of arm symptoms. Functional scales related to sex and the symptom scale 'upset by hair loss' were not related to the degree of breast edema in breast cancer patients. Caution when interpreting 'sexual functioning' and 'sexual enjoyment' is necessary, because there were many missing values for the items.

The breast edema patient group had worse QOL compared to reference groups of breast cancer patients with all stages of cancer and a group of breast cancer patients between 60 and 69 years, except for the functional scales related to sex. The study population ($n = 131$) was remarkably more upset by hair loss than the reference groups. Since 2007, breast cancer patients who need chemotherapy are treated with 4 cycles of FEC (500/75/600 mg/m^2) followed by 12 weeks paclitaxel (80 mg/m^2) or 6 cycles of FEC only, which causes hair loss. Possibly, the reference groups have been treated with other chemotherapy programs, which cause less hair loss. In general, the patient group without breast edema had better QOL than the reference groups. This could be caused by the inclusion of total mastectomy patients and longer follow-up in the reference groups. Total mastectomy patients tend to have worse QOL than patients with BCS over time (25).

Limitations

There are large differences in incidences of breast edema found in the literature. One of the reasons is that there is no consensus on the definition. Different criteria are used, and there is no standard method to measure breast edema. Many studies use clinical examination, with observation and palpation, and patient reported subjective symptoms to assess breast edema, but this method is subject to problems of inter- and intra-observer reliability. Thus, a limitation of this study is the use of a subjective symptom scale to assess degree of breast edema. It is unclear if all subjective symptoms of breast edema should be present to diagnose breast edema and if the subjective symptoms have the same weight in the calculation of the total symptom score. The use of a self-devised questionnaire is less reliable than a validated questionnaire or a face-to-face interview. Another limitation of the study is that it relies on volunteer study subjects rendering the study vulnerable for selection bias. Selection bias can influence the study results. Post-operative time intervals are not equally distributed in time and number of patients, which could also have affected the results.

Further Research

Despite the fact that incidence and degree of breast edema decrease after a certain period, the majority of the women still suffer from at least mild breast edema months and even years after cancer treatment. Breast edema negatively influences QOL, and breast cancer survivors have poor cosmetic outcome. Further research is necessary to develop objective quantitative measurement tools and consensus on diagnostic criteria.

Medical imaging, like ultrasound, should be used additionally for the evaluation of lymphedema of the operated and irradiated breast (6). Cutaneous breast edema can be diagnosed by measuring skin thickness, but parenchymal breast edema cannot be measured quantitatively with ultrasound. To set diagnosis, it is of great importance to use objective tools for measuring parenchymal and cutaneous breast edema. Further research is needed to confirm whether objective findings are concordant with results of clinical examination in a study with follow-up and objective measurement tools.

Our research group is studying incidence and degree of parenchymal and cutaneous

breast edema in breast cancer patients following BCS and radiotherapy, using ultrasound elastography. Measurements are performed before the operation, after the operation and after radiotherapy, with a follow-up of two years. Results are correlated with breast volume measurements, breast ptosis measurements, patient reported subjective symptoms, clinical examination and QOL. Preliminary results will be available soon (26).

CONCLUSION

BCS followed by radiotherapy results in a high incidence of breast edema, but most women suffer from only mild breast edema. Highest incidence is found in women in the first three months following surgery, but incidence stays high (65%), even 5 years following surgery. Breast edema is statistically related to BMI, chemotherapy, anti-hormone therapy, and age and not statistically related to axillary lymph node dissection, pre-operative bra cup size, locastion of the tumor, and whether the surgery is performed on the dominant side.

Breast cancer patients with breast edema have a decreased QOL compared to breast cancer patients without breast edema.

REFERENCES

1. Ferlay, J, P Autier, M Boniol, et al: Estimates of the cancer incidence and mortality in Europe in 2006. Ann. Oncol. 18 (2007), 581-592.
2. Olivotto, IA, LM Weir, C Kim-Sing, et al: Late cosmetic results of short fractionation for breast conservation. Radiother. Oncol. 41 (1996), 7-13.
3. Delay, E: Séquelles thérapeutiques du sein après traitement conservateur du cancer du sein. Annales de chirurgie plastique esthétiques. 53 (2007), 135-152.
4. Goffman, TE, C Laronga, L Wilson, et al: Lymphedema of the arm and breast in irradiated breast cancer patients: Risks in an era of dramatically changing axillary surgery. Breast J. 10 (2004), 405-11.
5. Pezner, RD, MP Patterson, LR Hill, et al: Breast edema in patients treated conservatively for stage I and II breast cancer. Int. J. Radiat. Oncol. Biol. Phys. 11 (1985), 1765-1768.
6. Rönkä, RH, MS, Pamilo, KA von Smitten, et al: Breast lymphedema after breast conserving treatment. Acta Oncol. 43 (2004), 551-557.
7. Wratten, CR, PC O'Brien, CS Hamilton, et al: Breast edema in patients undergoing breast-conserving treatment for breast cancer: Assessment via high frequency ultrasound. Breast J. 12 (2007), 266-273.
8. Edge, SB: Early adoption and disturbing disparities in sentinel node biopsy in breast cancer. J Natl Cancer Inst. 100 (2008), 449-450.
9. Devaraj, S, M Iqbal, J Donnelly, et al: Axillary ultrasound in invasive breast cancer: Experience of our surgeons. Breast J. 17 (2011), 191-195.
10. Voordeckers, M, J Van de Steene, V Vinh-Hung, et al: Adjuvant radiotherapy after mastectomy for pT1-pT2 node negative (pN0) breast cancer: Is it worth the effort? Radiother Oncol. 68 (2003), 227-231.
11. Adriaenssens, N, H, Van Parijs, V Vinh-Hung, et al: Preliminary analysis of a randomized clinical trial comparing shoulder-arm morbidity between early breast cancer patients treated with hypofractionated radiation therapy with TomoTherapy® and conventional post surgery radiation therapy. Eur. J. Cancer Care. (2011), (revisions under review).
12. Reynders, T, K Tournel, P De Coninck, et al: Dosimetric assessment of static and helical TomoTherapy in the clinical implementation of breast cancer treatments. Radiother. Oncol. 93 (2009), 71-79.
13. Kvamme, JM, J Holmen, T Wilsgaard, et al: Body mass index and mortality in elderly men and women: The Tromso and HUNT studies. J. Epidemiol. Community Health (3022) doi:10.1136/jech.2010. 123232.
14. Clark, B, J Sitzia, W Harlow, et al: Incidence and risk of arm oedema following treatment for breast cancer: A three-year follow-up study. Quarterly J. Med. 98 (2005), 343-348.
15. Montazeri, A, M Vahdaninia, I Harirchi, et al: Quality of life in patients with breast cancer before and after diagnosis: An eighteen months follow-up study. BMC Cancer 8 (2008), 330.
16. Portney, L, M Watkins: *Foundations of Clinical Research*. New Jersey: Prentice Hall, 2000.
17. Tassenoy, A, P van der Veen, A Bossuyt, et al: Lymphatic pathways of the upper medial

quadrant of the breast in healthy women: Radiotracer study of the sentinel lymph node. Lymphology. 35 (2002), 153-163.
18. Semb, K, S Aamdal, P Oian: Capillary protein leak syndrome appears to explain fluid retention in cancer patients who receive docetaxel treatment. J. Clin. Oncol. 16 (1998), 3426-32.
19. Lievens, P: Lymphedema or swelling? J. Lymphoedema. 3 (2008), 17-19.
20. Lievens, P, F Pastouret, A Leduc, et al: The short time effect of radiation therapy on the newly formed lymphvessels. Eur. J. Lymphology 19 (2008), 25-26.
21. Swinnen, E, K Tournel, V Vinh-Hung, et al: Invloed van radiotherapie op het lymfestelsel en mogelijke kinesitherapeutische implicaties. Invloed van radiotherapie op het lymfestelsel en mogelijke kinesitherapeutische implicaties. Tijdschrift voor kinesitherapie 2 (2008), 8-12.
22. Swinnen, E, K Tournel, V Vinh-Hung, et al: Invloed van radiotherapie op het lymfestelsel en mogelijke kinesitherapeutische implicaties. Fluvio. 21 (2010), 2-11.
23. Swinnen, E, V Vinh-Hung, J Lamote, et al: Study of the influence of radiatiotherapy on the lymphatic system and on the development of lymphedema. Eur. J. Lymphology. (2007) XXXIII g.e.l. Congress- Prague, 12-13 May.
24. Sohn, VY, ZM Arthurs, JA Sebesta, et al: Primary tumor location impacts breast cancer survival. Am. J. Surg. 195 (2008), 641-644.
25. Shi, HY, YH Uen, LC Yen, et al.: Two-year quality of life after breast cancer surgery: A comparison of three surgical techniques. J. Cancer Surg. 37 (2011), 695-702.
26. Adriaenssens, N, D Belsack, R Buyl, et al: Ultrasound elastography as an objective diagnostic measurement tool for lympoedema of the treated breast in breast cancer patients following breast conserving surgery and radiotherapy. Radiol Oncol. 46 (2012), in press.

Nele Adriaenssens, M.Sc.
Laarbeeklaan 103
Building F.045
1090 Jette (Brussel), Belgium
Fax: +32 2 477 45 29
Tel: +32 2 477 45 30; +32 2 477 60 15
E-mail: nmadriae@vub.ac.be