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Setup Errors and Imaging Verification Protocols for Head and Neck Cancers Radiotherapy in Morocco

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Abstract:

The goal of this study, the first of its kind in Morocco, was to evaluate 3D set-up errors and to propose optimal margins for (Planning Target Volume) coverage in head and neck cancers. We investigated if others imaging frequency protocols were as effective as the daily one.

Keywords: Set up errors; PTV margin; Verification imaging protocol

Introduction:

The main goal of Radiotherapy (RT) planning is to deliver the prescribed dose to the target tissues while limiting the dose to nearby healthy organs “risk organs”, in order to increase the control of tumor growth and to minimize side effects [1]. RT of head and neck cancers HNC is a great challenge [2], because of the shape complexity and the proximity of the target and risk tissues.

Therefore, the evaluation of RT related errors or uncertainties, even undesirable, are an unavoidable step of the RT process. They are defined as the difference between the actual and intended position with respect to radiation delivery. Each set-up error consists of a systematic component, as well as a random component [3].

The coverage of target volume depends on the consideration of set- up errors in RT process, to prevent inadvertent irradiation of adjacent normal tissues or partial missing of target volumes. Planning target volume PTV that encompasses the clinical target volume CTV with some margins to account for such uncertainties in patient positioning, organ motion, and beam geometry is universally accepted today as the benchmark for RT dose This study, the first of its kind in Morocco, analysed the set- up accuracy, using the concept of systematic and random errors, of patients treated for HNC with daily imaging set- up verification, in order to generate the optimal CTV to PTV margins. Ninety eight percent of the set-up deviations were within 5 mm. Also The CTV- PTV margins, according to van Hersk formula, were within 5 mm in all three directions.

The measurement of set-up errors by portal imaging or on board imaging OBI system with kilovoltage Kv images is an accepted practice [6]. The radiation oncology community has performed such assessments in order to reduce PTV margins, particularly for high- precision radiotherapy [7]. It is recommended that every institution generate data on its set-up accuracy because of the experience of RT staff can have a great impact on daily positioning of patients [8].

Our study focused on the inter-fraction patient set-up uncertainties analysis using daily image guidance for patients treated for HNC with volumetric modulated arc therapy technique VMAT. The goal was to evaluate three- dimensional 3D set-up errors and to propose adequat margins for PTV coverage in head and neck RT. Also we investigated if other imaging frequency protocols were as effective as the daily imaging protocol.

Discussion:

In the published studies [1,8,14-20], the population systematic errors varied between 0.02-3.2 mm versus 0.24 mm in this study which can reflect a rigorous “treatment preparation”. In the other side, the population random errors were larger (5mm versus 0.4-2.9 mm). Thus, it was clear that set-up errors were attributed to random component, in other words, to “treatment execution”, which can be hopefully improved and reduced with training and practice experience.

There are several formulas to generate the optimal CTV to PTV margin; The ICRU 62 [5] supposes that random and systematic errors have the same contribution to the dose distribution, which is uncertain. Random errors blur the dose distribution whereas systematic errors are responsible of a dose distribution shift [21]. Others formulas use coverage probability matrices and dose population histograms; Stroom’s margin [10]

Conclusion:

This study is a report on the set-up accuracy of patients treating for HNC with Rapidarc. PTV margins calculated according van Herk formula range between 3.96 mm and 4.26 mm. We can conclude that a 5-mm extension of CTV to PTV margin can be enough to ensure that 90% of patients in the population receive a minimum cumulative CTV dose of at least 95% of the prescribed dose. It is suggested that before adopting any published margin recipe, factors that can potentially impact upon margins should also be taken into consideration to ensure adequacy of target volume coverage. The eNAL seems to be effective as verification imaging protocol; however more studies with much more data are needed to confirm this result. The Daily online verification protocol is the advised verification protocol for patients treated with IMRT

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