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Original article

Arm lymphoedema and upper limb impairments in sentinel node-negative breast cancer patients: A one year follow-up study

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ABSTRACT

Purpose: The aim of this study is (1) to investigate the prevalence rate of arm lymphedema, pain, impaired shoulder range of motion, strength and shoulder function one year after a sentinel lymph node biopsy (SLNB) for breast cancer and (2) to determine predictive factors for these complications.
Methods: A longitudinal study was performed. One hundred patients with a sentinel-lymph node negative breast cancer were included. All patients were measured before surgery and one year after. Arm lymphedema was measured with the perimeter, pain with the Visual Analogue Scale, shoulder range of motion with an inclinometer, strength with a handheld dynamometer and shoulder function with the Disability of Arm, Shoulder and Hand questionnaire. Patient-, breast cancer- and treatment-related variables were recorded.
Results: One year after surgery 8% of sentinel node-negative breast cancer patients had developed arm lymphedema. Fifty percent of patients had pain, 30% had an impaired shoulder range of motion, 8% had a decreased handgrip strength and 49% had an impaired shoulder function. Pain, shoulder range of motion, strength and shoulder dysfunctions changed significantly over one year ($p < 0.001$). Higher Body Mass Index is a predictive variable for shoulder dysfunctions one year post-SLNB.
Conclusions: Prevalence rate of lymphedema and other upper limb impairments may not be underestimated after SLNB. Pain, shoulder range of motion, handgrip strength and shoulder function change significantly up to one year compared to preoperative values in sentinel node-negative breast cancer patients.

Introduction

Breast cancer is the most common cancer in women with 1.7 million new cases diagnosed worldwide in 2012, representing 25% of the overall cancer burden [1]. Upper limb impairments such as lymphedema, pain, decreased range of motion (ROM) and decreased strength are known complications after axillary lymph node dissection (ALND) for treatment of breast cancer [2]. Over the past decades, the surgical techniques for treatment of breast cancer have changed. Currently, in patients with negative sentinel lymph nodes only a sentinel lymph node biopsy (SLNB) is performed [3]. In comparison to an ALND, the less invasive SLNB decreases the prevalence rate of lymphedema and other upper limb impairments [4,5].

Lymphedema is significantly less reported in patients with the SLNB compared to patients with an ALND at 6 and 12 months after surgery [6–10]. Prevalence rates between 3 and 17% have been reported one year after SNLB, compared to 13–30% after ALND [9–14]. Arm volume changes were significantly smaller in the SNLB

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group at 6, 12 and 36 months [4,6–8,15–19]. Other studies demonstrated no significant differences between SNLB and ALND in arm volume change one year after surgery [14,20]. For **pain**, positive results in favour of the SLNB have been shown as well. Pain prevalence rates one year after the SLNB range between 9 and 37% compared to 12–47% after ALND [6,7,14,19,21–23]. Shoulder mobility is less often impaired after the SNLB compared to the ALND [4,8,17,21,24]. One year after surgery impaired ROM is reported in 5–10% and 7–21% after the SNLB and the ALND, respectively [5,11,14,23]. A reduction in **arm strength** is prevalent in 17–19% of the patients one year or later after SLNB, compared to 8–60% after ALND [5,13]. The occurrence of these complications in sentinel node-negative breast cancer patients should not be underestimated because of their impact on shoulder function, activities of daily living as well as on quality of life [9,11,25].

One year after SLNB complete recovery of the upper limb function is expected. In contrast, 5 studies reported prevalence rates of pain and upper limb impairments one year after surgery. However, these numbers varied among studies in such manner that conclusions on the 'real' prevalence rate of lymphedema and other upper limb impairments are hard to make. This large variability in results may be due to the methodological limitations of the current studies. First, they lacked baseline measurements such as a preoperative assessment [4,6,22,23]. Second, subjective, non-standardized measurements or self-reported questionnaires were used [4,6,15,22,23]. Third, sample sizes varied among studies. One study that reported prevalence rates at one year post-SLNB used standardised measurements but had a rather small sample size of only 43 patients [14]. Other studies had a large sample size ($n > 100$) but they used non-standardised measurements and questionnaires to assess upper limb problems [4,6,22,23]. Additionally, lymphedema and other upper limb impairments may be influenced by other factors besides the sentinel lymph node biopsy itself. Therefore, possible cancer-, treatment- and patient-related predictive factors for lymphedema and other upper limb impairments in sentinel node-negative breast cancer patients need to be defined [24].

The first aim of this prospective study is to investigate the prevalence rate of arm lymphedema and other upper limb impairments one year after SLNB for breast cancer in one sample at the same time, using reliable and valid measurements. The second aim is to determine predictive factors for these complications.

Methods

Participants

Patients were recruited from the Multidisciplinary Breast Centre of the University Hospitals in Leuven between February 2013 and February 2015. Inclusion criteria were (1) unilateral primary breast cancer; (2) a sentinel lymph node biopsy in clinical node negative patients and (3) preoperative evaluation of the upper limb. Patients were excluded if they had current episodes of cancer or metastasis.

The approval for this trial was obtained by the local ethics committee of K.U. Leuven (S54579).

Procedure

Eligible patients were assessed 12 months after the SLNB by three physical therapists. Patient's age, Body Mass Index (BMI) and handedness were evaluated as patient-related predictive factors. Stage of tumor and nodal status are considered as disease-related predictive factors. Further, the treatment-related factors such as type of surgery, levels of lymph node dissected, radiotherapy, chemotherapy, hormone therapy and target therapy were recorded and analysed as predictive variables.

Outcomes

First, point prevalence rate of arm lymphedema, pain at the upper limb region, impaired shoulder ROM (forward flexion and abduction), impaired handgrip strength and impaired shoulder function were assessed. Additionally, the number of patients with a clinical relevant decrease in shoulder ROM and handgrip strength were determined. Second, change the different outcomes was analysed. An overview of the measurement method is given in Table 1.

Statistics

Since data was normally distributed, the paired t-test was used to analyse the change in the outcomes. First, the association between the predictors and the upper limb impairments one year after SLNB was determined with bi-variable analyses (Pearson Correlation Coefficient). Second, general linear models were used to perform multivariable analyses. Statistical significance was taken as $p < 0.05$. All data were analysed with SPSS 22.0.

Results

One hundred women with a mean age of 60.5 (9.7) years and mean BMI of 25.1 (4.7) kg/m^2 were included. Fifty-nine patients had breast conserving surgery, of which 26 (44%) had a lesion at the upper outer quadrant. Patients' characteristics are given in Table 2. Before surgery, 8 patients already had a relative arm volume difference of 5% or more. Three patients had pain at the upper limb region before surgery. Three patients had both an impaired forward flexion and abduction ROM at the operated side before surgery. Additionally, 5 patients had an impaired abduction ROM and 1 patient an impaired forward flexion ROM. Three patients had already an impaired handgrip strength before surgery. No patients reported shoulder dysfunctions before surgery.

Table 3 shows the prevalence rates of lymphedema and other upper limb impairments one year after SLNB. One year after surgery, 8% of patients had a relative increase in arm volume of 5% or more. Three of them had a relative increase in arm volume of 10% or more. None of the patients who had a relative arm volume of 5% or more before surgery developed lymphedema. Fifty percent of the patients reported pain at the operated upper limb region during the week before the measurement. Impaired forward flexion and abduction ROM was reported in 26% and 30% of the patients, respectively. In 8% of the patients handgrip strength was impaired and in 49% shoulder function was impaired.

Additionally, the change in the different outcomes over the course of one year is given in Table 3. Relative arm volume itself did not change significantly over one year ($p = 0.596$). All other outcomes did change significantly over the course of one year (see Table 3).

Table 4 gives an overview of the bi-variable analyses for prediction of change in lymphedema and other upper limb impairments one year after SLNB. An increase in relative arm volume was associated with surgery at the non-dominant side and hormone therapy. A greater decrease in both forward flexion and abduction ROM was also associated with surgery at the non-dominant side. Ductal carcinoma were associated with a greater decrease in abduction ROM compared to other cancer types. An older age was associated with a greater decrease in forward flexion shoulder ROM. For handgrip strength, older age was a predictive variable as well. At last, higher BMI was associated with more shoulder dysfunctions. BMI was the only factor that remained a significant predictive factor in the multivariable analyses. Patients with a higher BMI had a significantly greater decrease in shoulder function (Table 5).