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Voluntary versus mechanically-induced deep inspiration breath-hold for left breast cancer: A randomized controlled trial

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Abstract

Background and purpose: Deep inspiration breath-hold (DIBH) protects critical organs-at-risk (OARs) for adjuvant breast radiotherapy. Guidance systems e.g. surface guided radiation therapy (SGRT) improve the positional breast reproducibility and stability during DIBH. In parallel, OARs sparing with DIBH is enhanced through different techniques e.g. prone position, continuous positive airway pressure (CPAP). By inducing repeated DIBH with the same level of positive pressure, mechanically-assisted and non-invasive ventilation (MANIV) could potentially combine these DIBH optimizations. Materials and Methods: We conducted a randomized, open-label, multicenter and single-institution non-inferiority trial. Sixty-six patients eligible for adjuvant left whole-breast radiotherapy in supine position were equally assigned between mechanically-induced DIBH (MANIV-DIBH) and voluntary DIBH guided by SGRT (sDIBH). The co-primary endpoints were positional breast stability and reproducibility with a non-inferiority margin of 1 mm. Secondary endpoints were tolerance assessed daily via validated scales, treatment time, dose to OARs and their inter-fraction positional reproducibility. Results: Differences between both arms for positional breast reproducibility and stability occurred at a sub-millimetric level (p < 0.001 for non-inferiority). The left anterior descending artery near-max dose (14,6 ± 12,0 Gy vs. 7,7 ± 7,1 Gy, p = 0,018) and mean dose (5,0 ± 3,5 Gy vs. 3,0 ± 2,0 Gy, p = 0,009) were improved with MANIV-DIBH. The same applied for the V5Gy of the left ventricle (2,4 ± 4,1 % vs. 0,8 ± 1,6 %, p = 0,001) as well as for the left lung V20Gy (11,4 ± 2,8 % vs. 9,7 ± 2,7 %, p = 0,019) and V30Gy (8,0 ± 2,6 % vs. 6,5 ± 2,3 %, p = 0,0018). Better heart's inter-fraction positional reproducibility was observed with MANIV-DIBH. Tolerance and treatment time were similar. Conclusion: Mechanical ventilation provides the same target irradiation accuracy as with SGRT while better protecting and repositioning OARs. © 2023 Elsevier B.V.

Author Keywords

Breast cancer; Deep inspiration breath-hold; Mean heart dose; Mechanical ventilation; Radiotherapy

Index Keywords

adjuvant radiotherapy, adult, aged, Article, artificial ventilation, breast cancer, breast ductal carcinoma, breast radiotherapy, breath holding, controlled study, deep inspiration breath holding, ductal breast carcinoma in situ, female, heart left ventricle, human, intermethod comparison, left anterior descending coronary artery, left lung, lobular carcinoma, lobular carcinoma in situ, major clinical study, multicenter study, non-inferiority trial, noninvasive ventilation, open study, randomized controlled trial, supine position, validation study, very elderly, voluntary deep inspiration breath holding, breast, breast tumor, clinical trial, heart, organs at risk, procedures, radiation response, radiotherapy dosage, reproducibility; Breast, Breast Neoplasms, Breath Holding, Female, Heart, Humans, Organs at Risk, Radiotherapy Dosage, Radiotherapy Planning, Computer-Assisted, Reproducibility of Results, Unilateral Breast Neoplasms

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