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Studi Teknik Penyinaran Radioterapi Adaptif: Evaluasi Dosimetri pada Pasien Tumor Otak = Study on Adaptive Radiotherapy Beam Delivery Technique: Dosimetry Evaluation in Brain Tumor Patients

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Abstrak

Penelitian ini bertujuan untuk mengevaluasi perhitungan dosis berdasarkan citra Cone Beam Computed Tomography (CBCT) pada pasien dengan diagnosa tumor otak. Perencanaan dan perhitungan dosis berdasarkan citra CBCT fraksinasi ke-16 yang dilakukan terhadap 13 pasien yang disinari menggunakan pesawat linac Elekta Versa HD dan 7 pasien yang disinari menggunakan pesawat linac Halcyon 2.0. Perencanaan dan perhitungan dosis dilakukan pada Treatment Planning System (TPS) Eclipse dan TPS Monaco. Hasil perhitungan dosis berdasarkan citra CBCT dibandingkan dengan citra Computed Tomography (CT) simulator. Penelitian ini memiliki beberapa tahapan, (1) kalibrasi Hounsfield Unit (HU) citra CBCT menggunakan fantom CIRS CT electron density 062M untuk melakukan perhitungan dosis di TPS dengan nilai HU yang sesuai, (2) proses pengumpulan data citra pasien yang memenuhi kriteria penelitian dan dilanjutkan dengan proses registrasi dan perencanaan citra CBCT, (3) analisis Dose Volume Histogram (DVH) untuk mengevaluasi kualitas perencanaan dengan parameter dosis yaitu Conformity Index (CI) dan Homogeneity Index (HI), (4) analisis dosis Organ at Risk (OAR) terhadap dose-constraint (batas dosis) untuk OAR batang otak, kiasma, sumsum tulang belakang, saraf optik, mata dan lensa. Nilai CI pada perencanaan berdasarkan CT tidak berbeda secara signifikan, Berdasarkan CBCT dari pesawat linac Elekta Versa HD diperoleh CI sebesar 0,05±0,21 (p=0,08) dan -0,01 ± 0,06 (p=0,02) berdasarkan CBCT dari pesawat linac Halcyon 2.0. Sementara itu, nilai HI pada perencanaan berdasarkan CBCT diamati berbeda secara signifikan terhadap CT, Berdasarkan CBCT dari pesawat linac Elekta Versa HD diperoleh HI sebesar 0,25 ± 0,43 (p=0,01) dan 0,08 ± 0,04 (p=0,01) berdasarkan CBCT dari pesawat linac Halcyon 2.0.

.....This research aims to evaluate dose calculations based on Cone Beam Computed Tomography (CBCT) images in patients diagnosed with brain tumors. Planning and dose calculations based on the 16th fraction of CBCT images were performed on 13 patients irradiated using Elekta Versa HD linear accelerator and 7 patients irradiated using Halcyon 2.0 linear accelerator. The planning and dose calculations were conducted using the Treatment Planning System (TPS) Eclipse and TPS Monaco. The results of the dose calculations based on CBCT images were compared with the Computed Tomography (CT) simulator images. The research comprised several stages: (1) calibration of Hounsfield Unit (HU) of CBCT images using CIRS CT electron density 062M phantom to perform dose calculations in TPS with appropriate HU values, (2) data collection of patient images meeting the research criteria followed by image registration and CBCT planning, (3) analysis of Dose Volume Histogram (DVH) to evaluate planning quality using dose parameters such as Conformity Index (CI) and Homogeneity Index (HI), (4) analysis of dose to Organs at Risk (OAR) against dose constraints for OARs such as brainstem, chiasm, spinal cord, optic nerves, eyes, and lenses. The CI values for the planning based on CT were not significantly different. Based on CBCT from Elekta Versa HD linear accelerator, the CI obtained was 0.05 ± 0.21 (p=0.08), and based on CBCT from Halcyon 2.0 linear accelerator, the CI obtained was -0.01 ± 0.06 (p=0.02). However, the HI values for planning based on CBCT significantly differed from CT. Based on CBCT from Elekta Versa HD linear accelerator, the HI

obtained was 0.25 ± 0.43 (p=0.01), and based on CBCT from Halcyon 2.0 linear accelerator, the HI obtained was 0.08 ± 0.04 (p=0.01).