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Name (First, last) | Hans Ligtenberg
---|---
Mailing address (including province/state, country, postal/zip code) | UMC Utrecht
| Heidelberglaan 100
| 3508 GA Utrecht, Utrecht, The Netherlands
Institution/organization | UMC Utrecht
Position | PhD Candidate
Telephone (including country prefix) | 0031887569268
Email | h.ligtenberg@umcutrecht.nl

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PRESENTATION TITLE
Target volume delineation of laryngeal cancer using diffusion-weighted MRI validated by pathology: a case series

AUTHOR(S)

ABSTRACT

Purpose:
In radiotherapy treatment planning, tumor delineation based on diffusion weighted (DW) MRI is a promising technique. MR-only based target definition becomes important with the recent development of MRI integrated radiotherapy treatment modalities. In this case series, DW-MRI based gross tumor volume (GTV) was validated using histopathology and was compared with al GTV delineated by a radiation oncologist based on CT and MR imaging.

Materials & Methods:
This case series includes three patients with a laryngeal tumor. Prior to total laryngectomy (TLE), imaging was performed on CT and MRI, including a DW-MRI scan. After TLE, the surgical specimen was processed and cut into 3 mm thick slices. Tumor was delineated on hematoxylin-eosin (HE) stained sections by a pathologist (tumorHE). This pathological imaging, including the tumorHE delineation, was 3D reconstructed and registered to the imaging. GTV was defined manually based on CT and MRI (GTVclinical) and semi-automatically based on DW-MRI (GTVDWI).

Results:
The GTVDWI was more concise than the GTVclinical to the tumorHE in case I and case II (Figure 1). In case III, GTVDWI missed the caudal part of the tumor, due to a low and heterogeneous DWI signal of the tumor (Figure 2). This caudal part was included in the GTVclinical. The microscopic tumor extent outside the GTVDWI contour was 3.0 mm, 2.7 mm and 11.3 mm for case I, II and III respectively. The part of the tumorHE overlapped by the GTVs was 80%, 74%, and 31% (GTVDWI) and 73%, 72% and 89% (GTVclinical) for the three subsequent cases respectively.

Conclusions:
In this case series, we demonstrated that, with careful use, DW-MRI has potential for MR-guided radiotherapy treatment. DW-MRI based GTV delineation can be a fast alternative to manual delineation, which might speed up the online target definition using an MRI-linac system.
**Figure 1:** A transverse plane of the larynx tumor of case II. The delineations depicted are the histopathological determined tumor (tumorHE, green), the GTV delineation by a radiation oncologist (GTV\textsubscript{clinical}, orange) and the DWI based GTV delineation (GTV\textsubscript{DWI}, blue). The GTV\textsubscript{clinical} overestimated the tumor\textsubscript{HE}, whereas the GTV\textsubscript{DWI} more closely resembles the tumor\textsubscript{HE}, especially in the posterior part of the larynx where tissue was excluded from the tumor\textsubscript{HE} and from the GTV\textsubscript{DWI} but included in the GTV\textsubscript{clinical}. This region was enhanced in the MRI T2-weighted image, which indicates these regions can be excluded from the GTV\textsubscript{clinical}.

**Figure 2:** A transverse plane of the larynx tumor of case III. The delineations depicted are the histopathological determined tumor (tumor\textsubscript{HE}, green), the GTV delineation by a radiation oncologist (GTV\textsubscript{clinical}, orange) and the DWI based GTV delineation (GTV\textsubscript{DWI}, blue). The tumor is heterogeneous as can be seen from the HE-section, which is reflected in the other imaging, were the enhancement is inhomogeneous within the tumor. The GTV\textsubscript{DWI} does not overlap with the whole tumor\textsubscript{HE} because of the higher ADC values in a part of the tumor. The GTV\textsubscript{clinical} shows a good overlap with the tumor\textsubscript{HE}. The delineations do vary in shape between the various images, because of angulation of the HE-sections compared to CT and MRI.