Fully automated organs at risk delineation for brain tumor radiation planning in patients with glioblastoma using deep learning

Type: Clinical

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Purpose/objective(s): To evaluate, if fully deep learning (DL) based automated segmentation of organs at risk (OAR) within the brain in glioblastoma (GBM) patients is non-inferior to human rater segmentation for radiation planning.
Materials/methods: We included post-OP MRI datasets of 23 GBM patients. Manual segmentations of OAR were performed by 3 radiation oncologists on T1c MRI sequence. For fully automatic segmentation, we developed an OAR segmentation method. The MRI data was co-registered for automatic segmentation. Manual delineations were utilized for training the DL system based on the U-Net architecture. We evaluated the segmentation method on the results of a 6-fold cross-validation considering the imaging data of all patients in terms of dice-coefficient (DC) (volumetric overlap) and volume similarity (VS) using the Kruskal-Wallis test.
Results: Large distribution of DC and VS were observed for small OAR between the raters [(0.78, 0.12), (0.43, 0.13), (0.49, 0.12); Kruskal-Wallis test: chi-square = 43.80, $p = 0.001$] and the automatic method: [(0.00, 0.23), (0.00, 0.26), (0.00, 0.18); Kruskal-Wallis test: chi-square = 81.29, $p = 0.001$]. For larger OAR, no statistical difference was detected between volumes among raters (Kruskal-Wallis test: chi-square = 4.6, $p = 0.098$) [(0.91, 0.02), (0.91, 0.02), (0.89, 0.02)], and compared to the automatic segmentation: [(0.91, 0.02), (0.91, 0.01), (0.90, 0.02)].
Conclusion: Performance of this system is highly dependent on raters agreement. The higher the agreement, the better predicts the prototype the OAR within the brain. With this proof of concept study, we generate first promising results, and plan next steps to improve results.

Safety and efficacy of local irradiation in patients with metastatic melanoma treated with the CTLA-4 antibody ipilimumab

Type: Clinical

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Introduction: Potentially beneficial interactions of radiotherapy (RT) and the immune checkpoint inhibitor ipilimumab have been reported in patients with melanoma. Here we report on a retrospective study analysing the safety of concurrent radiotherapy with ipilimumab in patients with metastatic melanoma.
Methods: Thirty-two patients with metastatic melanoma treated with ipilimumab and receiving local RT at the University Hospital Basel were included in the trial. Eight Patients received ipilimumab and radiotherapy with a longer time difference than 3 months, irrespective of order of treatment. Because of the long time difference no additive toxicity of the two therapies were expected and these patients were classified as a control group. The radiation-related adverse events of the treatment group ($n = 24$) and control group ($n = 8$) were compared using Fisher's exact test.
Results: The mean cumulative dose of RT was 32.4 Gy (range, 5–62). Twenty-nine patients (90.6%) had acute toxicities in the irradiated area (grade 1/2). The statistical analysis using Fisher's exact test showed a significantly lower toxicity rate for "mucositis" ($p = 0.037$) in the treatment group. The patients were irradiated in different areas, which may have caused this surprising result. While the control group had two patients irradiated in a mucositis-associated area, the treatment group only had one patient with RT in a similar area. All other radiation-related adverse events, such as "skin toxicity", "gastrointestinal", "fatigue", "alopecia", "central nervous system" and "others" did not show any significant difference.
Conclusions: The treatment group did not show an increased radiation-related toxicity rate compared to the control group. The toxicity rates for concurrent radiation therapy were not higher than reported in the literature. We therefore conclude that ipilimumab does not substantially increase local side effects of RT.

MR-guided adaptive SBRT for prostate cancer: stability of adaptive planning analyzed by repetitive imaging

Type: Clinical

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Aims: Magnetic resonance-guided radiotherapy promises reduced toxicity for prostate cancer patients treated with stereotactic body radiotherapy (SBRT) by means of daily plan adaption. However, creation, adaption and quality assurance of a plan-of-the-day takes up to 60 min. To date, the anatomic changes during re-planning are not considered. We therefore performed repeat MR-imaging in healthy volunteers over 60 min to assess these changes.
Methods: We recruited 10 healthy male volunteers and created baseline SBRT prostate cancer plans for the MRIdian Linear Accelerator (Viewray Inc) of 36.25 Gy in five fractions. The prostate and the lower 1/3 of the seminal vesicles were delineated as the CTV with a 5 mm PTV margin (3 mm posteriorly). On a separate day, the original plan was re-planned online using MRI-guidance followed by repeated MR-scans in 15-minute-intervals: changes in dose to OARs and target coverage over time were analysed to investigate the stability of online re-planning.
Results: Here, we report the interim analysis of the first 5/10 volunteers. Online adaptive re-planning improved coverage of the $D_{95\%}$PTV_Prostate significantly by median of 8% (1–28%; $p = 0.04$). Based on the repetitive MR-imaging, the $D_{95\%}$CTV_Prostate coverage after 60 min was significantly reduced by median 8% (0–17% $p = 0.04$), whereas coverage of the adapted plan was not significantly decreased after 45 min (0–12% n. s.) or at earlier time points. D_{1cc}Rectum did not change significantly over 60 min. D_{Mean}Bladder decreased significantly with a