

Introduction

The purpose of this educational exhibit is to review the unique physical and imaging properties of Holmium-166 (Ho-166) microspheres, and examine their clinical advantages and ongoing research in the treatment of hepatocellular carcinoma (HCC) using transarterial radioembolization (TARE).

Methods

We conducted a literature review of key differences between Ho-166 and traditional Y-90 microspheres including emission characteristics, imaging capabilities, and dosimetry. We assessed prospective, retrospective, and early-phase clinical trial data

Ho-166 Planning

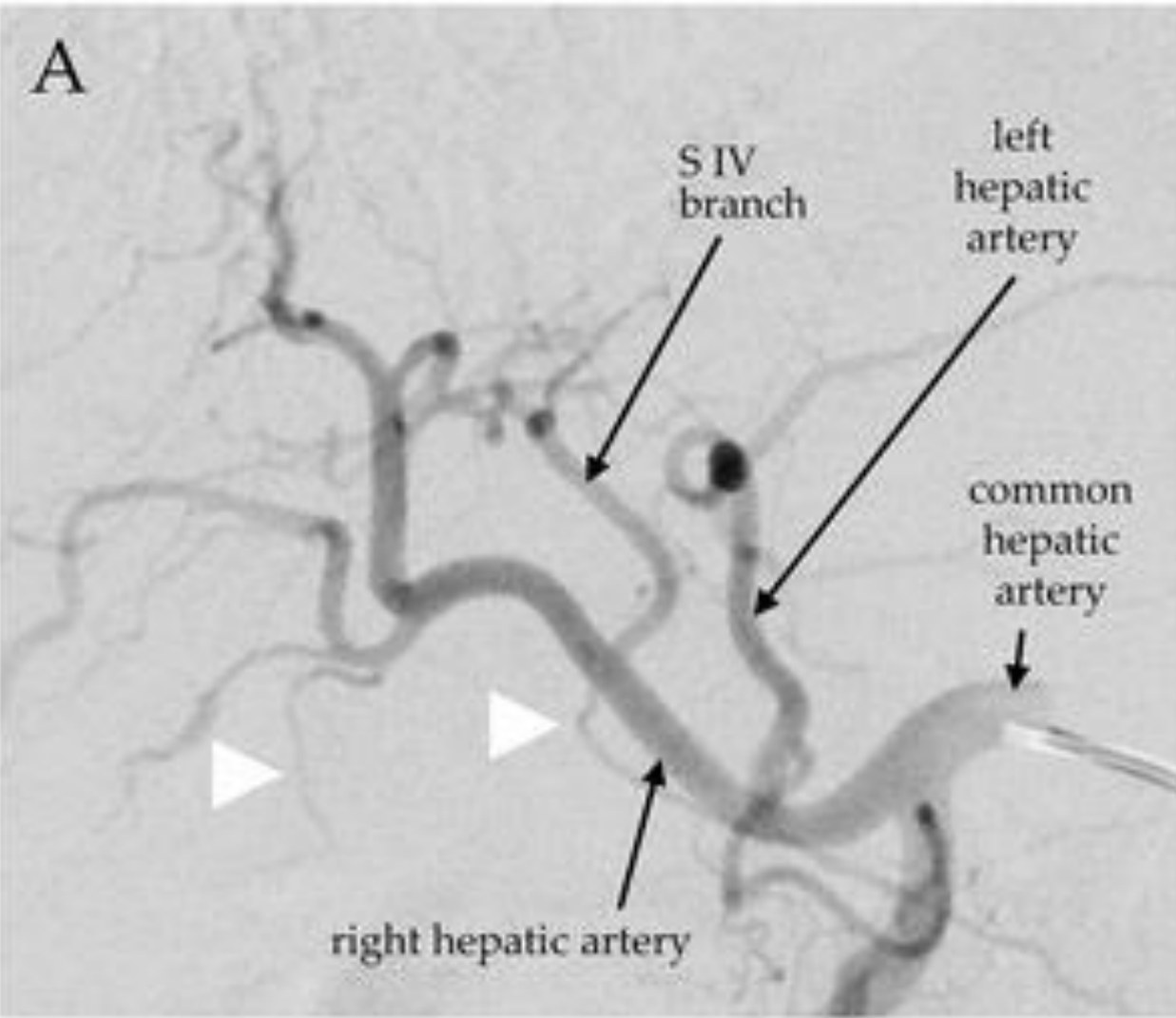


Figure and caption adapted from Drescher et al., Biomedicines 2023

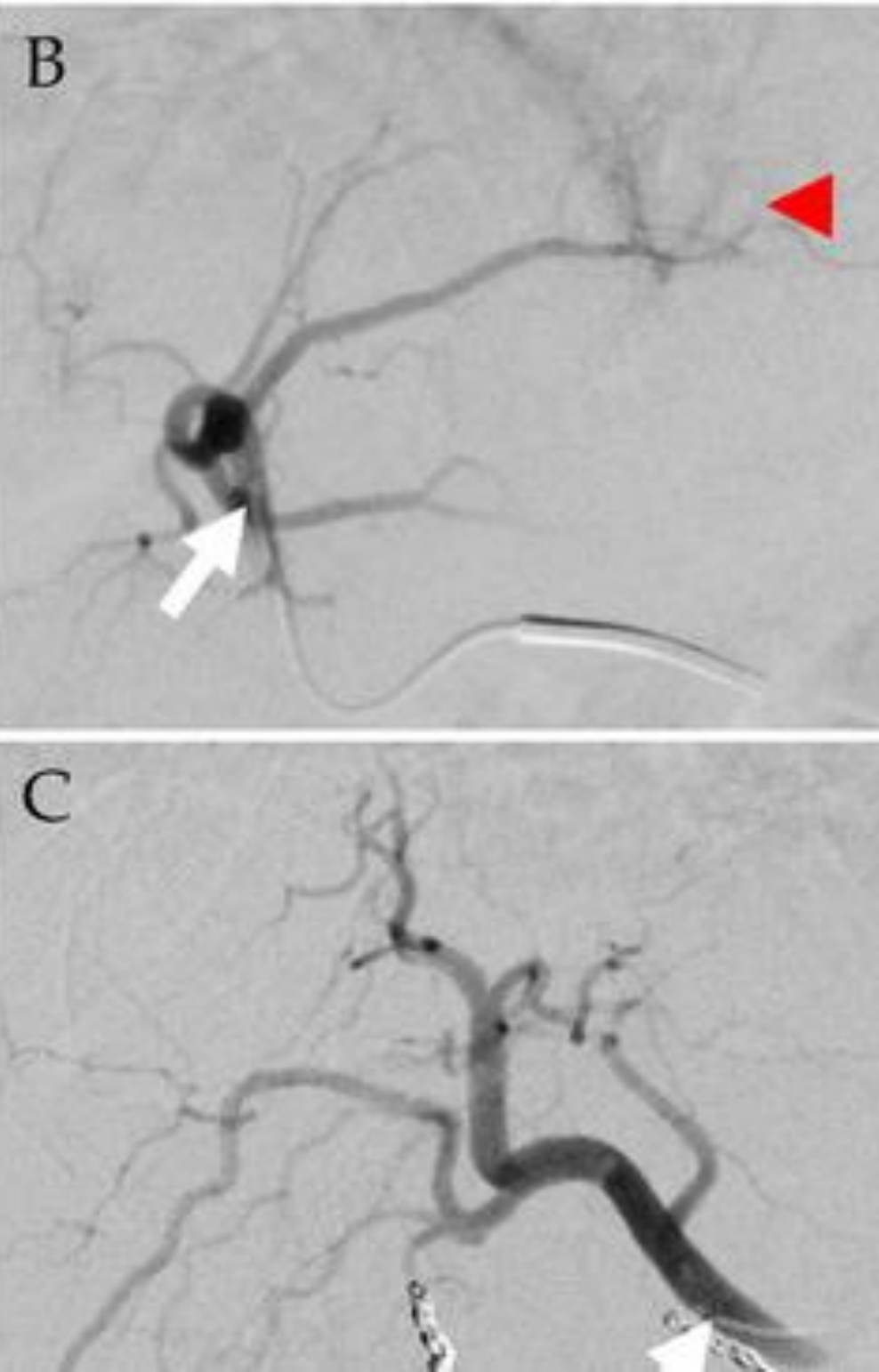


Figure 1. Patient #10, a 77-year-old man with HCC stage II. Pre-therapeutic hepatogram, catheter in the common hepatic artery (A). 166Ho-TARE of the left liver lobe was performed first, from a catheter position in the left hepatic artery ((B), arrow). Some tumor blush is seen corresponding to the lesion in seg. II ((B), arrowhead). Before treatment of the right liver lobe, the cystic artery and the aberrant right gastric artery ((A), arrowheads) were coil-embolized to prevent extrahepatic microsphere distribution. 166Ho-TARE was then performed from a relatively proximal catheter position in the right hepatic artery ((C), arrow), including the branch supplying the tumor lesion in segment IVa.

Results

Clinical studies of Holmium-166 TARE demonstrate encouraging efficacy in hepatocellular carcinoma, while highlighting the added value of real-time imaging and personalized dosimetry. Key outcomes from prospective and phase II trials, along with emerging dosimetry insights, are summarized below

Kühnel et al. J Pers Med. 2024	Disease control rate: 81.8% • Median OS: 17.2 months • Median PFS: 11 months
Drescher et al., Biomedicines 2023	Objective response: 54% at 3 months • Median OS: 14.9 months
Reinders et al., Eur J Nucl Med Mol Imaging 2025	90% tumor response= 155Gy 100% tumor response= 184Gy

Ho-166 Treatment

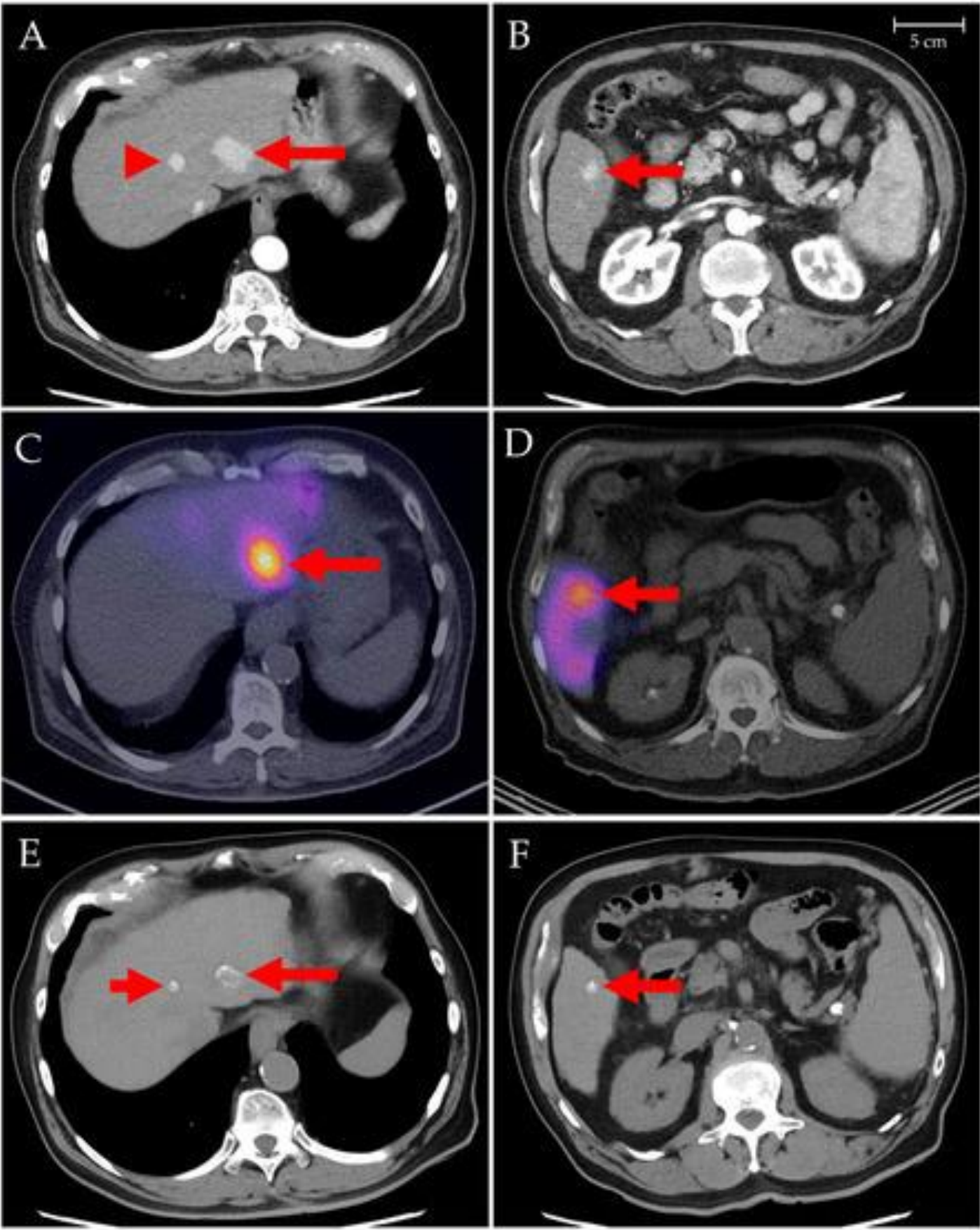


Figure and caption adapted fromDrescher et al., Biomedicines 2023

Figure 2. Patient #10. The contrast-enhanced CT showed multiple hypervascularized lesions in both liver lobes, the largest in segments II ((A), arrow) and V ((B), arrow). The small lesion was in segment IVa ((A), arrowhead). SPECT/CT fusion images after left-lobar (C) and right-lobar (D) 166Ho-TARE procedures show distinct microsphere accumulations in the lesions (arrows). Follow-up CT after 3 months revealed complete tumor remission, with lesions decreased in size and without contrast enhancement. Irregular hyperdensities, corresponding to the microsphere accumulations, were noted on non-contrast CT ((E,F), arrows).

Ho-166 Treatment

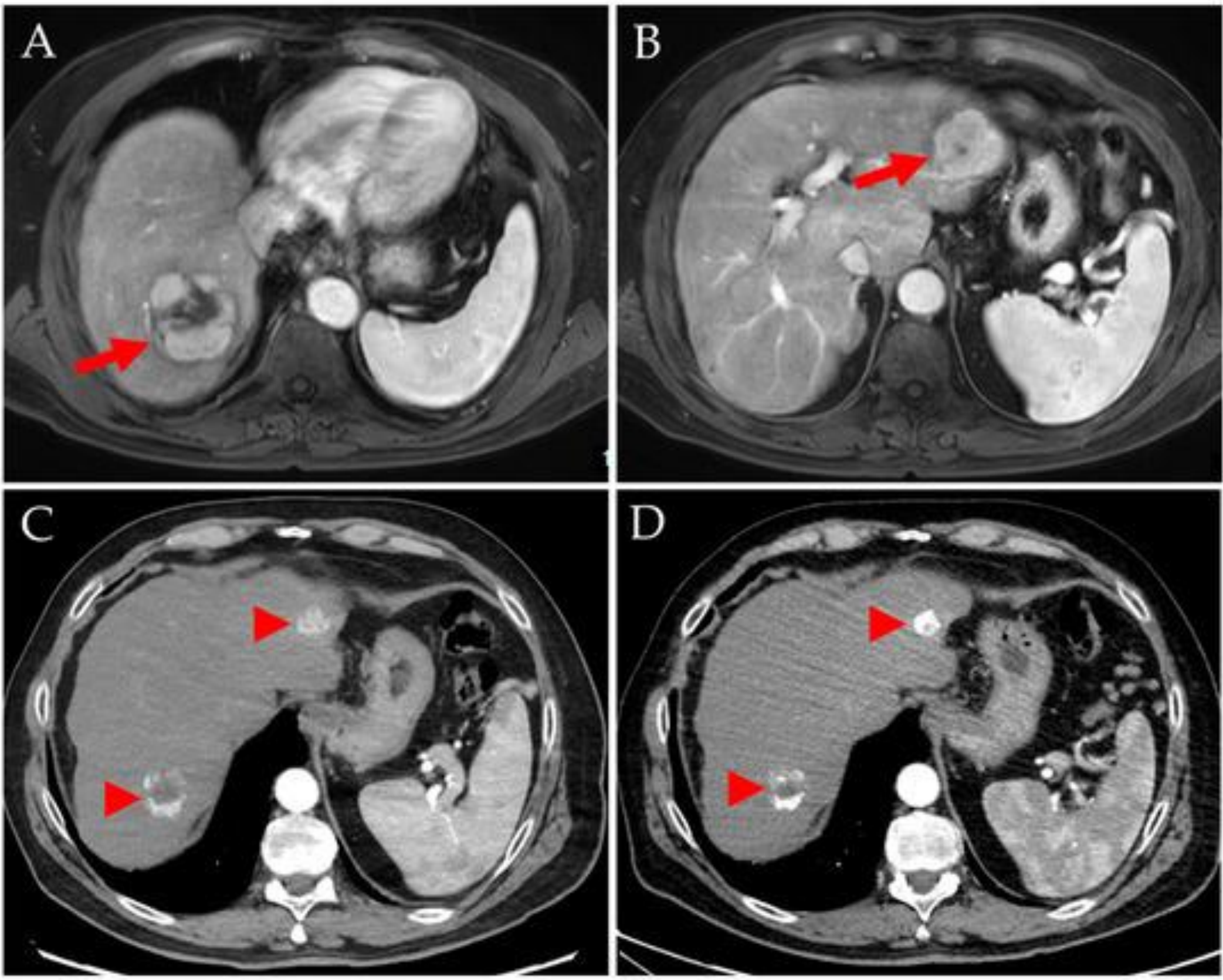


Figure 5. Complete remission after bilobar sequential TARE treatment of a 68-year-old man with HCC stage IIIA, MR imaging (A,B; T1-weighted fat-saturated sequence with contrast enhancement) shows multiple hypervascular lesions with a diameter of up to 5.3 cm (A, arrow). A follow-up CT scan 3 months after TARE revealed complete remission of all lesions according to the mRECIST criteria (C, arrowheads), the largest lesion measuring 2.8 cm. Further shrinkage was observed after another 4 months (D). The hyperdense areas in the regions of highest microsphere density are a typical finding after 166Ho-TARE.

Discussion

- **Theranostic advantage:** Holmium-166 microspheres enable real-time, quantitative SPECT/CT and MRI-based dosimetry: capabilities that are not available with Y-90 radioembolization
- **Encouraging Clinical Outcomes:** Phase II and prospective studies show Ho-166 TARE achieves meaningful disease control and overall survival in HCC, with favorable response rates compared to established therapies
- **Future directions:** Ongoing work should refine optimal dose thresholds, integrate Ho-166 with immunotherapy and ablation, and validate benefits in larger multicenter trials

References

Kühnel C, Köhler A, Brachwitz T, Seifert P, Gühne F, Aschenbach R, Freudenberg R, Freesmeyer M, Drescher R. Clinical Results of Holmium-166 Radioembolization with Personalized Dosimetry for the Treatment of Hepatocellular Carcinoma. J Pers Med. 2024 Jul 14;14(7):747. doi: 10.3390/jpm14070747. PMID: 39064001; PMCID: PMC11278198.

Drescher R, Köhler A, Seifert P, Aschenbach R, Ernst T, Rauchfuß F, Freesmeyer M. Clinical Results of Transarterial Radioembolization (TARE) with Holmium-166 Microspheres in the Multidisciplinary Oncologic Treatment of Patients with Primary and Secondary Liver Cancer. Biomedicines. 2023; 11(7):1831. <https://doi.org/10.3390/biomedicines11071831>

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