Retrospective Dosimetry for Hepatocellular Carcinoma Radioembolization with Yttrium-90 Resin Microspheres Planned using Body Surface Area Method

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Aim

The body surface area (BSA) method has been the reference activity planning method in radioembolization for yttrium-90 (^{90}Y) resin microspheres for the last years. Today, interest is growing for personalized dosimetry with advanced tools similar to the ones used in external beam radiation therapy.

This study aims to retrospectively analyze tumor dosimetry for hepatocellular carcinoma (HCC) patients treated with an activity of ^{90}Y-resin microspheres planned by the BSA method.

Materials and Methods

Thirty-eight HCC patients (representing 44 different treatments) treated by radioembolization with ^{90}Y-resin microspheres (SIR-Spheres®, SIRTeX, North Sydney, Australia) were included in this study. Injected activity was planned using the BSA method. Personalized dosimetry was retrospectively performed using a dedicated software (PLANET® Dose, DOSIsoft, Cachan, France). Dose was computed using a convolution method based on voxel-S factors. This was done for both predictive and *in vivo* dosimetry respectively based on ^{99}Tc^{m}-MAA-SPECT and ^{90}Y-microspheres-PET images. 3D dose distribution was analyzed to the tumor delineated on the injected CT/MR beforehand. Objective response (OR) (either complete or partial response) was assessed three and six months after treatment using RECIST, mRECIST and EASL criteria.

Results

Administered activities calculated using the BSA method ranged from 0.29 to 2.59 GBq with a median of 1.17 GBq (for target volumes from 12 to 1787 cm^3). The mean (±SD) and median predicted doses to the tumor over the 44 treatments were 70 Gy (± 47) and 55 Gy respectively. The mean (±SD) and median absorbed doses to the tumor evaluated on ^{90}Y-PET images were 63 Gy (± 41) and 54 Gy respectively. This retrospective evaluation shows a large variability of dose values and they are in most cases lower than the recommended 120 Gy threshold for treatment efficacy. This might be explained by the fact that the BSA method is not based on functional imaging which takes into account tumor uptake.

Response rates were lower than 25% for any criteria used. The receiver-operating characteristic analysis was conducted in each case. Compared to the literature, the first results indicate low dose threshold values with a low significance due to the limited number of patients included and in particular of OR.

Conclusion

These results highlight that 3D personalized dosimetry could provide more controlled and reproducible dose planning compared to the BSA approach. Dose-volume histogram analysis is ongoing and is expected to provide more robust indices to characterize the predictive value of dose distribution heterogeneity within the tumor volume.