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Does tangential radiation for breast cancer cover internal mammary nodes?

Breast cancer is one of the most common cancers in women in the United States. Radiation is a very commonly used treatment modality for breast cancer: it is offered to nearly all patients after lumpectomy (removal of the cancerous tissue in the breast) and sometimes, after mastectomy (removal of the whole breast) when there are high-risk features to the tumor. Radiation decreases the chance of the cancer coming back in the breast, on the chest wall and in the lymph nodes, and has been demonstrated to improve survival rates. The radiation is delivered using a focused high-energy beam the breast/chest wall and sometimes the lymph nodes, to treat microscopic cancer cells that may not be detected by imaging or removed at surgery.

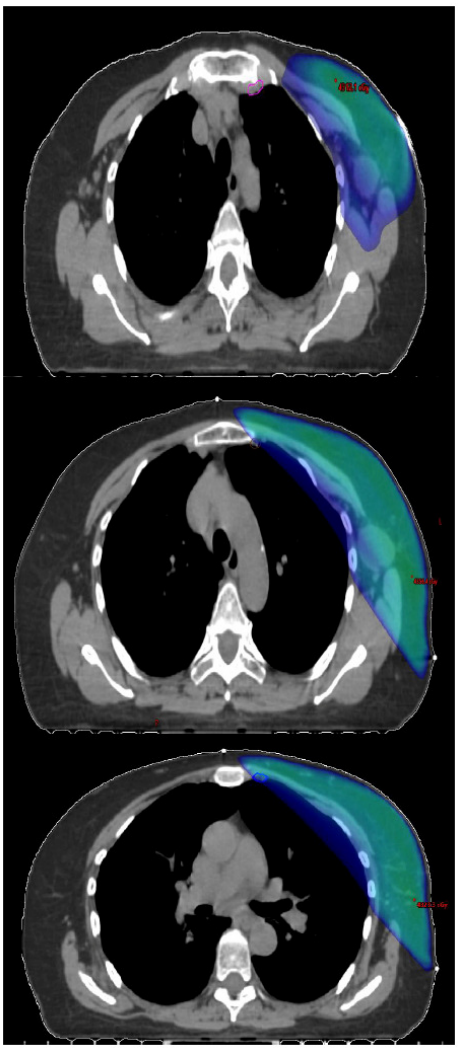

Fig. 1. Representation of the subregions of the IMN in a illustrative case: a. upper b. mid c. lower

Recently, several large international clinical trials have demonstrated that when radiation treats the regional lymph nodes, specifically the supraclavicular nodes and internal mammary nodes (IMN), with the breast/chest wall tangential fields, breast cancer outcomes are further improved compared to treatment targeting the breast/chest wall alone, in specific subsets of high-risk patients. The IMN are located along the sternum (or breast bone) very close to the breast/chest wall.

In our study, we hypothesized that the typical tangential radiation beam that treats the breast/chest wall may be also delivering radiation dose unintentionally to the IMNs, due to the close proximity of these nodes to the breast/chest wall tissue. To date, the available published data is on this topic have been limited. For our study, we analyzed 362 patients treated with standard (tangential) radiation for their breast cancers at Yale School of Medicine between January 2015 and July 2017. None of these patients were intentionally treated to their IMN, the prescription specified radiation to the breast/chest wall alone without IMN coverage. Intentional delivery to other regional lymph nodes (supraclavicular or axillary) nodes was permitted. For each of the 362 patients, the IMN were outlined and delineated on the treatment planning CT scan by one investigator (using RTOG 3509/3510 protocol guidelines).

For the purposes of the analysis, the IMN was divided into 3 sub-regions: upper, mid and lower thirds. Overall, the mean dose delivered to the IMN using the standard (tangential) beam was 36% of the prescribed dose to the breast/chest wall. The lower third of the IMN received the highest mean dose of 48%, compared to the upper third, which received 15.9% and the mid third, which received 32.6% of the prescribed dose. Other dosimetric parameters were analyzed and suggested that in certain patients, such as those with minimal pre-sternal fat, those treated after mastectomy to the chest wall (instead of after lumpectomy to the breast), those who did not undergo immediate reconstruction after mastectomy, and those with a prescribed supraclavicular field had an overall higher unintentional mean IMN dose. Nevertheless, only a small fraction of patients (0.5%) met the minimum required IMN coverage (IMN PTV V40 $\geq$ 90%) required by the protocol.

Our study represents the largest investigation asking the question of whether the IMNs receive radiation when using standard tangential breast/chest wall radiation fields, and strongly suggest that while there is some dose delivered to the IMN, it is insufficient in the vast majority of patients and unlikely to provide tumor control for high-risk patients. These findings suggest that for high-risk patients who require IMN radiation as part of their treatment course, radiation oncologists should be contouring/outline the IMN on the treatment planning CT scan, and specifying IMN inclusion in the treatment prescription so that the tangential fields are modified to deliver therapeutic doses to the IMN when inclusion of these nodes is clinically indicated.

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Publication

Standard Tangential Radiation Fields Do Not Provide Incidental Coverage to the Internal Mammary Nodes
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