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

Thesis

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By

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✍ Eman Abdelnaby

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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)***.