**Supplement Material**

*CT-guided high dose-rate brachytherapy.* iBT was performed following the recommendation guidelines described elsewhere (20-22). Briefly, patients received ablation under conscious sedation (midazolam and fentanyl) and local anesthesia (lidocaine). A 6F angiographic sheath was inserted percutaneously into the lesion under CT-fluoroscopy, then a closed-end 6F brachytherapy catheter was put through the sheath. For further treatment planning on a 3D radiation planning workstation, the catheter was depicted in relation to the tumor on a CECT scan (arterial phase [15 s after injection] with primary slice thickness of 0.625 mm and reconstructed slice thickness of 5 mm). The clinical target volume was manually segmented on these planning scans with the general intention to ablate each lesion with a tumor enclosing target dose of 20 Gray using an iridium-192 source. Adjacent structures at risk (such as stomach or duodenum) were manually marked and their dosages were calculated. Where necessary, overall dosage was modified due to large tumor volume or where adjacent structures were at risk of high exposure according to Collettini et al (8).

*Conventional transarterial chemoembolization.* cTACE was performed using 5cc of chemotherapy (50 mg doxorubicin in 2.5 cc and 10mg of mitomycin-C in 2.5 cc) mixed 1:2 with Lipiodol (approximately 10 cc; Guerbet, Villepinte, France), resulting in a total of approximately 15cc. The emulsion was created as previously described and titrated to the tumor burden. A sheath is placed in the common femoral artery, and a microcatheter is placed into the common hepatic artery. Subsequently, a microcatheter is advanced into the tumor feeding artery or as closely to the tumor as possibly using a guidewire under image guidance. Eventually, the emulsion was administered under digital subtraction angiography, followed by injection of Gelfoam to achieve blood flow stasis as the angiographic endpoint.

*Sequential treatments.* Sequential treatments were performed, when the patient had multifocal or large lesions at baseline to avoid adverse effects from tumor lysis or to reduce cumulative puncture risk at the discretion of the interventional radiologist. A treatment was considered completed when all target lesions determined at baseline were completely irradiated with the target dose of 20 Gray at iBT and/or when the tumoral Lipiodol uptake was homogenously distributed within the whole tumor mass during cTACE.

*MRI protocol.* MRI scans were either acquired on 1,5-Tesla-scanners (Avanto and Aera), or a 3-Tesla-scanner (Skyra; all scanners from Siemens, Erlangen, Germany) using an eight-channel body phased-array coil. The standard imaging protocol included breath-hold unenhanced and contrast-enhanced T1-weighted imaging (VIBE and in-phase/opposed-phase FLASH) as well as T2-weighted imaging (HASTE and TSE) and diffusion-weighted imaging (DWI) with apparent diffusion coefficient (ADC) map. For the dynamic contrast-enhanced sequences a hepatocyte-specific contrast agent (0,1 ml/kg intravenous Primovist; Bayer, Leverkusen, Germany) was applied. The dynamic contrast-enhanced sequences including arterial, portalvenous, venous and hepatobiliary phase (15, 50, 90 seconds and 20 minutes after contrast administration) were acquired in the axial plane covering the entire liver with 60-72 slices and an adjusted field of view of 255 - 300mm x 340 - 400mm (TR 4.26ms, TE 1.87ms, flip angle 10°, slice thickness 3mm, matrix size 256x127). Images were evaluated using Visage PACS client version 7 (Visage Imaging).

*Semantic Imaging Features.* Semantic imaging features included 1-2) the presence/absence of vessels in arterial phase and portalvenous phase, respectively, 3) homogenous/irregular tumoral enhancement pattern in arterial phase, 4-5) presence/absence of a perilesional arterial phase and hepatobiliary phase enhancement/deficiency, respectively, 6) smooth/non-smooth tumor margin in venous phase, 7) homogenous/irregular tumor capsule in venous phase, 8-9) relative arterial/protalvenous phase enhancement score (= tumoral intensity values in arterial/portalvenous phase - *t*umoral intensity values in non-enhanced T1-weighted imaging devided by tumoral intensity values in non-enhanced T1-weighted imaging), and 10-12) tumor-liver ratio in hepatobiliary phase, diffusion-weighted imaging and ADC-maps (tumoral intensity values in the respective phase devided by liver parenchyma intensity values in the respective phase).

*Overall survival*

OS was defined on a patient level as the time between the date of the *first* completed treatment cycle and the date of death. Patients were censored if they received orthotopic liver transplantation (OLT) or any additional therapy to the HCC target lesion, and if they were lost to follow-up or alive at the end of follow-up.

*Progression-free survival.* PFS was defined on a patient level as the time between the date of the *first* completed treatment cycle and the date of death or the occurrence of any type of intra- or extrahepatic tumor progression. Patients were censored if they received orthotopic liver transplantation (OLT) or any additional therapy to the HCC target lesion, if they were lost to follow-up or if they were alive at the end of follow-up without any tumor progression.

*Time-to-progression.* TTP was calculated on a tumor level and defined as the time between the date of *any* completed treatment cycle and the occurrence of any type of tumor progression. Patients were censored if they received OLT or any kind of additional therapy, or if they were lost to follow-up or have died, or if they were alive at the end of follow-up without any tumor progression.