Adaptive radiotherapy for H&N, breast and prostate cases: evaluation of CBCT dose calculation in order to trigger replanning

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Résumé

Introduction: Replanning during treatment course could be triggered to overcome anatomical variations appearing during radiotherapy. The aim of this study was to evaluate the uncertainty of CBCT dose calculation using a commercial tool compared to dose calculation on CT, and to analyse the need of replanning for H&N, breast and prostate RT.
Materials and Methods: 30 patients, 10 H&N (VMAT), 10 breast (IMRT Sliding Window) and 10 prostate (VMAT) were retrospectively included in this study. All patients had initial CT, replanning CT and CBCT (Halcyon, Varian) acquired the same day. Reference dose distributions were calculated on CTs, with Raystation v11B (Raysearch) TPS. Daily CBCT was acquired for all patients (protocols Head 100 kV and 139 mAs, Brest 125 kV and 301 mAs, Pelvis fast 125 kV and 592 mAs respectively). Virtual CT (vCT) was created from CBCT. First, uncertainty was estimated , comparing dose distributions on vCT and replanning CT. Then, a retrospective evaluation of replanning was performed, comparing initial dose planning calculated on initial CT and on vCT (from one CBCT during treatment course). Finally, an evaluation of dose distribution on vCT was realized for one H&N patient for the 33 treatment sessions. PTV coverage (V PTV 95%) and mean dose (Dmean) or maximum dose (D0.03cc) of main OARs were evaluated.

Results: A mean PTV dose coverage uncertainty of 1.1%, 1.3% and 1.7% for H&N, breast and prostate treatments was found between dose calculation on vCT and on replanning CT. Figure 1 presents dose differences between initial dose planning calculated on initial CT and on vCT. Taking into account dose uncertainty and dosimetric constraint for PTV coverage (V95%prescription $>$ 95% for H&N and prostate, V9D95%prescription $>$ 90% for breast), a replanning was justified for 13 patients (star symbols in Figure 1). Evaluation of dose distribution on vCT for one H&N patient shown an undercoverage of PTV as the third session (Figure 2). Replanning performed at the 21th session showed a coverage better or equal to 95% for the end of the treatment. OAR dose constraints was respected all along the treatment.
Conclusions: We validated the use of CBCT dose calculation with a mean dose uncertainty of 1.5% for H&N, breast or prostate. In this study, a dosimetric interest of replanning was found for 13/30 patients. The use of CBCT dose calculation to trigger a replanning will be deployed in the following months in our offline ART workflow.

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Mots-Clés: Radiotherapie adaptative, replanification, CBCT