Descriptive Analysis of Liver MR Enhancement Following Various Chemoembolization Techniques in Patients with Hepatocellular Carcinoma

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Abstract

Objectives:
•Interpret MRI findings for various transarterial chemoembolization (TACE) modalities including small (75-150um) LC beads, large (100-300um) LC beads, embospheres, and bland.
•Qualitatively describe unique MRI findings specific to each TACE modality including patterns of enhancement, diffusion, and capsular involvement.
•Compare and contrast MRI to CT findings.

Methods:
We will describe the various treatment options available for HCC with a specific emphasis on TACE including drug-eluting beads, embospheres, and bland embolization. Special features that one should look for on MR for pretreatment planning will be discussed. We will compare and contrast enhancement patterns, diffusion findings, and the presence or absence of infiltrative characteristics in the lesion and surrounding parenchyma post-TACE following various chemoembolization techniques.

Results:
Descriptive analysis of unique MR findings seen on follow-up imaging at 1-2 months and 4-6 months post TACE via small (75-150um) LC beads, large (100-300um) LC beads, embospheres, or bland embolization will be presented. We will briefly review mRECIST criteria and discuss how the imaging findings vary over time for each TACE modality.

Discussion:
There have been many studies that have described imaging characteristics of post-TACE treatment on CT. However, no such characteristics have been established for MR. By comparing and contrasting post-treatment MRs from various methods of chemoembolization, we hope to define characteristics that are unique on MR to more accurately assess response and ultimately improve patient outcomes.

Background

Hepatocellular carcinoma (HCC) is the fifth most common type of cancer, and the third most common cause of cancer related deaths in the world. The survival rate for HCC is dismal with an overall 5-year survival rate of less than 10% secondary to limited treatment options. While transplantation and resection are curative measures, most patients with advanced stage disease are poor surgical candidates. Locoregional therapy with transarterial chemoembolization (TACE) offers the best survival for patients with unresectable tumor or multifocal disease.

The liver is unique in that it has a dual blood supply getting 75% from the portal vein and 25% from the hepatic arteries. TACE takes advantage of this property by specifically targeting tumor through the hepatic arteries while minimally impacting the liver's synthetic function. There are several TACE modalities used in clinical practice which include small drug-eluting beads, large drug-eluting beads, embospheres, and liquid. Currently, the most commonly used method of TACE involves drug-eluting beads which are biocompatible carriers that slowly elute doxorubicin over a 7 day period.

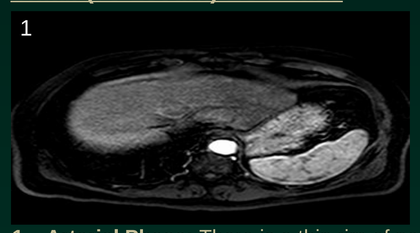
Typically, follow-up imaging with either CT or MR is performed at 1-2 month and 4-6 month intervals status post TACE to evaluate tumor response to treatment and identify residual tumor. The modified response evaluation criteria in solid tumors (mRECIST) has been utilized to assess lesion response after TACE on both CT and MR. mRECIST uses four categories to classify lesions post TACE which include complete response, partial response, stable disease, or progressive disease.

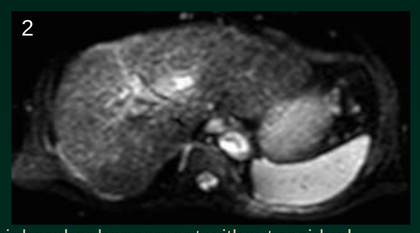
While mRECIST provides a broad generalization for characterizing tumor response, there continues to be lack of research that describes specific imaging changes on MR associated with each TACE modality at interval follow-up. Oftentimes, post TACE findings on MR tend to overlap and may overshadow the progression of HCC making it difficult to determine if residual tumor or recurrence is present. This can drastically affect patient care.

In this study, we plan to describe MR findings at 1-2 month and 4-6 month intervals post TACE for patients treated either with small (75-150um) LC beads, large (100-300um) LC beads, embospheres, or bland embolization.

MR Findings 1 - 2 Months Post TACE

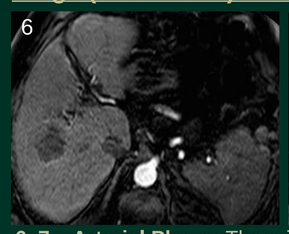
Small (75-150um) LC Beads

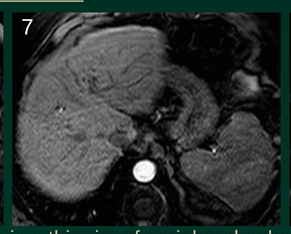


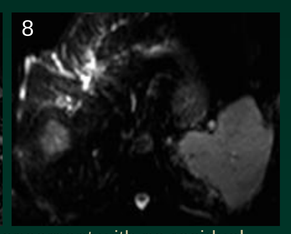


1 – Arterial Phase: There is a thin rim of peripheral enhancement without residual tumor. There are no scattered areas of peripheral parenchymal enhancement. There is no periductal enhancement or capsular retraction.
2 – DWI: Restricted diffusion is present.

Large (100-300um) LC Beads

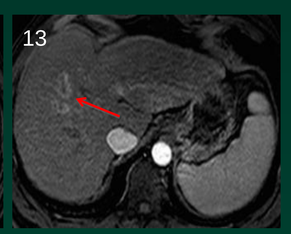


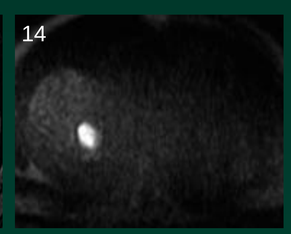




6, 7 – Arterial Phase: There is a thin rim of peripheral enhancement with no residual tumor. There is no scattered parenchymal enhancement, capsular retraction, or periductal enhancement.
8 – DWI: Restricted diffusion is present.

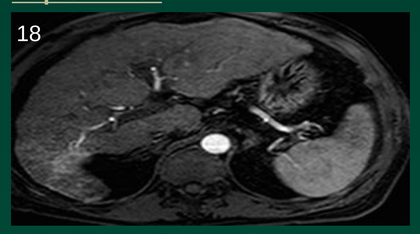
Embospheres

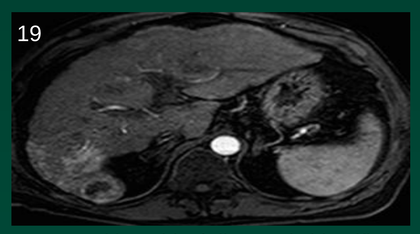




12, 13 – Arterial Phase: There is a thin rim of peripheral enhancement with no residual tumor. Periductal enhancement is present (red arrow). There is no scattered parenchymal enhancement or capsular retraction.
14 – DWI: Restricted diffusion is present.

Liquid TACE

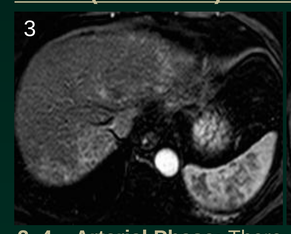


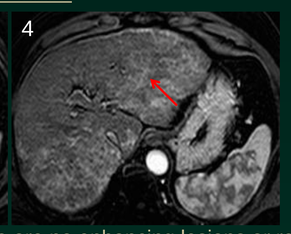


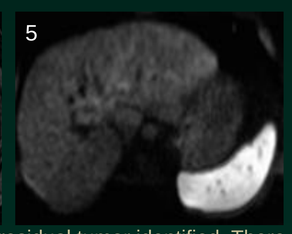
18, 19 – Arterial Phase: Thick nodular enhancement with residual disease is identified. There is scattered heterogeneous parenchymal enhancement. Periductal enhancement is noted. There is no capsular retraction or restricted diffusion.

MR Findings 4 - 6 Months Post TACE

Small (75-150um) LC Beads

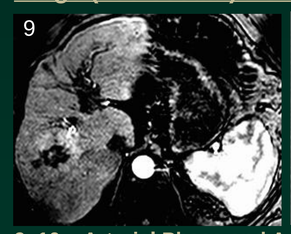


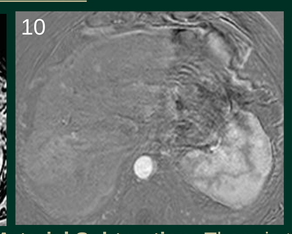


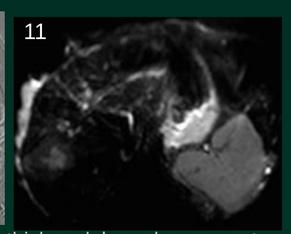


3, 4 – Arterial Phase: There are no enhancing lesions or residual tumor identified. There are scattered areas of parenchymal enhancement. There is periductal enhancement (red arrow), but no capsular retraction.
5 – DWI: No restricted diffusion is identified.

Large (100-300um) LC Beads

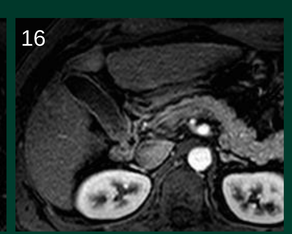


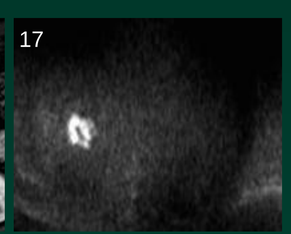




9, 10 – Arterial Phase and Arterial Subtraction: There is thick nodular enhancement with residual tumor. There is no scattered parenchymal enhancement, periductal enhancement, or capsular retraction.
11 – DWI: Restricted diffusion is present.

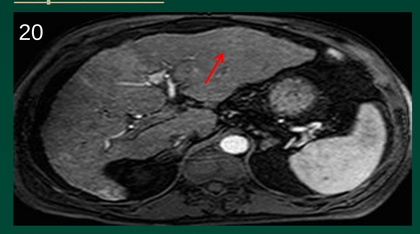
Embospheres

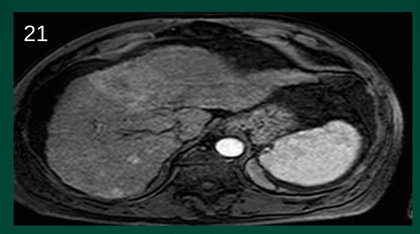




15, 16 – Arterial Phase: There is a thin rim of peripheral enhancement without residual tumor. There are scattered areas of heterogeneous parenchymal enhancement. There is no periductal enhancement or capsular retraction.
17 – DWI: Restricted diffusion is present.

Liquid TACE





20, 21 – Arterial Phase: There is thin nodular enhancement identified with residual disease as well as scattered heterogeneous areas of parenchymal enhancement. Periductal enhancement is seen (red arrow). There is no capsular retraction or restricted diffusion.

Discussion

MR findings were described for patients undergoing small (75-150um) LC bead, large (100-300um) LC bead, embosphere, or liquid TACE. Careful attention was paid to describe both tumor and parenchymal enhancement patterns, capsular retraction, periductal enhancement, and restricted diffusion at both 1-2 month and 4-6 month post TACE follow-up exams.

Those patients with small and large LC bead TACE displayed thin peripheral enhancement of tumor with restricted diffusion at 1-2 month follow-up. While both bead sizes initially exhibited restricted diffusion, only the large LC beads continued to restrict diffusion at the 4-6 month exam. Scattered heterogeneous parenchymal enhancement was seen in the 4-6 month exam only in the small LC bead group when comparing the two bead sizes. Also, periductal enhancement was unique to the small LC beads.

There were few similarities noted in the embosphere and liquid TACE group at the 1-2 month exam as the one characteristic that they shared was periductal enhancement. However, at the 4-6 month exam, both were found to display thin peripheral tumor enhancement and scattered heterogeneous parenchymal enhancement. Periductal enhancement was persistent with liquid TACE at 4-6 months. Restricted diffusion was seen only with embospheres in the exams 6 months post TACE.

From our sample size, there didn't appear to be one characteristic that was uniform amongst all of the groups. Liquid TACE was the only modality that didn't restrict diffusion at either follow-up exam, and also was the only modality that exhibited heterogenous parenchymal enhancement over the entire sixth month period.

We believe that identifying various post-TACE characteristics on MR per each TACE modality can be used in conjunction with mRECIST criteria to more accurately assess response and ultimately improve patient outcomes. We hope to continue this project and collect more data in an effort to describe post-TACE findings on MR similarly to how they are characterized on CT.

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