

Adaptive Planning Berdasarkan Citra Cone Beam Computed Tomography (CBCT) = Adaptive Planning Based on Cone Beam Computed Tomography Images

Tarigan, Sonak Tioria, author

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Abstrak

Penelitian ini bertujuan untuk mengevaluasi akurasi perhitungan dosis berdasarkan citra Cone Beam Computed Tomography (CBCT) sebagai adaptive planning. Perencanaan terapi radiasi dilakukan terhadap 3 pasien kanker laring, 7 pasien kanker paru dan 5 pasien kanker prostat dengan menggunakan teknik Intensity Modulated Radiotherapy (IMRT) dan Volumetric Modulated Arc Therapy (VMAT). Perhitungan dosis dilakukan pada TPS Eclipse v13.6 dengan variasi algoritma Analytical Anisotropic Algorithm (AAA) dan Acuros External Beam (AXB).

Penelitian ini diawali dengan tahapan (1) kalibrasi HU citra CBCT menggunakan fantom CIRS 002LFC (2) analisa dose volume histogram (DVH), (3) analisa gamma index dengan kriteria DD 2% / DTA 2mm serta DD 3% / DTA 3mm menggunakan perangkat EPID. Penyimpangan $D_{98\%}$, $D_{50\%}$ dan $D_{2\%}$ dari DVH dievaluasi dengan menjadikan citra CT algoritma AAA sebagai referensi. Diperoleh nilai penyimpangan $D_{98\%}$, $D_{50\%}$ dan $D_{2\%}$ tertinggi pada kasus kanker laring yaitu sebesar $9,08\% \pm 2,21$ (CBCT AXBm - CT AAA), $0,74\% \pm 0,37$ (CBCT AXBw - CT AAA) dan $3,79\% \pm 0,55$ (CBCT AXBw - CT AAA). Penyimpangan $D_{98\%}$, $D_{50\%}$ dan $D_{2\%}$ pada kasus kanker paru dan kanker prostat diperoleh lebih kecil dari 2%. Conformity index (CI) diperoleh pada rentang $0,98 \pm 0,011$ dan homogeneity index (HI) diperoleh pada rentang $0,08 \pm 0,015$. Analisa gamma index dengan kriteria 2%/2mm diperoleh pada range 87% - 94% dan kriteria 3%/3mm diperoleh 93% - 99%. Dari hasil penelitian ini didapati bahwa hasil kalkulasi dosis berdasarkan citra CBCT hampir sama dibandingkan dengan citra FBCT sehingga citra CBCT dilihat layak digunakan sebagai adaptive planning radiotherapy.

The purpose of this study was to evaluate the accuracy of dose calculation based on Cone Beam Computed Tomography (CBCT) as adaptive planning. Treatment planning was generated for 3 patients larynx, 7 patients lung and 5 patients prostate using Intensity Modulated Radiotherapy (IMRT) and Volumetric Arc Therapy (VMAT). Eclipse v13.6 treatment planning system (TPS) with Analytical Anisotropic Algorithm (AAA) and Acuros External Beam (AXB) algorithm has been used to calculate the dose.

This study was divided into three major parts : (1) HU calibration for CBCT images by using CIRS phantom 002LFC (2) dose volume histogram (DVH) analysis, (3) analysis of Gamma Passing Rate with criteria DD 2% / DTA 2mm and DD 3% / DTA 3mm using EPID. The DVH analysis for $D_{98\%}$, $D_{50\%}$ dan $D_{2\%}$ deviation was evaluated and CT images with AAA algorithm used as reference. The highest deviation of $D_{98\%}$, $D_{50\%}$ dan $D_{2\%}$ was found for larynx cancer with value $9,08\% \pm 2,21$ (CBCT AXBm - CT AAA), $0,74\% \pm 0,37$ (CBCT AXBw - CT AAA) and $3,79\% \pm 0,55$ (CBCT AXBw - CT AAA).

Deviation of $D_{98\%}$, $D_{50\%}$ dan $D_{2\%}$ for lung and prostate cancer is less than 2%. Range of conformity index based on CBCT images is $0,98 \pm 0,011$ and homogeneity index is in the range of $0,08 \pm 0,015$. The gamma criteria of dose difference and dose to agreement for 2%/2mm are 87% - 94% and for 3%/3mm are 96% - 98%. From the result, we found that the difference of dose calculation based on CBCT images is almost similar to CT images, so CBCT images are proper to be used for adaptive planning.