Abstract

Purpose: Transarterial chemoembolization (TACE) and radiofrequency ablation (RFA) are common treatments for hepatocellular carcinoma (HCC). Tumor staging, post-treatment surveillance and complications are performed with CT or MR. The purpose of this exhibit is to describe the expected and unexpected CT and MR imaging findings following HCC treatment.

Content: 1. Brief overview of TACE and RFA treatment methods. 2. Normal post-treatment appearance on CT and MR, including examples of coagulative necrosis, cavitation, and adjacent inflammatory change. 3. Common treatment complications using CT and MR case examples. 4. Appearance of residual and recurrent HCC, with examples of tumor along margin of ablation cavity as well as distant disease. 5. Appropriate timeline for treatment imaging follow-up.

Major teaching points: Knowledge of normal appearance after TACE and RFA for HCC treatment is critical for accurate differentiation of expected findings from complications or residual/recurrent tumor. Our exhibit will familiarize the reader with normal and abnormal post-treatment imaging findings using CT and MR.

Introduction

While liver transplant and surgery remain the gold standard curative treatment methods for hepatocellular carcinoma (HCC), image-guided percutaneous and transarterial treatments increasingly play a role in patient management [1, 2]. These minimally invasive techniques can serve as curative treatment for non-transplantable or non-resectable tumor, a bridge to transplant, or palliation.

Treatment methods

The two most commonly used treatments are radiofrequency ablation (RFA) and transarterial chemoembolization (TACE).

RFA involves placing a multipolar needle electrode into the tumor using either CT or US guidance. An alternating current passed through the electrode coagulates a zone of normal tissue, resulting in heating and coagulative necrosis. Tumor cell death can be suboptimal if the tumor abuts a blood vessel, which acts as a heat sink.

TACE takes advantage of the fact that HCCs are predominantly supplied by hepatic arteries, rather than portal veins like normal liver tissue. The artery feeding the tumor is sub-selected and injected with chemotherapeutic agent such as doxorubicin or cisplatin. The agent can be suspended in indoloid oil (lipiodol), which is preferentially retained in tumor tissue due to the lack of Kupffer cells [1]. After chemotherapy injection, embolization agents such as microspheres are used to block blood supply to the tumor. Alternatively, drug eluting spheres can be injected, which have a dual role of chemotherapy delivery system and embolization agent: More recently, injection of the radioactive agent Y-90 and anti-angiogenic agent sorafenib have also been utilized in treating HCC [2].

RFA can be effectively used alone for small tumors (<3 cm) in patients who are not candidates for surgery or as a bridge to transplantation. TACE is recommended as non-curative therapy for nonsurgical, non-transplantable patients with large or multifocal tumors who do not have extraparenchymal or vascular invasion [2, 3]. At our institution, a 2-day combination approach of TACE on day 1 and RFA on day 2 is often utilized. The effect of chemotherapy is likely enhanced with the addition of heat. Additionally, the lack of arterial supply after TACE may dampen the heat sink effect, improving RFA tissue heating [1]. Combination therapy may dampen recurrence and improve survival compared to single therapy, however this is controversial [5].

Follow-up and normal findings

CT and MRI are both used for following patients after RFA and TACE. While it has been suggested that MR is more sensitive and specific in assessing for recurrent tumor, there is no definite consensus on which modality is superior [3, 4]. Commonly used imaging exams vary; a typical schedule may include scan at 1 month to establish baseline, followed by scans every 3-6 months for a year, and annually thereafter. Follow-up at 1 week may also be considered to evaluate for immediate complications and gross residual tumor: The following are expected findings after RFA and TACE.

RFA. Tissue necrosis due to RFA ablation will result in a cavity in the location of the tumor. The cavity diameter should be about 0.5-1 cm larger than the original tumor, with the goal of preventing recurrence by eradicating any peripheral microscopic tumor foci. On both CT and MR images the internal cavity attenuation/signal will be heterogeneous, particularly in the first several weeks, due to proteinaceous material and blood product. However, there should not be any enhancement within the cavity [1, 4, 5]. Small foci of gas may be present internally for several days (Fig 5), prior to persistent gas should be suspicious for abscess (Fig 6, 7) [5]. On subsequent follow-up imaging, the cavity will attain a more homogeneous hyperintense T1, hypointense T2 signal, reflecting coagulative necrosis (Fig 1). Occasionally, T2 hyperintensity due to liquefactive necrosis may be present internally. A rim of mild, peripheral enhancement and edema, indicating inflammation and granulation tissue, are also expected findings and may persist for up to 3-6 months (Fig 1) [1]. Arterio-portal shunts caused by either needle puncture or thermal effects will appear as wodgel shaped areas of enhancement around the cavity; these usually decrease in prominence by 30 days.

TACE. Findings after TACE are similar to those described for RFA, including a necrotic cavity lacking central enhancement and peripheral inflammatory change. If iodized oil is used as suspension for chemotherapy, accumulation of this high attenuation substance in the tumor will act to increase its opacity on CT (Figs 8, 9). Faint accretion, partial defects, or washout of oil on follow-up exam should be evaluated with suspicion. As this may represent residual or recurrent tumor since iodized oil does not affect MR signal, MR may allow more accurate evaluation in these cases [1].

Recurrent and complications

Post-contrast images, particularly in arterial phase, are key in detecting residual or recurrent tumor. Any nodular, focal enhancement in the ablation cavity or around it is suspicious (Fig 5). The characteristic washout pattern of HCC is often lacking. Moderate T2 hyperintensity of recurrent tumors in contralateral hepatocellular coagulative necrosis, may also be a helpful finding [1]. Small, ill-defined peripheral enhancing foci can often be difficult accurately characterize; short-term follow-up should be utilized in these cases to evaluate for interval growth. Less commonly, recurrence may appear as a thin halo of enhancement around the cavity or gross cavity enlargement.

Major complications related to RFA and TACE include hemorrhage (Fig 5), infection (Fig 6, 7), biliary injury (Fig 8). RFA tract tumor seeding (Fig 4), diaphragmatic injury, pneumonia, and hepatic infarction [1, 6].

Conclusion

CT and MR play an important role in post-treatment surveillance after RFA and TACE. Familiarity with normal findings is important for accurate differentiation of expected findings from complications or residual/recurrent tumor.

References: