CPAP in radiotherapy: the first decade

Zvi Symon MD[1, 2], Sarit Appel, MD[1], Elisheva Jan MA RN[1] Eran Hamdi BA [1], Ilana Weis MA[1], Michele Schwob B.Ed[1], Sergey Dubinski PhD,[1], Maoz ben Ayun. PhD[1], and Yaacov R. Lawrence, MD, MRCP [1, 2]. Radiation Oncology, Sheba Medical Center, Israel [1], Gray Faculty of Health Sciences, Tel Aviv University, Israel[2]. symonz@sheba.health.gov.il

Introduction

Continuous positive airway pressure (CPAP) applied during radiotherapy was pioneered at our institution in 2014. CPAP increases lung volume on average by 1300 cc, modestly reduces tumor trajectory and moves the heart away from the chest wall with significant dosimetry gains in both lung and breast radiotherapy. CPAP combined with breath-hold provides supra-additive hyperinflation of the lung.

Aim

The aim of this study is to describe the implementation of CPAP in a 5- linac academic department treating over 200 patients a day.

Materials and Methods

An IRB approved database of patients solicited for CPAP during radiotherapy was reviewed. CPAP was offered to all patients with lung lesions or breast cancer who are unable to hold their breath or if breath-hold did not achieve favorable geometry or normal tissue constraints. Common indications include patients with chronic cough, restrictive/obstructive lung function tests, hearing loss, language barriers and phrenic verve paralysis. CPAP is applied with a portable Lowenstein Prima vent40 respirator and a full-face mask with a 10- minute automated ramp-up from 7.5 cm to 15 cm H_20 in steps of 2.5. A radiation nursing protocol is in place to assure comfort and safety on all applications. Patients on CPAP free breathing with motion more than 1 cm are re-simulated with a combination of CPAP and breath-hold.

Results

Between January 2014 and September 2025, 638 patients were included. 52 patients (8%) were not treated with CPAP: In 22 patients, CPAP was non-beneficial, 10 patients did not tolerate the mask, and the reason was indeterminate in 21 patients. 586 patients (91.8%) were irradiated with CPAP. 95% percent tolerated 15 cm H_20 well and 5% were treated with lower pressures. There was a single serious adverse event of vasovagal syncope while walking with CPAP to the linac. Sites were lung -410, breast -109, mediastinum- 32 and 35 esophageal cancer and metastasis. Standard fractionation was used in 92, moderate hypo-fractionation in 117, and ultra-hypofractionation in 374 patients. Two patients received single fraction ablation for malignant cardiac arrythmia. 412 patients were treated with CPAP free breathing and 174 patients were treated with combination CPAP and DIBH. Treatment duration with CPAP free breathing was associated with similar treatment times to fractions without motion management.

Conclusion

We have demonstrated a robust implementation of CPAP in a large volume radiotherapy center with more than 90 percent patient compliance. Continuous utilization of CPAP for over a decade demonstrates satisfaction of both patients and radiotherapy staff. CPAP should be included as a safe, simple and effective strategy for motion management in radiotherapy.