Advances in Radiation Oncology (2020) **5**, 573-574

advances
in radiation oncology

www.advancesradonc.org

Brief Opinion

Concerns for Active Breathing Control (ABC) With Breast Cancer in the Era of COVID-19: Maximizing Infection Control While Minimizing Heart Dose

Andrew J. Song, MD, Gregor Manukian, MD, Amy K. Taylor, MS, Pramila R. Anne, MD, and Nicole L. Simone, MD*

Department of Radiation Oncology, Thomas Jefferson University, Philadelphia, Pennsylvania

Received 21 March 2020; revised 23 March 2020; accepted 24 March 2020

Active breathing control (ABC) devices employ moderate deep inspiration breath hold (DIBH) techniques to spare cardiac structures from dosing in patients with left breast cancer (LBC) and is more commonly used than prone positioning.[1] ABC also helps in reducing dose to other organs at risk, including lungs and liver.[2] However, in the era of the COVID-19 pandemic, there are concerns regarding the safety of using such devices, with risks of transmission among multiple patients, especially because the virus has a relatively high transmission rate and increased risk of mortality among elderly patients.[3] This issue is particularly poignant for patients with cancer, who may be immunocompromised and are at increased risk of requiring invasive ventilation, requiring intensive care unit admission, or dying (39% vs 8%) because of COVID-19.[4] Alternatives to ABC, such as prone positioning, may provide comparable benefits to ABC without placing patients with LBC in situations at risk for direct exposure from shared respiratory devices.

At our institution, we use an Active Breathing Coordinator (Elekta; Stockholm, Sweden) for our patients with LBC. We previously published the results from a prospective trial using this device, in which we demonstrated a median reduction in mean heart dose of 1.7 Gy with an 8-year locoregional relapse rate of 7%.[5] A systematic review of 10 studies showed similar results with DIBH, including a reduction of mean heart dose up to 3.4 Gy, translating to a 13.6% decrease in risk of heart disease.[6] This includes reduction of dose to the left anterior descending artery, with mean dose reduced by nearly half and coronary events at 10 years down to 2.55% from 4.03%.[7]

Respiratory droplets are one of the main methods of transmitting the SARS-CoV-2 virus.[8] These can be generated through coughing, sneezing, breathing, and talking. The size and number of droplets can vary based on the expiratory activity, the region of origin in the respiratory tract, and the type of pathogen.[9] SARS-CoV-2 particles have had reported diameters ranging from 0.06 to 0.14 μm.[10] SARS-CoV-2 viral particles in aerosols can remain viable for up to 3 hours in air and for up to 72 hours on plastic and stainless steel surfaces.[11] Aerosol models in healthy humans have measured droplets from coughing as small as 0.1 μm, with the vast majority (97%) of droplets as submicrometer in size.[12] Viral aerosols, such as those generated by influenza, tend to skew toward this size distribution.[13]

The Active Breathing Coordinator uses a mouthpiece and filter kit that are designed for single patient use. The ViroMax viral/bacterial filter is constructed of a styrene-acrylonitrile copolymer, which supports the filter media, constructed from a blend of modacrylic and polypropylene fibers. This has been tested and certified to >99.99% viral and >99.999% bacterial efficiency (Food and Drug Administration Good Manufacturing Practice,

Source of support: Supported in part by NCI Cancer Center Grant P30CA056036.

Disclosures: none.

* Corresponding author: Nicole L. Simone, MD; E-mail: nicole.simone@jefferson.edu

https://doi.org/10.1016/j.adro.2020.03.009

International Organization for Standardization 13485:2016, Food and Drug Administration 510[k] clearance K063526). The filter has been tested to 0.1 μm particles, which should technically provide adequate protection from transmission. Because the SARS-CoV-2 virus may be as small as 0.06 μm, however, we have elected in our clinic to decide whether to use ABC on a case-by-case basis.

As an extra precaution during the pandemic, providers can consider alternatives to ABC. Prospective trials comparing prone positioning versus DIBH have found similar rates of cardiac sparing.[14,15] A randomized clinical trial comparing voluntary DIBH with ABC DIBH found no significant differences in doses to normal structures and that voluntary DIBH was preferred by patients.[16] Both prone positioning and voluntary DIBH can provide cardiac sparing comparable to ABC, and droplet precautions do not have to be considered. During the current pandemic, our institution has been favoring prone positioning over ABC for cardiac sparing. Prone positioning is not ideal for all patients with LBC, however, including those needing regional nodal irradiation, those with very medial or lateral lumpectomy cavities, and when anterior displacement of the heart toward the chest wall may not lead to effective cardiac sparing.[17] Therefore, one can consider simulating patients in both prone and supine positions and selecting a treatment plan that is most suitable for the patient. In addition, emphasis should be placed on optimizing treatment planning techniques such as field-in-field and intensity modulated radiation therapy.[18]

In summary, the COVID-19 pandemic gives radiation oncologists an opportunity to evaluate our standard practices and create institutional guidelines, taking into account (1) the size of the SARS-CoV-2 virus and (2) the type of device used for respiratory gating, to determine the risk–benefit ratio acceptable for our patients during this time. Alternatives to ABC, including voluntary DIBH, prone positioning, and optimizing treatment planning, should also be considered to mitigate risk of transmission between patients.

References

1. Desai N, Currey A, Kelly T, et al. Nationwide trends in heart-sparing techniques utilized in radiation therapy for breast cancer. *Adv Radiat Oncol*. 2019;4:246-252.
2. Lin CH, Lin LC, Que J, et al. A seven-year experience of using moderate deep inspiration breath-hold for patients with early-stage breast cancer and dosimetric comparison. *Medicine (Baltimore)*. 2019;98:e15510.
3. Sun P, Lu X, Xu C, et al. Understanding of COVID-19 based on current evidence [internet]. *J Med Virol*. jmv.25722. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1002/jmv.25722. Accessed March 20, 2020.
4. Liang W, Guan W, Chen R, et al. Cancer patients in SARS-CoV-2 infection: A nationwide analysis in China. *Lancet Oncol*. 2020;21:335-337.
5. Eldredge-Hindy H, Lockamy V, Crawford A, et al. Active Breathing Coordinator reduces radiation dose to the heart and preserves local control in patients with left breast cancer: Report of a prospective trial. *Pract Radiat Oncol*. 2015;5:4-10.
6. Smyth LM, Knight KA, Aarons YK, et al. The cardiac dose-sparing benefits of deep inspiration breath-hold in left breast irradiation: A systematic review. *J Med Radiat Sci*. 2015;62:66-73.
7. Joo JH, Kim SS, Ahn S Do, et al. Cardiac dose reduction during tangential breast irradiation using deep inspiration breath hold: A dose comparison study based on deformable image registration. *Radiat Oncol*. 2015;10:264.
8. Centers for Disease Control. Transmission of Coronavirus Disease 2019 (COVID-19). Available at: https://www.cdc.gov/coronavirus/2019-ncov/prepare/transmission.html. Accessed March 20, 2020.
9. Morawska L. Droplet fate in indoor environments, or can we prevent the spread of infection? *Indoor Air*. 2006;16:335-347.
10. Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med*. 2020;382:727-733.
11. van Doremalen N, Bushmaker T, Morris DH, et al. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *N Engl J Med*. NEJMc2004973, accessed March 20, 2020.
12. Zayas G, Chiang MC, Wong E, et al. Cough aerosol in healthy participants: Fundamental knowledge to optimize droplet-spread infectious respiratory disease management. *BMC Pulm Med*. 2012;12:11.
13. Fabian P, McDevitt JJ, DeHaan WH, et al. Influenza virus in human exhaled breath: An observational study. *PLoS One*. 2008;3:e2691.
14. Yan SX, Maisonet OG, Perez CA, et al. Radiation effect on late cardiopulmonary toxicity: An analysis comparing supine DIBH versus prone techniques for breast treatment. *Breast J*. 2020:1-7. https://doi.org/10.1111/tbj.13742, accessed March 20, 2020.
15. Gerber NK, Yan SX, Levinson BA, et al. A prospective trial to compare deep inspiratory breath hold (DIBH) with prone breast irradiation [e-pub ahead of print]. *Pract Radiat Oncol*. https://doi.org/10.1016/j.prro.2020.01.001, accessed March 20, 2020.
16. Bartlett FR, Colgan RM, Carr K, et al. The UK HeartSpare Study: Randomised evaluation of voluntary deep-inspiratory breath-hold in women undergoing breast radiotherapy. *Radiother Oncol*. 2013;108:242-247.
17. Haffty BG. Supine or prone breast radiation: Upsides and downsides. *Int J Radiat Oncol Biol Phys*. 2018;101:510-512.
18. Li JS, Freedman GM, Price R, et al. Clinical implementation of intensity-modulated tangential beam irradiation for breast cancer. *Med Phys*. 2004;31:1023-1031.