

Effectiveness of Continuous Positive Airway Pressure (CPAP) for Heart Sparing During Left-Sided Breast Radiotherapy

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ABSTRACT

This systematic review of seven studies (397 patients) found that continuous positive airway pressure (CPAP) consistently increased heart–target separation and reduced cardiac irradiation during left-sided breast radiotherapy. CPAP achieved substantial reductions in mean heart and left anterior descending (LAD) coronary artery doses, demonstrated excellent treatment reproducibility, and did not significantly increase setup time. These findings support CPAP as a practical and effective alternative to deep inspiration breath-hold (DIBH), particularly in patients with limited breath-hold capability and in resource-limited radiotherapy settings.

INTRODUCTION

Adjuvant radiotherapy following breast-conserving surgery or mastectomy reduces recurrence and improves survival in breast cancer patients. However, left-sided breast radiotherapy increases the risk of radiation-induced cardiac toxicity due to the proximity of the heart to the target region.

Continuous positive airway pressure (CPAP), a non-invasive ventilatory support technique, maintains airway patency and inflates the thorax, thereby increasing the distance between the heart and the chest wall and potentially reducing the radiation dose delivered to the heart during left-sided breast radiotherapy.

In this study, the available evidence regarding the efficacy of CPAP for heart sparing, considering both dosimetric and geometric factors, was systematically evaluated.

METHODS AND MATERIALS

In accordance with the PRISMA guidelines, a systematic literature search was performed in the PubMed database up to November 15, 2025. The search strategy combined free-text keywords and corresponding MeSH terms related to “continuous positive airway pressure (CPAP),” “breast cancer,” and “radiotherapy.” Original studies investigating the impact of CPAP on cardiac sparing during left-sided breast radiotherapy were identified and screened for eligibility. Relevant dosimetric and geometric data were extracted from the included studies.

RESULTS

A total of 7 studies involving 397 patients were included in this review [1-7]. Overall, CPAP was well tolerated, with applied pressures ranging from 8 to 15 cmH₂O. Compared with free breathing (FB), CPAP increased heart-to-target and LAD-to-target separation by more than 1 cm through thoracic expansion and caudal displacement of the heart.

Dosimetrically, CPAP substantially reduced cardiac irradiation compared with FB. The mean heart dose was reduced by 22–61%, with the greatest benefit observed in patients receiving internal mammary nodal irradiation. Mean LAD dose reductions ranged from 39.5% to 78%, while maximum LAD dose reductions of up to 78% were also reported. Furthermore, CPAP markedly decreased the volume of the heart encompassed within tangential radiation fields, with one study reporting a mean reduction of 96%.

From a clinical workflow perspective, CPAP did not significantly increase patient setup time compared with FB and may shorten treatment delivery relative to deep inspiration breath-hold (DIBH) by eliminating repeated breath-hold coaching and verification. In addition, CPAP demonstrated excellent reproducibility, with reported average intrafraction breast motion below 5 mm and inter-fraction heart displacement of only 2 ± 2 mm.

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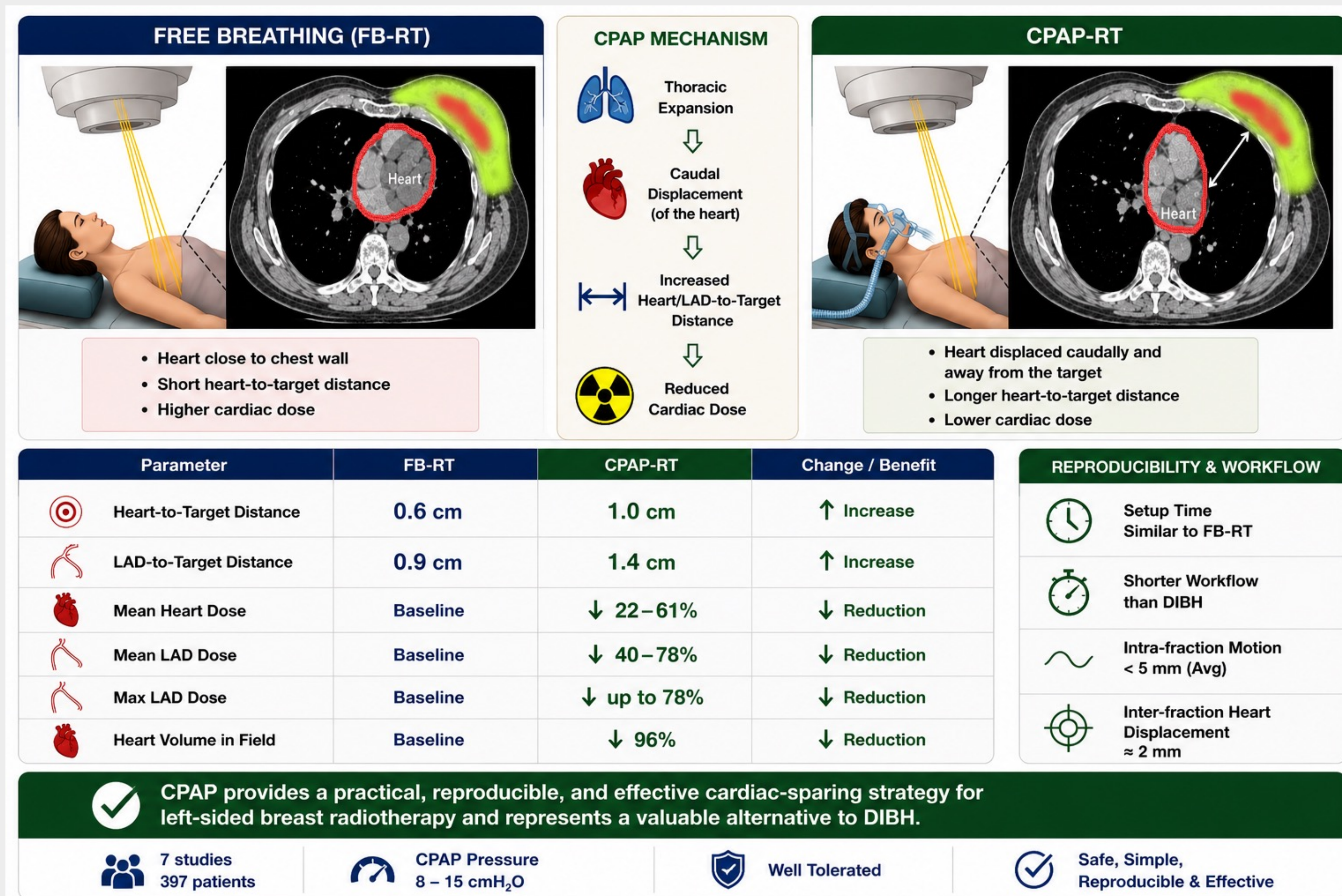


Figure 1. CPAP mechanism and key clinical benefits for cardiac sparing during left-sided breast radiotherapy.

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DISCUSSION

The findings of this review suggest that CPAP provides a practical, effective, and reproducible approach for cardiac sparing during left-sided breast radiotherapy. The technique consistently increases the separation between the heart, LAD, and the treatment target, resulting in substantial reductions in cardiac dose while maintaining excellent treatment precision. These dosimetric improvements may contribute to reducing the long-term risk of radiation-induced cardiac toxicity.

CPAP is well tolerated and does not significantly increase setup time, making it a practical alternative to DIBH, particularly for patients with limited breath-hold capability and in resource-limited settings. Furthermore, its excellent inter- and intra-fraction reproducibility may help reduce geometric uncertainties during treatment delivery. Further prospective studies are warranted to validate its long-term clinical benefits.

CONCLUSIONS

CPAP provides a practical, effective, and reproducible approach for cardiac sparing during left-sided breast radiotherapy. CPAP may serve as a valuable alternative to DIBH, especially in patients with limited breath-hold capability and in resource-constrained radiotherapy centers.