

A Comparison of Dosimetry and Clinical Outcomes in Patients Receiving Photon External Beam Therapy to the Pelvis: A Two Year Experience with 6MV and 10MV Photon Energies in Cervical Cancer Patients at Parirenyatwa Radiotherapy Centre (CMK Banda, A. Nyamhunga, B.Ngara, N. Ndlovu)

Background: Radiotherapy efficacy depends, among other things, on the ability of the treatment machine to deliver optimal radiation dose to the target volume while sparing normal tissue using different techniques, including 3-dimensional conformal radiotherapy (3DCRT). The photon energy determines penetrative power and thence ability to deliver adequate dose to the target. Higher photon energies are generally preferred over low photon energies when treating deep tumours like Locally Advanced Cervical Cancer (LACC) using 3DCRT.

Justification: In most low and middle income settings, availability of higher energies ($\geq 10\text{MV}$) is limited. At Parirenyatwa Group of Hospitals Radiotherapy Centre (PGH-RTC), also serving the whole Zimbabwe, is only one 10MV energy machine, which also has 6MV energy, electrons and other special characteristics suitable for multiple and unique tumour sites, thence needed the most compared to the 6MV machines available. There is paucity of data comparing 10 Megavoltage (MV) and 6MV photon energy plans and outcomes for treatment of pelvic tumours with 3DCRT. Pelvic tumours consist the majority of cancers needing radiotherapy and other tumours in Zimbabwe and other developing countries.

Objective: This study aimed to compare dosimetric and clinical tumour outcomes between the 10 and 6MV photon energies which are available in Zimbabwe.

Methods: We retrospectively analysed medical records for LACC patients who received definitive concurrent chemoradiotherapy (CCRT) at for the period between 1st January 2017 and 31st December 2018. Patient's treatment plans were stratified into two arms according to the photon energies used (10MV and 6MV) and their respective dosimetric and clinical tumour outcomes at three months post-treatment were compared.

Results: A total 875 cervical cancer patients were seen during the study period, of these 82 met the inclusion criteria and were evaluated. Out of these, 20(24.4%) and 62(75.6%) patients were planned and/or treated with 10MV and 6MV photon energy respectively. The differences in minimum doses to the planned target volume and dose homogeneity index between the two photon energies were statistically significant (p-values 0.027 and 0.028 respectively), whereas the other dosimetric parameters (maximum & average doses to the planned target volume, conformity index and maximum doses to rectum, bladder, femoral heads and bowel) were not statistically significant (p-values of 0.245, 0.309, 0.130, 0.19, 0.35 and 0.42, and 0.16 respectively). Complete clinical tumour response at 3 months post treatment was 95% in the 10 MV arm compared to 91% in the 6 MV arm.

Discussion: Statistical significance in only 2 (Minimum dose to PTV & HI) of the 9 studied dosimetric parameters favouring 10MV photon energy brings forward a two way interpretation. On one hand, correlates with the superiority of higher energies in achieving homogeneity in deep tumours as compared to lower energies, on the other hand it reflect the fact that 10MV and 6MV photon energies represents the extremes of high and low energies respectively, which are close to one another and thence are practically capable of achieving similar dosimetric outcomes. This then explains the non-inferiority shown by 6MV photon energy plans in this study.

Conclusion & Recommendation: This study showed that the dosimetric and clinical tumour outcomes in LACC patients receiving 3DCRT definitive CCRT using 10MV or 6MV photon energy in our setting are comparable. Follow-up prospective studies to further characterise the application of these photon energies in resource constrained settings is recommended.

References:

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