

Prone versus Supine Positioning for Breast Cancer Radiotherapy in Patients with Pendulous Breast

Thesis

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List of Abbreviations

Abb.	Full term
ADL	Activities of Daily Living
2D	Two-dimensional
3D-CRT	Three dimensional conformal radiotherapy
ACR	American College of Radiology
AJCC	American Joint Committee on Cancer
APBI	Accelerated Partial Breast Irradiation
BCT	Breast conservation therapy
BI-RADS	Breast imaging-reporting and data system
CBC	Complete blood count
CBCT	Cone-beam CT
CC	Craniocaudal
CCRT	Concurrent chemoradiotherapy
CF-WBI	Conventional fractionated WBI
CI	Contraindication
CI	Conformity index
CT	Computed tomography
CTCAE	Common toxicity criteria for adverse events
CTV	Clinical target volume
CVD	Cardiovascular disease
DBT	Digital breast tomosynthesis
DCE-MRI	Dynamic contrast enhanced magnetic resonance imaging
DCIS	Ductal carcinoma in situ
EACVI	European Association of Cardiovascular Imaging

Abb.	Full term
EGFR	Epidermal growth factor receptor
EIC	Extensive intraductal Carcinoma
ER	Estrogen receptor
ET	Endocrine therapy
FiF	Field in field
GBT	Glandular breast tissue
HF-WBI	Hypofractionated WBI
HG	Histological grade
HI	Homogeneity index
IBE	ipsilateral breast event
IBTR	ipsilateral breast tumor recurrence
IHC	Immunohistochemistry
IMC	Internal mammary lymph node chain
IMNI	Internal mammary node irradiation
IMRT	Intensity-modulated radiation therapy
Ki-67	Proliferation marker
LAD	Long anterior descending
LFTs	Liver function tests
LRFS	Local-recurrence-free survival
LVI	Lymphovascular invasion
MF/MC	Multifocality and multicentricity
MLC	Multileaf collimator
MLO	Mediolateral oblique
MRI	Magnetic resonance Imaging
NCI	National Cancer Institute
OARs	Organs at risk
OFS	Ovarian function suppression
PMRT	Post mastectomy RT

Abb.	Full term
PPV	Positive predictive value
PR	Progesterone receptor
QUANTEC	Quantitative Analysis of Normal Tissue Effects in the Clinic
RAPID	Randomized trial of accelerated Partial breast irradiation
RIHD	Radiation-induced heart disease
RIPF	Radiation-induced pulmonary fibrosis
RS	Recurrence score
SLNB	Sentinel lymph node biopsy
SMNs	Secondary malignant neoplasms
SRI	Surgery-radiotherapy interval
SSO/ASTRO	Society of Surgical Oncology and the American Society for Radiation Oncology
TNBC	Triple-negative breast cancers
US	Ultrasonography
WBI	Whole breast irradiation

Introduction

Breast cancer is one of the most common cancers in women and ranks first in cancer death within the 20-59 year age group. Surgical treatment for breast cancer had traditionally been radical mastectomy. Over the past decade, the decrease in death rates from breast cancer is largely attributed to the improvements in early detection and treatment (*Jemal et al., 2014*).

Women presented with early stage breast cancer have the option of electing breast-conserving surgery with adjuvant whole breast irradiation and has been shown in several large randomized controlled trials to yield local control and survival rates equivalent to those of mastectomy (*Darby et al., 2011*).

Whole breast irradiation is typically delivered in the supine position, which is considered to deliver adequate results while also having a more reproducible set up. However, in the case of patients with pendulous breasts, potential clinical problems arise when trying to adequately treat the planned target volume, while sparing critical structures including lung and heart. Adverse events following irradiation of breast include pain, pigmentation

and ulceration of the skin, soft tissue fibrosis, myocardial infarction, pericardial effusion, and asymptomatic or symptomatic lung damage had been reported (*Henson et al., 2013*).

Many studies had reported that radiation-related late cardiovascular damage was attributed to the increased non-breast cancer related death rate and was a trade-off for the increased local control and overall survival. Wang et al. tracked 12,696 patients with breast cancer from 1995 to 2005 and found that coronary artery dysfunction was not more increased in left breast cancer patients than in right ones at an early time after radiotherapy; however, the risk significantly increased in these patients after 10–15 years (*Wang et al., 2011*). Another study on the dose-volume effect of the heart showed that cardiovascular-related deaths 15 years post radiotherapy would be less than 1% if the V25 of the heart was less than 10% (*Gagliardi et al., 2010*).

Radiation pneumonitis is a form of acute or subacute lung damage related to the dose of radiation. It develops along the irradiated fields with a dose > 20 Gy and results in pulmonary fibrosis (*Yumi Oie et al., 2013*).

Several studies showed advantages of the prone position as regard more homogenous dose distribution with a reduction in the size of the hot spots, resulting in decreased acute reactions, and irradiation of less normal tissue especially in patients with pendulous breast (*Morrow et al., 2007*). Other studies showed that, the prone position was better than the supine position for sparing both lung and the heart in the majority of left breast cancer patients, especially in case of large breasts (*Kirby et al., 2010*).

A prospective single institution trial of four hundred patients demonstrated that the prone position was associated with reduced in-field lung volumes compared with supine (86.2% reduction for right breast cancer, a 91.1% reduction for left breast cancer). In patients with left breast cancer, the prone position was associated with a reduction of in-field heart volumes compared with supine (85.7% reduction) (*Formenti et al., 2012*).

Prone breast radiotherapy also provided better cosmetic outcomes for patients with pendulous breast compared to those observed in supine series because there is often improved breast positioning at the inframammary fold. Minimizing fold reduces a blousing effect, acute skin dermatitis and erythema in this area (*Tran et al., 2011*).