Radiography 22 (2016) e143–e148

Contents lists available at ScienceDirect

Radiography

journal homepage: www.elsevier.com/locate/radi

Case report

Delivery of radiation therapy of large target volumes in Hodgkin's disease using IMRT technique: A dosimetric case study

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ARTICLE INFO

Article history:
Received 27 October 2015
Received in revised form
7 February 2016
Accepted 11 February 2016
Available online 4 March 2016

Keywords:
Mantle field
Inverse planning
Parallel oppose pair
Target dose
Organs at risk

ABSTRACT

Radiation therapy techniques for early stage Hodgkin's disease (HD) include simple parallel-opposed-pair (POP) and Intensity-Modulated Radiation Therapy (IMRT). This case report compared the dosimetry achieved with POP and IMRT by evaluating target volumes and organs at risk (OAR). It showed that the IMRT technique could be a valuable technique when treating HD. Optimal target coverage can be achieved while at the same time reducing dose given to critical structures such as lung and thyroid.

Background

Patients with early stage Hodgkin's disease (HD) receive chemo-radiotherapy to involved lymph nodes as an effective treatment modality.[1–3] Radiation therapy techniques include simple parallel-opposed-pair (POP) and Intensity-Modulated Radiation Therapy (IMRT). This report aimed to compare the dosimetry achieved with POP and IMRT by evaluating target volumes and organs at risk (OAR).

Case presentation

The case subject selected was a 23-year old man with biopsy confirmed Stage IIA nodular sclerosis HD. In addition to central mediastinal involvement, patient also presented with bilateral cervical, hilar, supraclavicular and axillary adenopathy. The largest node was approximately 5.0 × 3.1 cm. The patient was offered consolidative radiotherapy for increasing local control after a complete response to 3 cycles of chemotherapy (Adriamycin, Bleomycin, Vinblastine and Dacarbazine).

Radiotherapy technique & outcome

Patient underwent Computed Tomography (CT) Simulation and was immobilized with a thermoplastic mask for treatment positioning. Pinnacle treatment planning system (v9.0, Philips Medical Systems) was used to calculate the plan with a dose grid resolution of 0.25 cm. The radiation prescription (Rx) was 35 Gy in 20 fractions. The Planning Target Volume (PTV) was 1866 cm^3. POP and IMRT plans were generated (Figs. 1 and 2).

For the POP technique, shielding designs by multi-leaf collimator (MLC) were suboptimal and resulted in higher doses to OAR (Fig. 3). Additionally, the POP treated larger areas of non-PTV tissue with prescription dose. A 7-beam IMRT plan was created. Inverse planning objectives addressed the challenge of treating the large target volume and sparing multiple adjacent OARs. Dose Volume Histogram (DVH) information was shown in Table 1 and Fig. 4. It was observed that both PTV coverage and OAR sparing were superior with the IMRT plan. With treatment delivered by IMRT, patient experienced mild mucositis with no other significant acute toxicities as per clinical dictation. Follow-up CT after 6-month and 1-year revealed no disease progression and no significant late toxicities.

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http://dx.doi.org/10.1016/j.radi.2016.02.002
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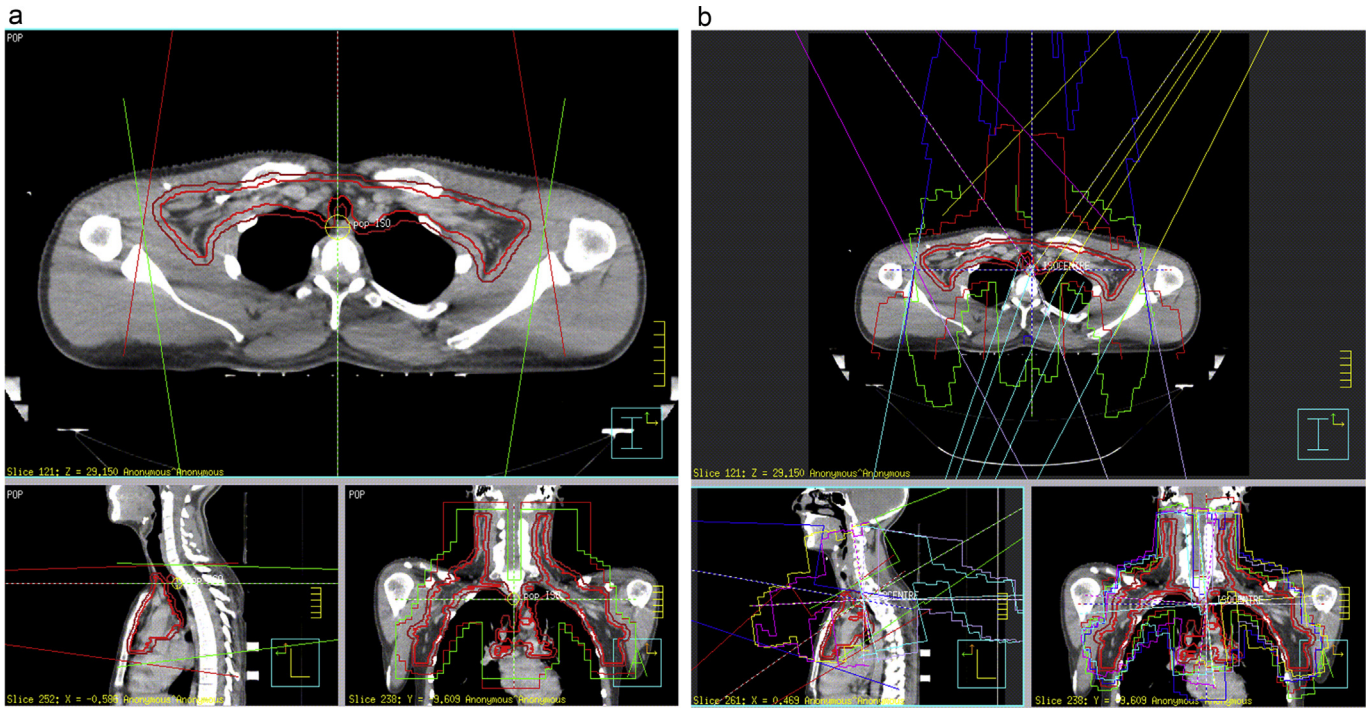

Figure 1. Radiation beam arrangements for (a) 6 & 18 MV POP plan, and (b) 7-beam non-coplanar 6 MV IMRT.

Discussion

Early stage HD usually presents at a young age. Treatment has a high cure rate with long life expectancy.[4] It is important to ensure adequate target coverage and sparing of OARs. The dosimetric data from our case showed similar results in the literature. When comparing IMRT with POP, Goodman et al.[5] observed that dosimetric parameters were significantly better in IMRT cases in terms of minimum, maximum, mean dose, volume receiving 95% of prescribed dose (V95%), and inhomogeneity index of PTV. The study populations had a mean PTV volume greater than 1000 cm^3, but there was a variation in disease extension within the supra-diaphragmatic area. These cases could be considered as modified mantles where full bilateral axillary nodes were not involved. Although our patient had extensive involvement and large target volumes similar to a

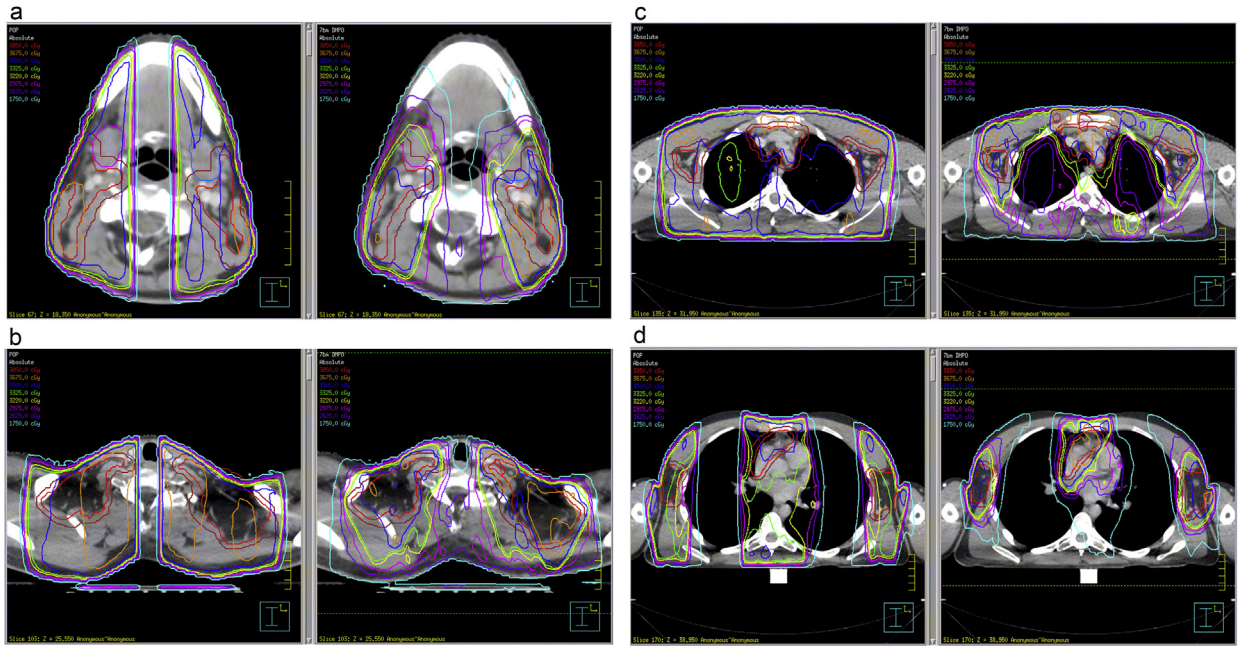

Figure 2. Dose distribution comparison between POP plan (left) and IMRT plan (right) at (a) level of the neck (pink & light blue: left & right submandibular glands); (b) level of shoulders (steel blue: thyroid gland); (c) level of mediastinum; & (d) bilateral axillae.