Available online at www.sciencedirect.com

ScienceDirect

journal homepage: http://www.elsevier.com/locate/rpor

Original research article

Comparison of two treatment strategies for irradiation of regional lymph nodes in patients with breast cancer: Lymph flow guided portals versus standard radiation fields

Sergey Nikolaevich Novikov[a,*], *Sergey Vasilevich Kanaev*[a], *Vladimir Fedorovich Semiglazov*[b], *Ludmila Alekseevna Jukova*[a], *Pavel Ivanovich Krzhivitckiy*[a]

[a] *Department of Radiation Oncology and Nuclear Medicine, N.N. Petrov Institute Oncology, Leningradskaya, 68, Pesochny-2, 194291 St. Petersburg, Russia*

[b] *Department of Surgery No. 1 (Breast Cancer), N.N. Petrov Institute Oncology, Leningradskaya, 68, Pesochny-2, 194291 St. Petersburg, Russia*

ARTICLE INFO

Article history:
Received 3 January 2014
Received in revised form 5 May 2014
Accepted 23 June 2014

Keywords:
Breast cancer
Radiotherapy
Sentinel lymph-nodes

ABSTRACT

Aim and Background: Radiotherapy being an essential part of breast cancer treatment, we evaluate various radiotherapy strategies in patients with breast cancer.

Materials and methods: Lymph node (LN) scintigraphy was performed in 172 primary patients with BC. LN visualization started 30–360 min after intratumoral injection of 75–150 MBq of 99mTc-nanocolloids.

Our standard recommendation for postoperative radiotherapy in patients with LN invasion by BC were as follows: for patients with external localization of tumour – breast + axillary (Ax) + sub-supraclavicular (SSCL) regions; with internal localization – all above + internal mammary nodes (IM). Proposed strategy of lymph flow guided radiotherapy is based on the assumption that only regions that contain 'hot' LNs must be included in a treatment volume.

Results: Among 110 patients with external localization of BC, Ax LNs were visualized in all cases and in 62 patients it was the only region with 'hot' LN. Twenty-three patients (20.9%) had drainage to Ax + SSCL, 12 (10.9%) – Ax + IM, 13 (11.8%) – Ax + SSCL + IM regions. After the visualization of lymph flow patterns, standard treatment volume was changed in 87/110 cases (79.1%): in 56.4%, reduced, in 22.7%, enlarged or changed.

In 62 patients with tumours in internal quadrants, we revealed the following patterns of lymph-flow: only to the Ax region in 23 (37.1%); Ax + IM, 13 (21%); Ax + SSCL, 15 (24.2%); Ax + IM + ISSCL, 11 (17.7%) cases. After lymph-flow visualization, the standard irradiation volume was reduced in 53/62 (85.5%) cases.

* *Corresponding author*. Tel.: +7 9500437996.
E-mail address: krokon@mail.ru (S.N. Novikov).

http://dx.doi.org/10.1016/j.rpor.2014.06.001

Conclusion: Visualization of an individual lymph flow pattern from BC can be used for the optimization of standard fields used for irradiation of regional LNs.

1. Background

Radiotherapy is an essential part of breast cancer treatment, it provides 70–75% decrease of risks of locoregional relapses.[1,2] Up till now, the decision about the volume and topography of a radiation field is made considering the probability of lymph nodes (LN) invasion. In particular, in cases of metastatic involvement of axillary lymph nodes and external localization of breast cancer, it is recommended to irradiate the rest of axillary and sub-supraclavicular LNs, while in the cases of central or internal localization of breast cancer irradiation of internal mammary LNs can be discussed.[3,4] Unfortunately, the question about the volume of internal mammary irradiation has not been settled yet. Some groups[5] recommend using wide radiation fields that include the area of internal mammary LNs (IMLNs) on both sides of the sternum. Other investigators underline the monolateral character of IMLN involvement and advocate "narrow fields" which cover only IMLNs located on the side of the tumour. Approaches to the question about the length of an IMLN radiation field can be different as well. According to a generally accepted technique, the upper border of the field includes LNs of the I intercostal space, while the lower border ends on the IV rib.[6] On the other hand, Veronesi et al.[7] mentioned, that in the cases of tumours localized in the upper quadrants of the breast, only IMLNs located in the I–III intercostal spaces are at an increased risk of invasion when the lower quadrants are affected by breast cancer – high risk LNs are distributed between the III and V intercostal spaces.

One of the ways to resolve these contradictions is to determine lymph flow from a tumour in every patient's case; this will definitely allow to optimize the volume of regional radiotherapy and adapt it to the needs of a specific patient.[8,9] In this study, we tried to compare the topography of standard radiation fields with treatment portals arranged according to individual properties of lymph flow from each breast lesion determined by a scintigraphic visualization.

2. Materials and methods

The study population consists of 172 consecutive patients (*32–63 years old*) with breast cancers that were diagnosed and treated in the N.N. Petrov Institute of Oncology between 2008 and 2011. In all the cases, included in the analysis, breast cancer was confirmed by aspiration and/or excision biopsy before or during operation. Scintigraphic visualization of lymph flow from breast cancer (SVILF) was performed in all cases and preceded surgical intervention, including the excision biopsy. Patients who had had previous operations on the breast were excluded from the analysis. Breast-conserving surgery was performed in 131 women included in this study, the remaining 41 patients underwent mastectomy. Breast surgery was accompanied by sentinel lymph node biopsy or limited (less than 6 nodes) lymph node dissection in 149 cases and in another 23 women – by standard axillary lymph node dissection (7–22 lymph nodes). According to histological examinations, 26.7% (46 cases) of 172 operated patients had metastases in the removed axillary lymph nodes.

In patients with histological signs of LN involvement by breast cancer, the extent and topography of standard fields designed for postoperative radiotherapy are highly determined by primary tumour localization. In patients with breast cancer located in the external quadrants, treatment volume usually included axillary and sub-supraclavicular LNs, in cases of internal localization of the tumour, radiation portals covered IMLNs lying in the I–IV intercostal spaces on one or both sides of the sternum. For the purpose of this study, to compare a standard and lymph-flow guided strategy of regional lymph node irradiation, we evaluated all 172 patients that underwent SVILF as candidates for regional radiotherapy.

SVILF was performed as a series of static images obtained 30–60 and 240–360 min after intratumoral injection of 75–150 MBq (0.1–1 ml) of 99mTc-nanocolloids (NCs) with the size of the particles less or equal to 80 nm. NCs were prepared according to the standard protocol, recommended by manufacture. After preparation of 75–150 MBq of NCs in the volume of 0.1–1.0 ml, they were injected directly into the tumour. Static images were detected with an interval of 5–10 min over first 30 min after injection of radiocolloids until image of the sentinel LNs appeared. Delayed scans were performed 240–360 min after infection in order to document the final distribution of the tracer in the sentinel and second echelon LNs. All nodes visualized on early and delayed images were considered as target (regional) to the breast lesion. This approach helped us to design radiation portals in accordance with individual lymph flow patterns and stipulated irradiation of the regions with LNs actively accumulating NCs.

When sentinel LNs were revealed in the internal mammary region, their localization with regard to standard anatomical landmarks was specified by a gamma camera. Moreover, with the help of specialized radioactive pointer, the projection of 'hot' LNs was marked on the skin of the front chest wall. This simplified further use of scintigraphic information for the design of radiation fields.

At the last stage, we carried out a comparative analysis of radiation portals, designed according to our standard strategy driven by localization of the primary tumour and a strategy which was based on scintigraphic data presenting individual lymph flow from every breast cancer.