Alexandria Journal of Medicine xxx (2017) xxx–xxx

HOSTED BY

Contents lists available at ScienceDirect

Alexandria Journal of Medicine

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

Original Article

Significant reductions in heart and lung doses using semi lateral decubitus techniques for left sided breast cancer patients: A comparative dosimetric study with supine techniques

Amr Abdul Aziz [a], Lila Mosa [a], Mohamed Farouk [a], Azza Helal [b,c,*], Mahran Abdo [a]

[a] Clinical Oncology Department, Faculty of Medicine, Alexandria University, Egypt
[b] Medical Physics Unit, Radiology and Intervention Dept, Faculty of Medicine, Alexandria University, Egypt
[c] Physics Department, King Abdulaziz University, Jeddah, Saudi Arabia

ARTICLE INFO

Article history:
Received 31 August 2016
Revised 9 November 2016
Accepted 15 December 2016
Available online xxxx

Keywords:
Cardiac sparing
Breast irradiation
Breath hold
Dosimetric study

ABSTRACT

Introduction: Various treatment techniques as breath hold techniques have been developed to spare the heart and lung in breast cancer patients receiving adjuvant radiotherapy.
Purpose: to compare the heart and lung dosimetric parameters of semi lateral decubitus technique with and without deep inspiration breath hold with standard supine techniques for left-sided breast cancer patients undergoing breast conservative surgery and adjuvant radiotherapy.
Methods: Fifty patients with left-sided breast cancer were simulated using standard supine, semi lateral decubitus and semi lateral decubitus and deep inspiration breath hold. The three plans carried out using two tangential opposed photon beams were compared.
Results: There was a significant reduction in heart V_{5Gy}, V_{10Gy}, $V_{25Gy,}$ $V_{30Gy,}$ mean dose & max dose with semi-lateral decubitus and breath hold technique compared to supine technique & semi-lateral decubitus technique ($P < 0.001$). There was also a significant reduction in the above mentioned heart DVPs with semi-lateral decubitus ($P < 0.001$) compared to supine technique.
Results: There was a significant reduction in ipsilateral lung V_{20Gy} and mean dose with semi-lateral decubitus and breath hold technique compared to supine technique ($P < 0.001$) & semi-lateral decubitus technique ($P = 0.003$ & 0.006) respectively. There was also a significant reduction in ipsilateral lung V_{20Gy} and mean dose with semi-lateral decubitus ($P < 0.001$ & 0.007) compared to supine technique.
Conclusion: Semi-lateral decubitus techniques with and without breath hold for left sided breast cancer patients significantly reduce the dosimetric parameters of the heart and ipsilateral lung compared to supine technique with comparable target dose coverage.

1. Introduction

Radiotherapy to the intact breast is considered a major part of breast cancer conservation management to prevent recurrences. But it has been shown that radiation increases the risk of heart and lung diseases so increases their mortality. This is more common in the left sided breast cancer patients.[1,2]

Various simulation and treatment techniques have been developed in order to reduce the volume of the heart and lung received high dose in breast cancer patients underwent adjuvant radiotherapy specially when treating the left side.[3,4] These techniques include free breath hold, respiratory gating and voluntary deep inspiration. Simulation and treating the patients in prone,[5,6] lateral and semi-decubitus positions could also improve cardiac and lung

Abbreviations: CTV, clinical target volume; PTV, planning target volume; RTOG, Anatomical Boundaries of Breast Cancer Atlas for Radiation Therapy Planning of radiation therapy oncology group; 3DCRT, Three Dimensional Conformal Radiotherapy; OARs, organs at risk; DVPs, dose volume histogram parameters; CT, computed tomography; MLCs, multi-leave collimators; DVH, dose volume histograms; HI, homogeneity index; DIBH, deep inspiration breath hold; FR, free breath; RT, radiotherapy; RSD, Reverse semi Lateral Decubitus; ILD, Isocentric Lateral Decubitus; IMRT, Intensity Modulated Radiotherapy; ICRU, International commission on Radiological Units and Measurements.

Peer review under responsibility of Alexandria University Faculty of Medicine.

* Corresponding author at: Physics Department, King Abdulaziz University, Jeddah, Saudi Arabia.

E-mail addresses: amrelsaid@yahoo.com (A. Abdul Aziz), lailamousprof@hotmail.com (L. Mosa), Mfarouk69m@yahoo.com (M. Farouk), helals2002@yahoo.com (A. Helal), drmahran99@yahoo.com (M. Abdo).

http://dx.doi.org/10.1016/j.ajme.2016.12.002
2090-5068/

dosimetry.[7,8] Another ways of cardiac sparing are intensity modulated radiotherapy (IMRT) and proton beam radiotherapy.[9]

Breath hold reduces the heart dose because the heart volume exposed to radiation is reduced as the heart moves away from the chest wall. Respiratory gating is an alternative technique for cardiac sparing as the distance between the heart and the radiation fields is enlarged during respiratory expansion of the thorax.[5,6]

In prone positioning technique the breast moves away from the chest wall so the radiation beam edge is positioned away from the heart. However the benefit of the prone technique in cardiac protection is limited to the patients with large breast.[10,11]

Treatment of the patient in lateral decubitus position appears to be associated with a limited risk of heart and lung complications as the irradiation of the heart and lungs is extremely low.[8]

The semi-decubitus (RSD) technique is an alternative method for cardiac and lung sparing for patients who are unable to tolerate breath hold.[7]

Computerized leaves of IMRT allow for radiation field shaping and help dose escalation to the target with significant reductions in the cardiac dose. IMRT is successfully used as a class solution for cardiac protection in left sided breast cases especially for patients with large breast.[12–15] Proton beam radiotherapy allows rapid dose fall off beyond the Bragg peak. This reduces cardiac toxicities as it causes dose reduction to the organs beyond the target volume such as the heart.[16]

Purpose: to compare the heart and lung dosimetric parameters of semi lateral decubitus technique with and without deep inspiration breath hold with standard supine techniques for left-sided breast cancer patients undergoing breast conservative surgery and adjuvant radiotherapy.

2. Materials and methods

2.1. Patient selection and simulation technique

Fifty patients with early stage left sided breast cancer who referred to Alexandria university main hospital and Alexandria Ayadi Al Mostakbal Oncology Center to undergo breast conservative surgery and adjuvant radiotherapy from October 2015 to April 2016 were enrolled in this study.

The patients were scanned on CT simulator in three positions with 5 mm slices from the level of the larynx to the level of the upper abdomen including both lungs.

In the first scan; patients underwent CT simulation in supine position on ordinary breast board. The ipsilateral arm was abducted above the head (Fig. 1A). In the second scan; patients were immobilized using a special breast board with lateral angle enabled the left side elevation by 20 cm from the couch on reveres semi decubitus. The ipsilateral arm was abducted above the head. Both CT simulation scans were performed free breathing (Fig. 1B).

The special board allows reproducible arm positioning and semi lateral adjustment as the breast board provides arm supports above the head to give unimpeded access to the treatment area. It also has lateral angle in order to achieve semilateral decubitus with the breast elevated up in a consistent comfortable position (Fig. 1B).

In the third scan; patient position was the same as in the second scan with deep inspiration breath hold for 20 s. There was a training session before the simulation for each patient to ensure that the patient is able to hold his breath for 20 s. During this session the patient was trained to hold his breath gradually for 5 s, 10 s, 15 s then 20 s.

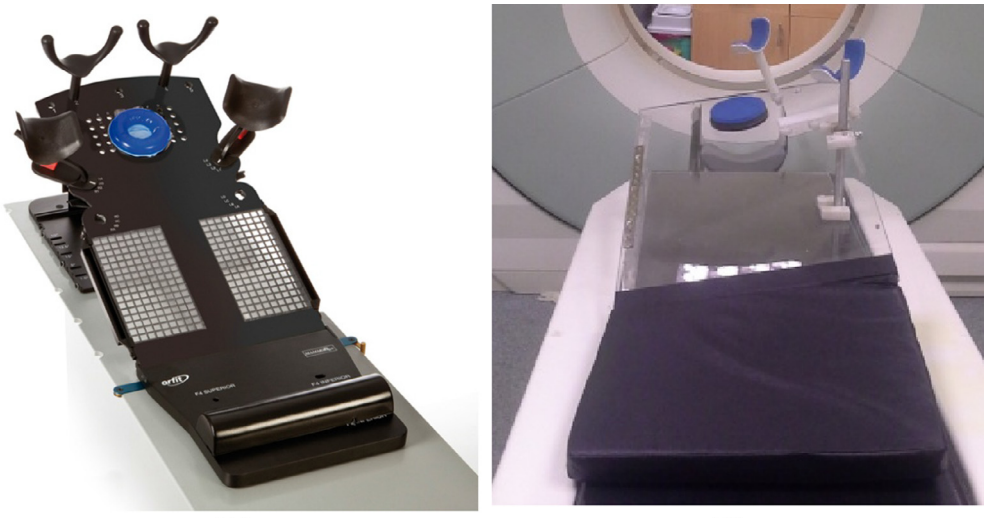
2.2. Target definition and organs at risk

CT slices of selected patients were transferred to Electa Xio treatment planning system. Target volumes include clinical target volume (CTV) and planning target volume (PTV) were outlined according to the Anatomical Boundaries of Breast Cancer Atlas for Radiation Therapy Planning of radiation therapy oncology group (RTOG).[17] Organs at risk (OARs) include heart, ipsilateral and contralateral lung were also outlined. The heart was contoured from the cardiac apex to the level of the pulmonary trunk superiorly including the myocardium (excluding pericardium and the major vessels). Right and left lung were contoured separately with the automatic contouring tool of the planning system (Fig. 2).

2.3. Planning process

To define the conventional field borders the border of medial field was marked at mid sternum, and that of lateral field was placed 20 mm dorsally from the lateral palpable breast. The borders of the cranial and caudal field were marked 20 mm beyond the palpable breast.

For each patient in the three positions 3DCRT plans were carried out using two tangential opposed wedged photon beams (6 and 15 MV). To optimize PTV dose coverage the field size was adjusted



(A) (B)

Figure 1. Standard breast board (A) & special breast board (B).

Please cite this article in press as: Abdul Aziz A., et al.. Alex J Med (2017), http://dx.doi.org/10.1016/j.ajme.2016.12.002