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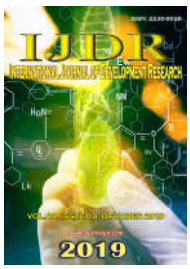

RESEARCH ARTICLE OPEN ACCESS

# SIMULATION AND TREATMENT LEFT WITH THE DIBH TECHNIQUE

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**ABSTRACT**

Radiotherapy treatment for left breast cancer may include the ipsilateral lung and especially the heart in the treatment fields. One way to minimize doses to these risky organs is to use the Deep Inspiration Breath Hold (DIBH) technique, called deep breath holding. The objective of this study was to propose a standard operating procedure for the stages of simulation and tele-therapeutic treatment using the DIBH technique. This is a descriptive research, to develop the document in the form of protocol with the DIBH technique in the service in question, a questionnaire was applied to professionals involved in the simulation and treatment of this technique. As a result, a standard operating procedure for the DIBH technique was built including simulation and treatment without the aid of a breath monitoring system. At the institution the technique proved to be feasible and reproducible, being included in clinical practice. It is concluded that the dissemination of voluntary DIBH technique should be encouraged for patients with left breast cancer.



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## INTRODUCTION

Breast cancer is the cancer that has the highest incidence and highest mortality in the female population worldwide, in both developing and developed countries (INCA, 2018). The standard treatment for patients with early-stage breast cancer is conservative breast surgery followed by adjuvant radiotherapy (KIROVA, 2016). This therapeutic approach has shown improvement in local control and overall survival of these patients (EARLY BREAST CANCER TRIALISTS 'COLLABORATIVE GROUP, 2011). In left breast irradiation the ipsilateral lung and especially the heart may be encompassed in the treatment fields due to the patient's anatomy. This is particularly due to the proximity of the chest wall to cardiac structures such as the left anterior descending coronary artery (LAD) and left ventricle. Therefore, patients undergoing radiotherapy for left breast cancer have the risk of changes in cardiac perfusion, as well as later cardiac morbidity and mortality (MACRIE *et al*., 2015). Despite reducing breast cancer recurrence rates, radiotherapy has disadvantages such as acute and late toxicities. Toxic effects occur when normal cells located within the treatment field suffer some damage and may cause reactions such as pneumonitis, fatigue, dermatitis, skin hyperpigmentation, heart disease, rib fractures and pulmonary fibrosis, many of these effects are caused by the inevitable inclusion of these. Structures in the radiation field (TOKATLI *et al*., 2005). Evidence suggests that there is a dose response relationship between the heart and the radiation dose received, making the rate of ischemic heart disease proportional to the average dose received by the heart (HARRIS, 2008; ZHAO *et al*., 2018). In modern breast cancer

therapy, we seek to minimize damage to surrounding tissues, such as the heart, and thereby decrease cardiotoxic agents (BORST *et al*., 2010). Deep Inspiration Breath Hold (DIBH) treatments, called deep breath-held inspiration, have been implemented to reduce the cardiac dose during radiotherapy.

When deep breath-holding inspiration occurs, it keeps the heart displaced posteriorly, medially and inferiorly: that is, away from the breast and away from the edge of the tangential fields, which are the fields usually used in planning. Thus, the dose in the heart reduces approximately by half compared to the dose administered when the patient remains in free breathing (NISSEN; APPELT, 2013; ZAGAR *et al*., 2017). In a recent study, there was a reduction of about 45.7% in the mean cardiac dose with the use of the DIBH technique compared with the free-breathing treatment (DELL'ORO *et al*., 2019). Given the above, the general objective of the article was to propose a standard operating procedure for the stages of simulation and tele-therapeutic treatment using the deep breath suspension technique.

## MATERIAL AND METHODS

This research is defined as descriptive, as it sought to detail a process that is applied in a radiotherapy service. To describe the protocol with the DIBH technique in the service in question, a questionnaire was applied to the professionals involved in the simulation and treatment of this technique. In this data collection tool, options were provided for the steps involved in the tomographic simulation process and tele-therapeutic treatment, as well as conducts pre-established by the institution. The practitioner who performs any of these phases has chosen an option from multiple options to identify which protocol the study site uses for this type of treatment.
To analyze the data of the research instrument, the information was grouped in order of frequency. There were slight divergences in specific stages, however we chose to describe the data that was congruent with the largest number of participants. In order to validate the protocol adopted by the researched institution, the results were compared with previous studies that described the stages of the planning and treatment process using the technique.

## RESULTS

The result was presented as a standard operating procedure (SOP). This document aims to standardize activities, so that it describes all steps for the individual to achieve the expected result of the activity (NOGUEIRA, 2014). However, it is important to emphasize that this must be a continuous development process, ie, changeable, and with the participation of professionals who participate in the work process. Thus, the suggested POP is a synthesis and can be applied to any radiotherapy service that has an Image Guided Radiation Therapy (IGRT) system, without the need for an accessory respiratory control tool. Each service should adapt the protocol to their work routine. The document provides a detailed description of the following items: pre-simulation, simulation, treatment and general observations about the DIBH technique. Thus, the protocol can be applied to any service that is willing to modify its work routine. To create the standard operating procedure of the DIBH technique, a document made available by Anvisa (SNVS, 2019) was used as a model.

**Standard operational procedure**

**Title:** Protocol for Simulation and Treatment of Left Breast Cancer Using the DIBH Technique

**Objective:** To standardize the conduct of professionals as well as patients in performing the IHL technique.

**Scope:** This document should be applied to all professionals involved in the process of planning and radiotherapy treatment using the technique of DIBH.

**Symbols and Abbreviations**

- DIBH: deep inhalation with breath hold.
- FB: free breathing.
- IGRT: image-guided radiotherapy.
- CT: computed tomography.

**Responsibilities:** The correct application of this protocol is the responsibility of the entire medical physics team (physicist, dosimetrist and radio-oncologists), as well as the technician / technologist team that performs the treatment on the linear accelerator.

**Mainsteps**

**Pre Simulation**

- After selecting the patient with left breast cancer, they should be informed verbally and in writing about the procedure of the DIBH technique.
- For the patient to be eligible for the protocol, she must be able to perform a deep breath followed by apnea for about 20 to 30 seconds.

**Simulation**

- Prepare the CT room: use of the rectified table and immobilization accessories according to the routine of the service.
- Definition of anteromedial and lateral tattoos (right and left) in free breathing. Palpable breast marking and surgical scar with radiopaque material.
- Positioning of IGRT system accessories, if necessary.
- Technique training until deep breathing is achieved followed by reproducible and stable apnea.
- Time the apnea time and document this information.
- Define new tattoos by performing the DIBH technique.
- Verify geometric consistency visually using lasers and DIBH skin tattoos.
- At CT control, acquire the image in free breathing.
- At the CT command, ask the patient to train the DIBH technique as soon as the CT scan is stable.
- Evaluation of a competent practitioner, such as a physician, dosimetrist, and radio-oncologist, to compare DIBH and free breathing images and to verify that there is sufficient room for cardiac displacement to justify treatment with DIBH, or to simulate inputs. tangential field tests to analyze the feasibility of the technique.
- Once the eligibility of the technique is confirmed, the patient should be instructed to continue the training of

the DIBH technique until the beginning of the treatment.

**Treatment**

- Position the patient identically with the same immobilization accessories as the CT scan.
- Aligning free-breathing skin markings to isocenter location.
- Following the location of the free breathing isocenter, the DIBH technique is requested twice to check inspirational tattoos as soon as reproducible mark the SSD.
- On command, the treatment room camera image is enlarged towards the patient's skin tattoos to verify the coincidence of the lasers with the DIBH markings.
- At the IGRT console ask the patient for the DIBH technique through the audiovisual monitoring system.
- When the side tattoos match the lasers make an image for position verification. IGRT fusion should be performed considering the upper part of the vertebra and the middle part of the ribs. If necessary repeat the procedure and make corrections.
- Once the positioning is consolidated, enter the data in the console of the device, when finished ask for a new DIBH.
- The beam is released manually as soon as the lasers exactly match the DIBH tattoos or the positioning in the IGRT system is verified.
- At each field change, re-instruct DIBH and confirm positioning for beam release.
- Treatment should be discontinued manually if there is a change in breathing depth or any non-standard patient movement.

**General observations**

- FB and DIBH tattoos should be clearly marked so that professionals can distinguish each one.
- Monitoring by the video system should be performed at all times during the treatment fraction.
- Patient guidance on breath retention is provided through a communication system.
- At each step that the DIBH technique is requested, the provider should not forget to instruct the patient to breathe normally as soon as possible.
- Add a tag to the beam wrench on the treatment unit to provide a reminder to practitioners requesting the patient to perform DIBH.
- If the IGRT system allows, guide the patient to monitor their breathing through the system screen in the treatment room.
- Resources required: IGRT system, audiovisual monitoring system and staff training.

**Expectedoutcome**

The purpose of this document is to make processes uniform across the team, providing the patient with more certainty in their treatment. In addition, the standard operating procedure is expected to be adapted to the work routine of each team and is a continuous and modifiable document.

**Conclusions**

Based on the experience of the researched service, the POP was constructed in the form of an adapted protocol, without the indispensability of a respiratory monitoring system. In this institution the technique proved to be feasible and reproducible, being included in clinical practice. In view of the protocol description and the perception of its feasibility, positive aspects of its application are pointed out. The simplicity of this method ensures that any device featuring lasers, audiovisual monitoring control and positioning verification system (IGRT) is capable of performing the technique. As seen, DIBH does not require additional equipment or resources for apnea monitoring, so it can be implemented in services that meet these minimum requirements. DIBH can be challenging because of the patient's individual ability to perform the method and ensure daily reproducibility. In addition, it is up to each radiotherapy service to evaluate the feasibility of application, considering the challenges of this technique, such as the need for two simulation tomographs, the planning of fields to which the beam remains radiating for up to 30 seconds, additional scheduling time. on the device, staff training to accompany the patient, training and patient collaboration (RICE *et al*., 2017; CZEREMSZYNSKA *et al*., 2017). In short, the method is able to provide a reproducible dose reduction in risk organs, especially in the cardiac structure (DROST *et al*., 2018), proving to be a modern technique, with low financial cost, constituting a highly valuable in treating left breast. Conclusions derived from the study provide a suitable starting point for other radiotherapy centers. In addition, the results achieved may encourage the dissemination of the DIBH technique to patients with left breast cancer.

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