

Reducing Cardiac and Lung Dose During Breast Radiation Therapy

RTS 10

Introduction

Breast cancer is known for being the most common cancer in women.⁵ It is the second leading cause for mortalities, accounting for 14% of all deaths in females.⁵ In 2018, it was estimated that 266,120 people will be diagnosed with invasive breast cancer and 63,960 will be diagnosed with in situ breast cancer in the United States.³ Numerous types of treatments can be effective such as surgery, chemotherapy and radiation therapy. In radiation therapy, there is controversy about the benefits and risks of patients being positioned supine versus prone while comparing heart and lung doses. Supine is the traditional position, however there is evidence that prone can achieve lower doses to surrounding critical structures.

Clinical Trial

There are many clinical trials going on worldwide to determine the best way to treat breast patients. One trial out of the United Kingdom uses the motion of surgical clips implanted inside the breast along with lateral chest wall movements to compare results while another study in Belgium is analyzing cosmetic outcomes.^{2,4}

The trial from the UK aimed to address the limitation of existing data concerning the amount of heart dose during traditional breast cancer RT treatments in the United States. This trial encompassed 20 locations across Michigan with the intent of recognizing practices in RT that could decrease complications from treatment to the breast tissue.¹

Methods

- During the UK's clinical trial, patients were selected from 20 urban, suburban and rural hospitals across Michigan. Each facility had a range of 22 to 486 patients enrolled in this study. To help understand the results and trends of the trial, a linear regression model was used. Each patient was prescribed a dose of 4256 cGy in order to accurately analyze all results.¹

Variables ¹	Values ¹
Number of patients	4,688
Breast side	
Right	2,031
Left	2,657
Treatment technique	
3D-CRT	60.2%
IMRT	39.8%

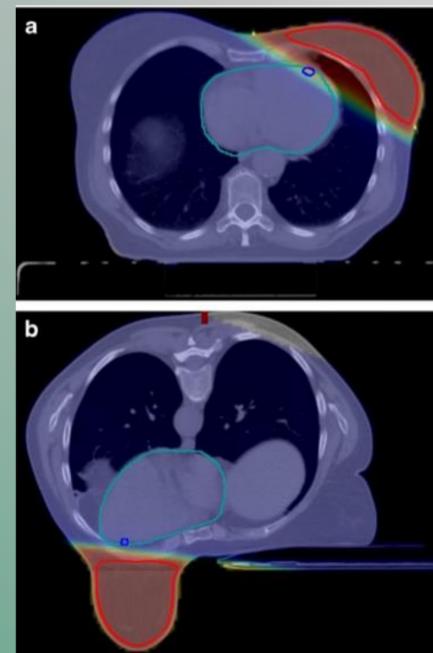


Image obtained from the Pathology & oncology Research journal.⁶

The Role of Radiation Therapy

In the previous years, radiation therapy (RT) treatments have been considered a standard treatment option used for early stage breast cancer and for post-breast conservation surgery. Adjuvant RT has been proven to improve overall outcomes in these patients. Treatments are typically done with the patient supine in order to improve the patients' overall survival (OS) and local control of the tumor.⁴ However, it has been confirmed that supine whole breast RT can severely damage nearby critical structures.⁴ Possible side effects, such as cardiovascular mortality or secondary malignancy occurring in the lungs can last up to fifteen to twenty years after radiation exposure.⁴

Recent clinical trials are beginning to provide positive evidence of decreased dose rates to the heart and lungs by monitoring respiratory movement, PTV/CTV, and treatment planning techniques.^{1,2,4}

Observations

- An increased dose is delivered to lumpectomy cavities when using an electron boost.¹
- To avoid increasing cardiac dose, careful placement of electron fields and photon boost should be considered.¹
- Patient positioning plays a major role in reduction of cardiac dose resulting in:
 - Left-sided breast cancer treated prone = 32% decreased heart dose
 - Left-sided breast cancer treated supine with deep inspiration breath hold (DIBH) = 18% decreased heart dose¹

Results

Results showed a decreased heart dose in left-sided breast cancer treatments from 2.19 Gy to 1.65 Gy due to reduced separation from treating prone.¹ For patients with right-sided breast cancer, it was known from the start of the trial that the heart dose would be much lower than that of the left as a result of the hearts anatomical position. The results were not compared to the left side because it would skew the outcomes.¹ Correlating right side breast cancers to each other, the heart dose remained without much change or slightly increased.¹ Dose is believed to increase as a result of the heart falling more anteriorly towards the chest wall than when treating supine. The article recommends using 3D conformal RT when treating breast patients prone because DIBH and intensity modulated radiation therapy (IMRT) were seen to increase the average heart dose.¹

Conclusion

With breast cancer being very prevalent in women, it is important to constantly be advancing how people see the disease. In this study, the dose to the heart and lungs decreased when the patient was placed in the prone position. By sparing cardiac dose, it reduces potential serious side effects such as a cardiac event from radiation. Decreasing lung dose also reduces one's risk of developing fibrosis of the lung and other side effects that can affect one's quality of life post radiation treatments. Researchers conducting this trial will be focusing on other ways to optimize dosing to decrease cardiac dose further by focusing on the use of IMRT.¹

References

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