Evaluation of Dose Variation in Head & Neck Patients During their Course of Treatment

Vandana Puri R.T., (R)(M)(T), Pasquale Montanaro M.S., (DABR)
Texas Oncology, Presbyterian Cancer Center Dallas

INTRODUCTION

The purpose of this research is to evaluate the dose variations in head and neck patients during their treatment due to anatomical changes, differences in planning techniques, and tumor control. The sample included head and neck patients over the course of their treatment due to anatomical and tumor changes. The strategy is to review the planning target volume (PTV) coverage, mean dose to the parotids, and evaluate the spinal cord – a sensitive structure in high dose regions. Head and neck patients are treated with Intensity Modulated Radiation Treatment (IMRT) plans that significantly assist physicians in sparing organs at risk (OARs) while the tumor is irradiated to the full extent. Along with IMRT, daily imaging has advanced from 2D imaging to 3D imaging techniques, especially with Cone Beam Computed Tomography (CBCT) for image registration. CBCTs taken throughout the course of treatment allow for comparable results under different planning techniques. With daily imaging, it is imperative to image these patients on a daily basis to adapt to the intended plan as tighter tumor volumes show a greater difference on a weekly basis. Research correlating the dose actually received by patients with clinical results such as anatomic, dysphagia, and tumor control is justified. The IMRT CBCT plans, both parotid and max, under-dosed whereas in the VMAT CBCT plans due to tumor being on the left side, the right parotid received over the planned dose and the left parotid received less at a given point. Slices with the greatest uncertainty and variables in dose deposition between the two different planning techniques along with tumor location is also noted. The tumor location for the IMRT plan is centralized whereas the tumor location for the partial VMAT is on the left side. In the IMRT CBCT plans, both parotids are under-dosed whereas in the VMAT CBCT plans due to tumor being on the left side, the right parotid received over the planned dose and the left parotid received less at a given point portraying a possible effect of partial arcs.

METHODS AND MATERIALS

In this research, data was received from 2 head and neck patients who plan to evaluate dosimetric variations with definitive radiotherapy using IMRT and VMAT planning techniques. The IMRT plan was prescribed to 70 Gy. The mean cord dose was 1290 cGy while the partial VMAT plan was prescribed to 59.4 Gy. The maximum parotid dose ranged from 947 cGy to 1437 cGy when being normalized to 33 fractions. Treatment variability is due to changes in anatomy, the ability to set the patient up consistently and possibly differences in planning techniques. Variability was greater with 3 partial arc VMAT plan when comparing it to the IMRT plan.

RESULTS

Dosimetric changes were seen upon evaluation of the cord, parotids glands, and tumor volume coverage amongst the two head and neck plans. In the IMRT plan, the mean dose to the right parotid ranged from 2449 cGy to 2925 cGy as compared to setting up with the planned CT with a mean dose of 2785 cGy. Similarly, the mean dose to the left parotid in the CBCT IMRT plans ranged from 2569 cGy to 2879 cGy against the planned CT mean dose of 3008 cGy. The max cord dose varied from 4246 cGy to 4694 cGy while the planned CT max dose measured 4378 cGy. Tumor volumes of TV70 Gy D90 ranged 6697 cGy to 7055 cGy as compared to 6990 cGy in the planned CT. Tumor volumes of TV70 Gy D90 ranged 5144 cGy to 5550 cGy in comparison to 5520 cGy in the planned CT. These numbers reflect a definite change due to anatomical and setup variations. In the VMAT planning, the mean dose to the right parotid ranged from 561 cGy to 633 cGy as compared to with the planned CT with a mean dose of 503 cGy. Similarly, the mean dose to the left parotid ranged from 947 cGy to 1437 cGy against the planned CT mean dose of 1290 cGy. The max cord dose varied from 4286 cGy to 4398 cGy while the planned CT max dose measured 4300 cGy. Tumor volumes D90 ranged from 550 cGy to 5922 cGy as compared to the planned CT of 8070 cGy.

CONCLUSIONS

In this study, results showed dosimetric variations throughout the course of treatment for head and neck radiotherapy delivered by IMRT or VMAT. Variation was larger for certain anatomical structures than others, however, over the course of treatment, the largest deviation from the IMRT plan was the left parotid value by 242 cGy and the smallest dose deviation was in the max dose cord value by 5 cGy. The largest deviation from the VMAT plan was the PTV 5940 by 276 cGy and the smallest deviation was the max dose cord and maxa global value by 35 cGy when each fraction was summed and averaged simulating the entire treatment. Because our research showed little more than clinically significant variation in dose to critical structures and tumor volumes, additional studies should be performed to help indicate when re-planning should occur. Certain measures such as skin separation and tumor shrinkage could be measured and evaluated with respect to dose variation.

REFERENCES