Importance of Deep Inspiration Breath Hold for Left Breast Cancer Treatment

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Did you know...

- There are over 2 million breast cancer diagnoses per year (Habatsch et al., 2022, p. 111).
- Breast cancer is the leading death for women worldwide.
- Chest wall involvement is a common complication of breast cancer.
- 5% of breast cancer diagnosis also include a chest wall tumor (Mundt & Roeske, 2011, p. 285).
- 1 in 50 patients have a primary diagnosis of a chest wall tumor (Mundt & Roeske, 2011, p. 286).

What is Gating?

- Gating is a breathing technique used during external radiation therapy treatments (Rollins et al., 2019, p. 449).
- Gating is used to treat chest wall, lung, and breast tumors (Rollins et al., 2019, p. 449).
- Patient simulations are conducted by placing a reflective marker box on the patient's abdomen, while in the supine position, and the reflective marker box is detected with the infrared camera (Rollins et al., 2019, p. 435).
- Software programs are connected to the infrared camera, which monitors the marker box movement that is correlated with the patient's diaphragm (Rollins et al., 2019, p. 449).
- Treatments are administered by using gating and lining up to clips in the patient's body.

Image 1: Displays gaiting simulation set up (GE Medical Systems, n.d.)[Picture].

- Gating resulted in a 67% reduction of overall radiation dose to the patient when deep inspiration breath hold was used (Ciervide et al., 2021, p. 2358).

Deep Inspiration Breath Hold (DIBH)

- Commonly used for patients with left breast cancer as a heart-sparing approach for radiotherapy (Wolf et al., 2023, p. 380).
- Patients, lying in the supine position, are instructed to take a deep breath in and hold it for the duration of 20 seconds (Wolf et al., 2023, p. 381).
- Gating window width is set to 5mm for admiration of treatment (Wolf et al., 2023, p. 382).
- Breathing parameter is then calculated in planning and patient must be in that window during treatment.
- Radiation Therapist instructs the patient on breathing to be within the planned area on the control panel and the use of the marker box and camera.

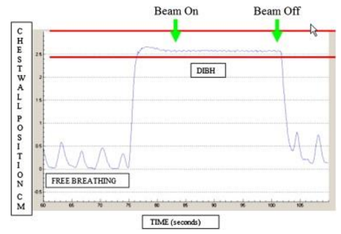


Image 2: DIBH breathing parameter for treatment on control panel (Wolf, et al., 2023, p. 383) [Image].

- Utilizing the deep inspiration breath hold technique allows for the heart to be displaced posteriorly, medially, and inferiorly away from breast border of tangential fields (Eber et al., 2023, p. 2467).
- DIBH is beneficial in preserving cardiac perfusion, especially with low cardiac doses of less than 5Gy at 6 months to 1-year post-radiation (Eber et al., 2023, p. 2466).
- DIBH technique can prevent the appearance of early (3 month) and medium-term (6 and 12 month) perfusion disorders (Eber et al., 2023, p. 2468).

Inclusion Criteria

- Patients with left-sided breast cancer histologically confirmed after lumpectomy or mastectomy with/ without lymph node involvement (Eber et al., 2023, p. 2467).
- Patient treatment is planned for the utilization of DIBH-RT or IMRT (intensity modulated therapy) (Eber et al., 2023, p. 2467).
- Patient may simultaneously receive chemotherapy.

Exclusion Criteria

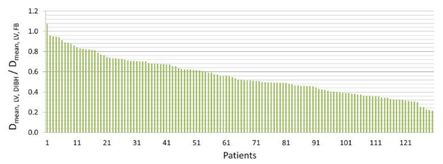
- Bilateral breast cancer diagnosis (Eber et al., 2023, p. 2467).
- History of thoracic irradiation (Eber et al., 2023, p. 2467).
- Pregnancy or breastfeeding (Eber et al., 2023, p. 2467).
- Any medical contradiction to cardiac SPECT or chest CT angiography (Eber et al., 2023, p. 2467).

Free Breathing vs. DIBH

- Free breathing poses a higher risk of lung and heart irradiation on left side breast cancers (Burton et al., 2022, p. 22).
- Free breathing allows free movement of the chest/breast tumor during treatment administration (Habatsch et al., 2022, p. 112).
- Changes in respiration between simulation and treatment may lead to target under- or over-doses with using free breathing (Burton et al., 2022, p. 21).
- Research concludes that perfusion defects are from chest wall motion abnormalities from using free breathing (Eber et al., 2023, p. 2467).
- DIBH spares heart and lung tissue allowing for a decreased risk of future complications (Eber et al., 2023, p. 2467).
- DIBH allows for the dose to surrounding organs radiation dosage to be lower than the tolerance dose (Rollins et al., 2019, p. 435).
- DIBH technique is reproducible for radiation treatment purposes (Mundt & Roeske, 2011, p. 435).
- DIBH produces almost 100% lung inflation capacity each treatment (Mundt & Roeske, 2011, p. 436).

Dose Reduction with DIBH

- All organs have a dose parameter that cannot be exceeded in treatment planning and administration.
- A case study completed from December 2017 until December 2019 demonstrates the dose parameters and actual dosage administered for 130 patients using DIBH technique (Wolf et al., 2023, pp. 382-386).
- Datum is compared to free breathing with organ dosage.
- The mean for heart dose (Dmean) in DIBH group is 1.3Gy with a range of 0.5- 3.6 (Wolf et al., 2023, pp. 382-386).
- Mean heart dose for free breathing (FB) patients is 2.2 Gy with a range of 0.9- 8.8 (Wolf et al., 2023, pp. 382-386).
- The mean heart (Dmax) dose in DIBH group is reduced 50% in comparison with the FB group (Wolf et al., 2023, pp. 382-386).
- The mean left ventricle dose (Dmean) in DIBH patients is 1.5 Gy with a range of 0.6-4.5 (Wolf et al., 2023, pp. 382-386).
- Mean left ventricle dose is 2.8Gy with a range of 1.1-9.5 for free breathing patients (Wolf et al., 2023, pp. 382-386).
- Dmean in left ventricle dosage for DIBH patients is reduced by about 50%, (Wolf et al., 2023, pp. 382-386).



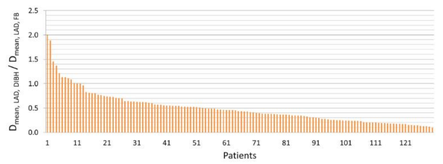


Image 3 demonstrates the ratio of Dmean LV in DIBH to FB position.

Image 4 demonstrates the relative ratio of Dmean LAD in DIBH to FB position (Wolf et al., 2023, p. 384) [Images].

- Acute adverse side effects are limited to grade 1 skin toxicity on the irradiated area on patients (Cervide, et al., 2021, p. 2361).
- Median follow-up of 66.7 months demonstrated patients experienced excellent breast cosmoses outcomes (Cervide, et al., 2021, p. 2361).

Conclusion

- Breast cancer remains most fatal to women in the United States. Recent studies show that 50.8% of women are diagnosed with left side breast cancer (Rollins et al., 2019, Chapter 30). The utilization of DIBH allows for patient comfort and plays a role in dose reduction by incorporating surface guiding technology.
- The use of DIBH assist doctors, dosimetrists, physicists, and radiation therapists in the location of the tumor for treatment purposes. Surface guiding technology allows for the treatment to only be administered when the patient remains within a certain parameter of deep inspiration.
- The lack of motion using DIBH allows the tumor to remain within planned parameters that are away from heart and lung tissue. Technique allows for patients to have an overall lower mean dosage rate to breast, lung, and heart tissues. Also, DIBH decreases the likelihood of chest wall involvement and complications.
- All medical procedures pose risks and benefits for each patient. However, patients should carefully consider the advantages of DIBH technique after a left side breast cancer diagnosis.

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