

An innovative procedure at Mary Bird Perkins – Our Lady of the Lake Cancer Center has turned taking a deep breath into a technique that lowers long-term complications for cancer patients.

Just Breathe

BREATH HOLD TECHNIQUE REDUCES RADIATION DAMAGE

By Anna Thibodeaux

Called deep inspiration breath hold, this procedure has proven beneficial to patients with left-sided breast cancers who have an increased risk of heart damage from adjuvant radiation therapy, which is applied after a lumpectomy or mastectomy. The majority of these patients, those who undergo lumpectomy for early-stage disease, as well as many breast cancer patients who undergo mastectomy for more extensive disease, receive additional radiation therapy. Studies determined this could cause serious health issues later in life.

“The long-term complications this technique helps reduce are ischemic heart

disease, heart failure and possibly valvular disease,” said Dr. Renee A. Levine, radiation oncologist at the Cancer Center. “This can be worsened by patients who have or develop atherosclerotic heart disease or cardiac problems related to chemotherapy or targeted agenda like trastuzumab.”

Also called respiratory gating, the procedure involves synchronizing delivery of radiation with breathing to restrict the amount of tissue exposed to the treatment. The patient takes a deep breath to inflate the lingula or upper lobe of the left lung. By doing this, the inflated lingula distances the heart and chest wall from the path of the radiation beam, which lowers the risk of heart damage.





A patient is seen in position for the breath hold technique. A video monitor records movement of the abdominal marker, which radiation therapists use to verify proper treatment protocol. The patient watches a separate monitor (eye glasses) to see if the requisite inhalation level is achieved for the 20-second breath hold.

The act of deep breathing pulls the diaphragm down and, along with it, the heart. “You are essentially moving the heart down and away from the upper and central chest wall,” Levine said, “where the breast (or post mastectomy chest wall) and lymph nodes are located.”

The technique helps reduce the risk of heart damage by decreasing how much of it is exposed, as well as the dose per volume.

Devices are used to monitor the degree of inhalation, she said. These include markers placed on the chest, video

cameras, and monitors for both the therapist and the patient.

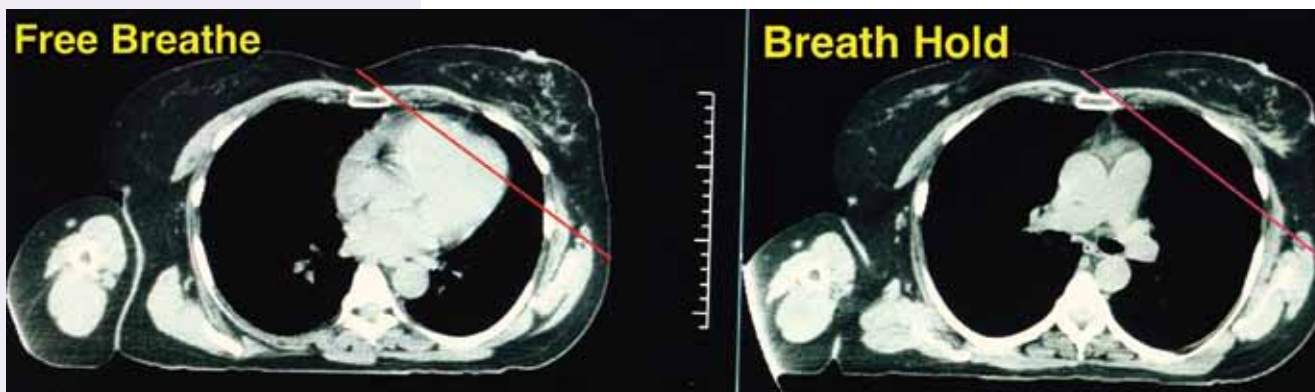
The American Cancer Society estimates 232,000 new cases of invasive breast cancer were diagnosed in 2014, as well as 62,500 cases of breast carcinoma. The majority of these women

1945 First visualization of the coronary arteries.

1955 The x-ray image intensifier allows dynamic x-ray imaging that can be shown on television screens.

1946 Development of the film cassette changer by George Schoenander allows for a series of cassettes to be exposed at a rapid rate.





The above graphics demonstrate the effectiveness of the Cancer Center's Breath Hold Technique. The image on the left shows the heart during normal breathing and the redline indicates the angle of radiation. The image on the right shows the heart position during a deep breath where radiation avoids the heart completely.

received breast-conserving surgery followed by radiation. Breast irradiation has been shown to decrease the risk of local recurrence after surgery with few adverse effects, but one of the most concerning complications of breast radiotherapy is cardiotoxicity from radiation to the heart.

Cardiotoxicity was most frequently reported as decreased myocardial function or coronary artery disease (also reported as ischemic heart disease or decreased cardiac perfusion). However,

less common toxicities can include myocardial infarction, congestive heart failure, pericarditis, arrhythmias, angina or valve dysfunction. While generalized decreased cardiac function has been reported, some studies have pinpointed decreased left ventricular or left anterior descending coronary artery function or perfusion after radiation.

A review of more than 1,600 patients with 16 years of follow-up found left-sided breast cancer patients treated with radiation had a 38 percent increase in cardiovascular disease compared to right-sided cancer patients. While radiation treatment likely improved from the time of these studies, the cardiotoxicity connection to radiation was documented and addressed.

As data became available to quantify this risk, strategies were developed to reduce it without compromising radiation to the breast. Several broad categories of

techniques to reduce cardiac radiation doses were identified, including breath hold techniques, prone positioning, intensity-modulated radiation therapy and accelerated partial breast irradiation, as well as small techniques to improve traditional three-dimensional conformal radiation therapy.

One of the solutions that came out of these studies was breath hold, which had patients take a deep breath during CT simulation and treatment each day. According to the University of Texas' M.D. Anderson Cancer Center, these patients' hearts usually receive "a glancing blow of radiation, with the superficial portions of the heart - the pericardium and the coronary arteries - receiving the highest radiation dose. The pericardium is generally fairly tolerant of radiation, and radiation-induced pericarditis is uncommon among patients with left-sided breast cancers. Much more susceptible to the

1960

The first ultrasound is made possible through the use of sonar technology developed during World War II.

1972

Geoffrey Hounsfield and Allan Cormack invent Computed Tomography (CT) scanning.

1971

Blood is tested for hepatitis B for the first time.





Chief of Physics Jonas Fontenot, PhD and Radiation Oncologist Rene Levine, MD at Mary Bird Perkins – Our Lady of the Lake Cancer Center collaborate on a treatment plan design using the breath hold protocol.

“We know the technique can reduce heart doses by 50 percent or more in some patients. We know the technique is well tolerated by most patients (80 percent or so) when proper coaching is provided.”

adverse effects of radiation are the coronary arteries.”

The breath hold technique proved so successful that it has become a standard in treatment for left-sided breast cancers. According to Dr. Jonas Fontenot, chief of physics with Mary Bird Perkins – Our Lady of the Lake Cancer Center, studies supporting use of the breath hold technique began appearing in literature about 10 years ago. The initial reports came from Harvard Medical School in Boston, Mass., with the first larger clinical studies coming from William Beaumont Hospital in Detroit, Mich.

The first patient treated with this

procedure at Mary Bird Perkins – Our Lady of the Lake Cancer Center was in 2014. The center’s focus on cutting-edge treatment put it among forerunners that recognized the significance of the breath hold technique, as well as its application.

“Each breath hold performed by the patient must be extremely precise and reproducible, generally to within a couple of millimeters (the width of nickel),” Fontenot said. “Coaching a patient to pause their breathing in such a predictable way - and independently confirming they have done so correctly each time - requires much more time and effort from the physics team throughout the patient’s

course of treatment compared with traditional breast radiation therapy.”

Although breathing seems simple, the technique requires extensive collaboration between radiation oncologists, medical physicists, and other treatment team members to utilize it safely and effectively. Typically, only academic cancer centers are able to offer such complex and specialized treatments. However, the large academic medical physics team at the Cancer Center provides the support that makes it possible to offer this sophisticated technique.

“We know the technique can reduce heart doses by 50 percent or more in some patients,” Fontenot said. “We know the technique is well tolerated by most patients (80 percent or so) when proper coaching is provided.”

As a result, the technique has seen growth, primarily at academic centers, he said. Current users include M.D. Anderson Cancer Center, Beaumont Cancer Institute, University of Michigan, Princess Margaret Hospital in Toronto, Canada, and the University of North Carolina.

Asked if patients benefit from breath hold, Levine said, “Absolutely.” She added that advanced treatment techniques certainly minimize the dose significantly compared to standard treatments and the breath hold technique can reduce it even further.

She’s also found that patients are “generally pleasantly surprised with how easy it is to learn how to control their breathing for short periods of time.” She added, “In my experience, they have been delighted to know they are participating in reducing their long-term cardiac risk.” ■