

The superior predictive value of ^{166}Ho -scout compared with $^{99\text{m}}\text{Tc}$ -macroaggregated albumin prior to ^{166}Ho -microspheres radioembolization in patients with liver metastases

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Background

Treatment planning for radioembolization of liver tumors is generally performed with technetium-99m-macroaggregated albumin ($^{99\text{m}}\text{Tc}$ -MAA) however, as an alternative, a scout dose of ^{166}Ho -microspheres (^{166}Ho) can be used prior to ^{166}Ho -radioembolization, which may improve the predictive value pre-treatment analysis of distribution

Objective

The aim of this study was to analyze whether the intrahepatic distribution of ^{166}Ho -scout has a better agreement with the ^{166}Ho -therapeutic dose distribution when compared with $^{99\text{m}}\text{Tc}$ -MAA

Methods

All patients treated in phase 1 and phase 2 Holmium Embolization Particles for Arterial Radiotherapy (HEPAR) studies were analyzed. These patients had unresectable liver metastases from various primaries (Fig. 1)

Two separate scout dose procedures were performed ($^{99\text{m}}\text{Tc}$ -MAA and ^{166}Ho -scout) before treatment with ^{166}Ho -radioembolization in 53 patients, a total of 55 procedures

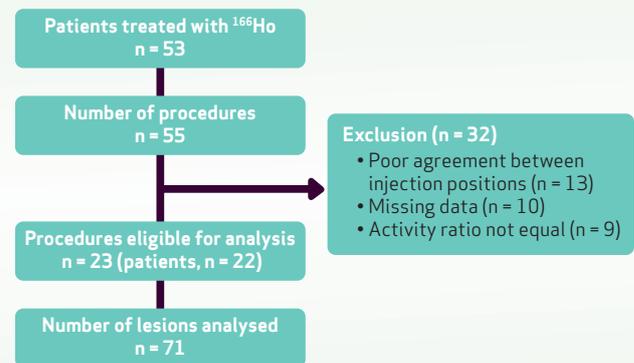


Fig 1: Inclusion flowchart of patient data

- 150 MBq $^{99\text{m}}\text{Tc}$ -MAA (0.8mg, approximately 1.8 million particles TechneScan LyoMAA: Mallinckrodt Medical B.V., Petten, the Netherlands) was administered. Followed by planar- and SPECT/CT imaging to check for extrahepatic deposition and excessive lung shunting ($>30\text{Gy}$). If no contraindications presented, the patient was scheduled for treatment 7 days later
- A **scout dose of ^{166}Ho -microspheres** (consisting of approximately 3 million microspheres with an activity of 250MBq) was administered on the morning of the same day of treatment followed by planar- and SPECT/CT imaging
- Total **treatment activity** with ^{166}Ho was planned based on aimed whole liver absorbed dose of 20, 40, 60 and 80Gy for HEPAR 1 patients, and 60Gy for HEPAR 2 patients
- All injections were performed with a standard 2.4F or 2.7F microcatheter (Progreat®, Terumo, Japan)

Exclusion of cases where differences in injection positions might have influenced distribution, was determined independently by 3 observers, using a 4-point scale. As a result, a total of 23 procedures (71 lesions, 22 patients) were included for analysis

Two blinded nuclear medicine physicians performed the **qualitative assessment** by visually rating the agreement between the ^{99m}Tc -MAA, ^{166}Ho -scout, and ^{166}Ho -therapeutic dose SPECT-scans (i.e. all performed in the same patient) on a 5-point scale

Agreement of the intrahepatic distribution was measured quantitatively by delineating lesions and normal liver on FDG-PET/CT. These volumes of interest (VOIs) were co-registered to the SPECT/CT images. The predicted absorbed doses (based on ^{99m}Tc -MAA and ^{166}Ho -scout) were compared with the actual absorbed dose on post-treatment SPECT

Results

Qualitative analysis: In 15 procedures shown ^{166}Ho -scout was superior, in 5 procedures MAA was superior and in 3 procedures there was no difference. As a result ^{166}Ho -scout was superior with a median score of 4 vs 2.5 for ^{99m}Tc -MAA ($p < 0.001$) (Fig. 2)

Quantitative analysis: ^{166}Ho -scout performed significantly better with significantly narrower 95%-limits of agreement compared with ^{99m}Tc -MAA when evaluating lesion absorbed dose (-90.3 and 105.3 Gy vs -164.1 and 197.0 Gy respectively)

Evaluation of normal liver absorbed dose did not show a statistically significant difference in agreement between both scout doses and ^{166}Ho -therapeutic dose

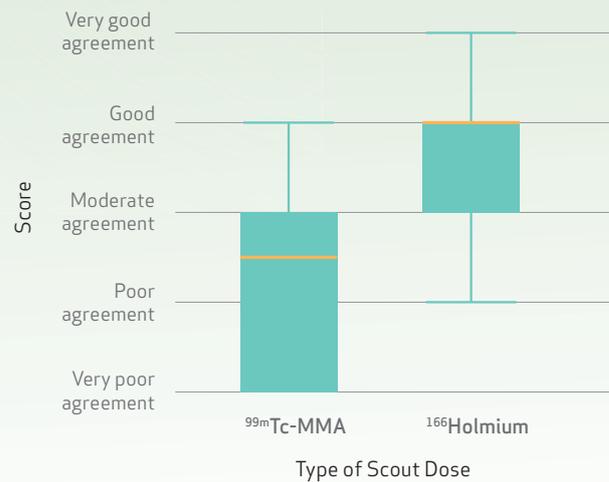


Fig. 2: Box plot. Scores of the overall agreement between both ^{99m}Tc -MAA and ^{166}Ho -scout and ^{166}Ho -therapeutic dose of all 23 procedures are plotted in a box plot. Median and interquartile lines are indicated. Holmium scout dose performs significantly better than ^{99m}Tc -MAA ($p < 0.001$)

CONCLUSION

^{166}Ho -scout has shown to have a superior predictive value for intrahepatic distribution in comparison to ^{99m}Tc -MAA prior treatment with ^{166}Ho -radioembolization

Key Takeaway

- Use of ^{166}Ho -scout dose can improve treatment planning for ^{166}Ho -radioembolization in comparison to ^{99m}Tc -MAA prior treatment with ^{166}Ho -radioembolization