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
НІ	 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

List of Abbreviations

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).

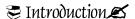
Women presented with early stage breast cancer have the option of electing breast-conserving surgery with adjuvant whole breast irradiation and has been shown in several large randomized controlled trials to yield local control and survival rates equivalent to those of mastectomy (*Darby et al.*, 2011).

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*).