ROLE OF DYNAMIC CONTRAST ENHANCED AND DIFFUSION WEIGHTED IMAGING IN PREDICTION OF TUMOR RESPONSE TO TACE IN UNRESECTABLE H.C.C PATIENTS

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ABSTRACT

Background: To evaluate the role of MRI in the detection of recurrent or residual tumor viability in prediction of the response of the irresectable HCC patients who had locally treated with TACE by studying the enhancement (vascularity) pattern and the volume changes of the HCC after TACE. We were also aiming to improve the technique and to standardize MR protocol to be used after interventional therapy for malignant hepatic tumors.

Results: The study group consisted of 20 patients and the results were analyzed as 31 treated hepatic focal lesions. The patients underwent DCE MRI with DWI in one / three months duration following TACE procedure and were radiologically assessed to observe tumoral post treatment response for non-viable, viable post treatment response categories. Statistical analysis showed that dynamic MRI had 100% level of sensitivity, specificity of 88.89%, PPV of 91.67% and NPV of 100% with an overall agreement of 95%. While on the other hand, statistics showed that DWI has 81.82% level of sensitivity, specificity of 88.9%, PPV of 90%, NPV of 80% with an overall agreement of 85%. The difference between non-viable and viable groups’ ADC variables was found statistically significant at P value < 0.018 and best cut off value that augments sensitivity and specificity is 1.24. At this ADC value, showed 90.91% level of sensitivity, specificity of 87.5%, PPV of 90.9%, NPV of 87.50% with an overall agreement of 79.5%.

Conclusion: Dynamic contrast enhanced MRI is a powerful tool in detection of tumour viability and complications after TACE of hepatocellular carcinoma. Imaging protocol should include dynamic study combined with diffusion imaging with post processing of the images to obtain ADC measurements for better tissue characterization and should be performed at regular time intervals to enhance the diagnostic confidence of MRI for post treatment response viability detection.

Keywords: HCC–TACE– DCE MRI –DWI.

I. BACKGROUND

Hepatocellular carcinoma (HCC) accounts for more than 90% of all primary liver cancers, it is the fifth most common cancer and the third leading cause of cancer-related deaths worldwide [1]. TACE is the most commonly used treatment for HCC that cannot be submitted to surgery. It is based on the objective of tumoredevascularization, in which the oxygen and nutrient supply to the tumor is blocked, resulting in tumor necrosis [2].

Conventional trans-arterial chemoembolization (TACE) is the gold standard for the treatment of patients with HCC who cannot receive curative therapies. TACE for liver cancer has been proven to be useful in local tumor control, to prevent tumor progression, prolong patients’ life and control patient symptoms [3].
Non-contrast CT studies can evaluate the application of the chemotherapeutic agents into the detected mass lesions. It is often hard to assess enhancement of contrast in an observation with partial retention of lipiodol droplets, due to the inevitable beam hardening imaging artifacts of lipiodol droplets. On the other hand, MRI signals are not degraded by lipiodol droplets; therefore, a residual/newly developed tumor is better detected by MRI. In this manner, MRI of the liver is viewed now as the chosen radiological modality for diseases of the liver [4].

In 2018, LI-RADS is consistent with and fully integrated into the American Association for the Study of Liver Diseases (AASLD) 2018 HCC clinical practice Guidance (Ren et al., 2019)[5].

Liver Imaging Reporting and Data Systems LI-RADS v2018 introduces a new algorithm to standardize the reporting of treated observations, regardless of their pretreatment LI-RADS category, and is applicable after any loco-regional therapy. The radiologist should assess whether the treated observation is evaluable. Occasionally, due to image degradation, poor contrast bolus, or lack of multiphasic imaging, an accurate treatment response assessment is not possible. In such cases, the radiologist should assign an LR-TR Non-evaluable category [6].

The LI-RADS lexicon divides imaging features into major features and ancillary features. Only major features contribute to LR-5 categorization(Fig 1). These features include non-rim APHE, non-peripheral “washout” appearance, enhancing “capsule” appearance, size, and threshold growth [7].

Imaging findings are among the factors that can be used to confirm diagnosis and treatment. Although radiologists provide initial estimates of the relative likelihood of HCC or tumor viability after local-regional treatment by assigning a LI-RADS diagnostic or treatment response category, respectively(Fig 1) [8].

In DWI obtained after treatment, a viable tumor is represented by hyper-intense signals indicating a restricted diffusion capacity, whereas a necrotic area was depicted as hypo-intense indicating free diffusion [9].

Figure 1: Summary of recommendations for category management and liver CT and MRI reporting systems.

AIM OF WORK

To evaluate the role of dynamic and DWI MRI in the detection of recurrent or residual tumor viability in prediction of the response of the irresectable HCC patients who had locally treated with TACE by studying the enhancement (vascularity) pattern and the volume changes of the HCC after TACE.
II. METHODS

Patients:
- This study was done on 20 patients with 31 treated HCC lesions who received TACE. The study was achieved in El-Agouza police hospital. The patients were referred from the hepatology department to the radiology department over a period of 36 months (between June 2018 and May 2021). The patients’ age ranged from 48 and 75 years of age (median 63); 2 were females and 18 patients were males.

Inclusion criteria:
- All patients showing cirrhotic configuration with elevated AFP.
- Both sexes were included.

Exclusion criteria:
- Recently systemic chemotherapy treatment for HCC.
- Other hepatic focal lesions other than HCC.
- Contraindications to administration of contrast media, e.g., elevated creatinine, allergy
- Absolute MRI contraindications, e.g., claustrophobia and cardiac pacemakers.

All cases had been subjected to the following:
- History in details and clinical data.
- Revision of the patient's laboratory investigations including renal function tests (urea and creatinine).
- Revision of the previous radiological investigations done for the patients.
- Informed consent was obtained from all patients.
- Patients were scheduled to undergo MRI within 1 month after TACE. In case of absent evidence of viable/non-evaluable lesions, follow up arranged to be after 3 and 6 months after TACE.

MRI protocol:
20 cases were performed using Philips 1.5 Tesla MRI scanner (Achieva) equipped with phased-array torso surface coil.

a) Pre-contrast imaging:

<table>
<thead>
<tr>
<th>Sequence</th>
<th>TR(msec)</th>
<th>TE(msec)</th>
<th>FOV(mm)</th>
<th>Flip angle</th>
<th>Slice thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>axial T1 TFE</td>
<td>10</td>
<td>4.6</td>
<td>300-350</td>
<td>15</td>
<td>7 mm</td>
</tr>
<tr>
<td>axial T2 TSE</td>
<td>1000</td>
<td>80</td>
<td>300-350</td>
<td>90</td>
<td>7 mm</td>
</tr>
<tr>
<td>axial T2 SPAIR</td>
<td>1000</td>
<td>80</td>
<td>300-350</td>
<td>90</td>
<td>7 mm</td>
</tr>
</tbody>
</table>

b) Diffusion study & ADC value measurement:
Before dynamic studies, diffusion MRI was performed using respiratory triggered fat-suppressed single-shot spin echo echoplanar sequence.

c) Dynamic study:
Dynamic study was performed after manual bolus injection of 0.1 mmol / kg body weight GdDTPA.

Acquisition parameters for 1.5 Tesla machines were TR 4.4 msec., TE 2.1 msec., flip angle 10°, matrix size, 172x163, field of view 300–350 mm and cut thickness 2–3 mm.

MRI Image Analysis:
The images are sent to the Phillips Extended MR Workspace for further processing.

The morphological features of each lesion, including size, contour and signal intensity, are recorded on T1, T2 and SPAIR images.

Assess the presence of complications and the likelihood of survival or recurrence of the tumor.

Dynamic study analysis:
We perform arterial and portal phase subtraction which is automated process available on the workstation.

Color coded perfusion mapping is then performed which includes relative enhancement and maximum relative enhancement.

Pattern of enhancement in the dynamic imaging, subtracted images and color mapping was then studied.

Quantitative diffusion analysis (ADC measurement):-
ADC maps were created on the workstation. Calculation of the ADC value is an automated process available on the workstation.

The ROI included the entire chemo-embolized lesion.

Another area of 2 cm diameter in the surrounding cirrhotic liver parenchyma was also measured in each case.

The ADC was measured three times and the three measurements averaged.

Post-processing and interpretation of images:

(A) Dynamic analysis: There are five major features which are typically seen in HCC in patients with liver cirrhosis (fig 2).

1. Arterial phase hyperenhancement (APHE): APHE is a non-peripheral arterial lesion enhancement greater than that of the surrounding liver. Rim enhancement is not a feature of HCC.

2. Non-peripheral washout: Decrease in attenuation or intensity from earlier to later phase, resulting in hypoenhancement in the portal venous or delayed phase.

3. Capsule: Smooth, uniform border surrounding all or most of an observation.

4. Size: A large lesion has a greater chance of being a HCC than a small lesion (longest axial dimension through post contrast enhancing area of treated lesion).

5. Growth Threshold: Growth Threshold is an increase of 50% or more within 6 months after imaging.

- The pattern of MR signal in T1 and T2 as well as fat saturated sequences.
Figure 2: Major features which are typically seen in HCC in patients.

(B) **DWI analysis**: Signal intensity on DWI with ADC values was evaluated side to side using windows workstation. Pattern of diffusion restriction was classified into heterogeneous or nodular and rim.

(C) **ADC measurement**: Pixel-based ADC maps were generated on the workstation using the three b values (0, 500, and 800 s/mm²). Artifacts caused by physical limitations and image distortion were taken into account. Measurement of ADC in heterogeneous lesions with different signals in DWI was assessed by placing the ROI on an appropriate ADC map in a more limited solid area, where the ADC value is considered to be the lowest in the entire tumor.

**Analysis of diagnostic indicators**

- As a reference in our study, surgery was not suitable for the treatment of our cases and therefore it was difficult to obtain a histopathological report of any patient, and biopsy errors due to technical difficulties, so we depended on the LI-RADS v2018 major and ancillary features were used to evaluate post TACE treatment response figure 3. So, our reference standard was:

1. **LR-TR viable category (residual/ recurrent HCC)**: *case 1*: Treated lesions with non-rim peripheral APHE and/or delayed washout inDCE MRI follow-up imaging or sustained lipiodol droplets accumulation in the hyper-vascular treated lesion on the hepatic arteriography with another TACE procedure.

2. **LR-TR non-viable (resolved lesions)**: *case 2*: Treated hepatic lesions with no pathological arterial enhancement or with TACE-specific expected enhancement.

3. **LR-TR Equivocal**: Atypical enhancement not expected for treatment-specific expected post contrast enhancement pattern and also not meeting criteria for viability.

4. **LR-TR non-evaluable category**: for cases where the image is degraded by motion artifacts.
Figure 3: Summary of management recommendations for CT and MRI treatment response Liver Imaging Reporting and Data System categories.

Statistical analysis

- Data were coded and entered using the statistical package SPSS (Statistical Package for the Social Sciences) version 25, and was summarized by calculation of median, mean, standard deviation, minimum and maximum in quantitative data and performing relative frequency (percentage) and frequency (count) for categorical data. The calculated standard diagnostic indices included sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic efficacy [10].

- The ROC curve is based on an area under the curve analysis obtained to determine the best ADC measurement for detection of viability.

III. RESULTS:

This study was prospectively done on 20 patients (2 females and 18 males) with 31 treated lesions, the mean age for all patients was 63 years (age range, 48-75 years) as shown in Table 1.

Table 1: showing the demographic data of 20 treated observations.

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>LR-TR</th>
<th>T-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Viable</td>
<td>Viable</td>
<td>t</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ±SD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thirteen from the 20 HCC treated lesions showed elevated AFP post treatment response while on the other hand seven treated lesions had normal AFP due to proper tumoral embolization as shown in Fig. 3.
Eleven from the 20 HCC treated lesions showed radiological features suggestive of LR-TR viable post treatment response while on the other hand nine treated lesions were considered as LR-TR non-viable due to proper tumoral embolization as shown in Fig. 4.

The size of viable treated lesions ranged from 2.8 to 7.5 cm in maximum diameter and non-viable treated hepatic lesions’ size ranged from 2.5 to 6 cm. The mean and standard deviation of viable and non-viable LRTR groups are shown in Table 2.

In our study, we found that the absence of APHE represents a good response after TACE at 88.9 % of LR-TR non-viable category (i.e., true negative) in dynamic MRI study, while APHE with /or delayed washout represents

<table>
<thead>
<tr>
<th>Lesion size (mm)</th>
<th>LR-TR</th>
<th>T-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Viable</td>
<td>Viable</td>
</tr>
<tr>
<td>Range</td>
<td>25 - 60</td>
<td>28 - 75</td>
</tr>
<tr>
<td>Mean ±SD</td>
<td>40.778 ± 9.770</td>
<td>46.000 ± 12.853</td>
</tr>
</tbody>
</table>
tumoral viability in 100% of the LR-TR viable category (i.e. true positive) in dynamic MRI study. Statistical analysis showed that dynamic MRI had 100% level of sensitivity, specificity of 88.89 %, PPV of 91.67% and NPV of 100% with an overall agreement of 95%, illustrated in Table 3.

Table 3: Correlation of dynamic MRI result to the final diagnosis in the studied group.

<table>
<thead>
<tr>
<th>Dynamic enhancement</th>
<th>LR-TR</th>
<th>Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Viable</td>
<td>Viable</td>
</tr>
<tr>
<td></td>
<td>N %</td>
<td>N %</td>
</tr>
<tr>
<td>Negative</td>
<td>8 88.89</td>
<td>0 0.00</td>
</tr>
<tr>
<td>Positive</td>
<td>1 11.11</td>
<td>11 100.00</td>
</tr>
<tr>
<td>Total</td>
<td>9 100.00</td>
<td>11 100.00</td>
</tr>
</tbody>
</table>

ROC Curve

<table>
<thead>
<tr>
<th></th>
<th>Sens.</th>
<th>Spec.</th>
<th>PPV</th>
<th>NPV</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic</td>
<td>100.0</td>
<td>88.89</td>
<td>91.67</td>
<td>100.0</td>
<td>95%</td>
</tr>
</tbody>
</table>

However, facilitated lesions on DWI represent excellent therapeutic response of 88.9 % of LR-TR non-viable lesions (i.e., true negative), while around 18.18% of the LR-TR viable lesions lack diffusion restriction (i.e., false negative). On the other hand, 81.82% of the LR-TR viable lesions showed restricted diffusion (i.e., true positive), while around 11.1 % of the LR-TR non-viable lesions showed restricted diffusion (i.e. false positive). Statistical analysis showed that DWI MRI had 81.82% level of sensitivity, specificity of 88.9%, PPV of 90%, NPV of 80% with an overall agreement of 85%, illustrated in Table 4.

Table 4: Correlation of DWI MRI result to the final diagnosis in the studied group.

<table>
<thead>
<tr>
<th>DWIs</th>
<th>LR-TR</th>
<th>Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Viable</td>
<td>Viable</td>
</tr>
<tr>
<td></td>
<td>N %</td>
<td>N %</td>
</tr>
<tr>
<td>Negative</td>
<td>8  88.89</td>
<td>2  18.18</td>
</tr>
<tr>
<td>Positive</td>
<td>1  11.11</td>
<td>9  81.82</td>
</tr>
<tr>
<td>Total</td>
<td>9  100.00</td>
<td>11 100.00</td>
</tr>
</tbody>
</table>

ROC Curve

<table>
<thead>
<tr>
<th></th>
<th>Sens.</th>
<th>Spec.</th>
<th>PPV</th>
<th>NPV</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>DWIs</td>
<td>81.82</td>
<td>88.89</td>
<td>90.0</td>
<td>80.0</td>
<td>85%</td>
</tr>
</tbody>
</table>

The difference between the LR-TR viable post TACE response and LR-TR non-viable groups ADC values was statistically significant with a P value of <0.018. The best cut off value that provides sensitivity and specificity is 1.24 with mean and standard deviation illustrated in Figure 5.

Figure (5): Distribution of lesions into high, low ADC value groups.
The ROC curve obtained by plot at different cut off values is shown in Figure 6. The best cut off value that maximizes sensitivity and specificity is 1.24. At this ADC value, Statistical analysis showed that ADC value measurement had 90.91% level of sensitivity, specificity of 87.5%, PPV of 90.9%, NPV of 87.50% with an overall agreement of 79.5%, as shown in Table 6.

![ROC curve](image)

**Figure (6):** Results of receiver operating curves for ADC values in distinguishing LR-TR non-viable and LR-TR viable groups.

**Table 6:** Roc curve analysis revealed that ADC value was a significant discriminant factor in predicting non-viable from viable treat lesions groups (p value<0.018).

<table>
<thead>
<tr>
<th>ROC curve between Viable and Non-Viable</th>
<th>Cutoff</th>
<th>Sens.</th>
<th>Spec.</th>
<th>PPV</th>
<th>NPV</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADC value</td>
<td>≤1.24</td>
<td>90.91</td>
<td>87.50</td>
<td>90.9</td>
<td>87.50</td>
<td>79.5%</td>
</tr>
</tbody>
</table>

IV. DISCUSSION

We performed this study to evaluate the value of DCE MRI and DWI in assessing post treatment response for TACE in HCC patients with elevated AFP. Dynamic MRI examination has an important role in assessment of HCC viability following TACE via avoiding the interference of accumulated iodized oil as conventional non-contrast magnetic resonance imaging sequences show changes in morphology and fluid content changes as well as fibrosis, while dynamic study clearly shows the perfusional criteria of treated lesion.

(Afifi et al., 2016) and (Ebrahim et al., 2017) showed that treated lesion selicithyperintensity on conventional T1 WIs and hypo-intensity on conventional T2-WIs images with T2 hyperintensity in cases of viability. However, Hyperintensesignals on T2 WIs not only represents tumoral viability but may be due to lesionsalhemorrhage, inflammation or cystic necrosis [4,11].

In our study, we had higher sensitivity for dynamic MRI in comparison to other researches done by (Yu et al., 2009), (Ebeed et al., 2017), Goshima et al., 2008) and (Osama et al., 2013, that occurs because in all other researches inappropriatebreath holding led to motion artifacts with subsequent false negativeinterpretation by the viewer, therefore no definite false negative cases in our study[11,12,13,14].

(Afifi et al., 2016) cleared that the increase in false positive findings caused by perilesional parenchymal insults that showed sustaininghyperintensity on DWI with increasing b factors. They demonstrated that hypercellularity intercalated with afibrotic component in the inflammatorygranulation tissue could restrict water diffusion[11].

In the studies of (Ebeed et al., 2017) and (Osama et al., 2013) intra-lesional necrosis and liquefactive breaking down are recognized to be the cause of hyperintensity in DWI images of post therapeutic breaking down of viable lesions[4,14].

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In our study, only one false positive lesion out of 31 lesions were misdiagnosed on diffusion weighted imaging. We considered this false positive result in our study is likely due to post-treatment hemorrhage or liquefactive tumoral necrosis that causes lack of diffusion facilitation.

(Mohammedet al., 2016) reported that the difference in ADC values in HCC lesions in studies done before and following TACE treatment. The mean ADC of the lesions pre-TACE was 1.27 ± 0.25 10^-3 s/mm² while increased in post-TACE reaching 1.57 ± 0.22 x 10^-3 s/mm² with a statistically significant difference (P= 0.002) [15].

In our study, the difference between ADC values variables between the viable and non-viable groups was statistically significant with P value < 0.018. The best cutoff that sensitivity and specificity values are maximized at is 1.24. At this ADC value, the sensitivity is 90.91% and specificity is 87.50%. Based on the ROC, ADC value is a good indicator to detect viability of HCC from non-viable lesions.

Studies done by (Ebeed et al., 2017) and (Mohammedet al., 2016) proved that ADC mapping series values showing significant increase in nonviable lesions after TACE treatment than in viable lesions [4,15].

Our results showed that DCE MRI side to side DWI have significant role in assessing post-TACE treatment response and tumoral viability. As in our study, dynamic MRI had 100% level of sensitivity, specificity of 88.89%, PPV of 91.67% and NPV of 100% with an overall agreement of 95% however DWI MRI had 81.82% level of sensitivity, specificity of 88.9%, PPV of 90%, NPV of 80% with an overall agreement of 85%.

(Fahcem, et al. 2017) and our study agreed that DWI and ADC value has some advantage in comparison to dynamic MRI study in case of contrast agent contraindication, and for a relatively shorter time examination. Furthermore, less time is consumed in post-processing for DWI images in comparison to dynamic MR imaging. [16].

In our study, we found that DWI is of great value in case of contra-indication to contrast administration. However, it cannot completely substitute for dynamic MRI study assessment and interpretation should always be made beside dynamic study to avoid false negative results.

Our recommendation, in our study Dynamic MRI with subtraction was taken together with DWI for maximum image interpretation in assessment of HCC viability post TACE and using LIRADS v2018 to rule out false negative results caused by motion artifacts.

V. STUDY LIMITATIONS

We found few obstacles in our study. Starting from, obtaining proven histopathology reports in patients who received TACE was difficult because our patients were not suitable candidates for lesion resection or liver transplantation.

In addition, we encountered some technical difficulties in DWI in sometreated lesions located near to the diaphragmatic copula where are very sensitive to respiratory motion as well as apical artifacts arising from the heart leading to relatively poor signal-to-noise ratio as well as degradation in spatial resolution. Also, during calculating ADC mapping values, we faced inevitable imagenoise leading to calculation errors in one case. We tried to overcome this hurdle by setting the lowest ROI and taking multiple measurements.

VI. CONCLUSION

Our study proved that dynamic MRI has 100% level of sensitivity while DWI has 81.82% level of sensitivity enhancing the diagnostic confidence of dynamic MRI for post treatment response viability detection.

REFERENCES


Illustrated cases

Case 1: A 64-year-old male patient with chronic viral hepatitis C with elevated AFP level (660), diagnosed as HCC involving right hepatic lobe segment VIII in triphasic CT-scan underwent TACE ablation followed up by triphasic CT-scan with still elevated AFP level (500), and DCE MRI for assessment of treatment response after 1 month of chemo-embolization showed tumoral viability.

Pre-treatment Triphasic CT-scan

Figure (a): Arterial phase showing right hepatic lobe segment VIII enhancing focal lesion, measuring about 28 mm in maximum diameter.

Figure (b): Delayed phase showing corresponding washout, suggestive of HCC

Report as adopted by LI-RADS v2018

Observation #: 1
Location: Segment VIII
Size: 28 x 26 mm
Tumor in Vein: No
Non rim AP hyperenhancement: Yes
Non peripheral washout appearance: Yes
Enhancing capsule appearance: No
Ancillary features: NAD.
Favoring benignity: None
LI-RADS v2018 Category: LR-5

Post-treatment Triphasic CT-scan during one month from TACE

**Figure (a):** Arterial phase of triphasic CT-scan showing homogenous uptake of hyper-dense lipidol right hepatic lobe segment VIII focal lesion without significant post contrast pathological enhancement.

**Figure (b):** Delayed phase of triphasic CT-scan showing homogenous uptake of hyper-dense lipidol right hepatic lobe segment VIII focal lesion without significant post contrast pathological enhancement or washout.

Report as adopted by LI-RADS v2018
Observation #: 1
Treatment modality: TACE
Location: Segment VIII
Pre-treatment category: LR-5
Pre-treatment size: 28mm
Enhancement in a nodular, mass-like or thick irregular pattern: No
Size of enhancing component: NAD
Enhancement characteristics:
- Arterial phase hyperenhancement: No
- Washout appearance: No
- Other: NAD

Category: LR-TR non-Viable, (pre-treatment, LR-5, 28 mm).

Post-treatment DCE MRI with DWI following one month from TACE
Figure (a): Axial T1 WIs revealed faint hypo-intensity of the chemo-embolized segment VIII treated lesion.

Figure (b): Axial STIR WIs revealed faint hyper-intensity of the chemo-embolized segment VIII treated lesion.

Figure (a): Pre-contrast and Late arterial phases of T1 LAVA showing non rim APHE in most of its portions.

Figure (b,c): Porto-venous and delayed phases of T1 LAVA showing washout of the previously noted non rim APHE.

Figure (1): Diffusion weighted imaging (b value 800) and the corresponding ADC map showing restricted diffusion of the lesion with ADC value of $0.91 \times 10^{-3} \text{ s/mm}^2$.

Final Diagnosis: LR-TR Viable 53 mm, (pre-treatment, LR-5, 28 mm).

Report as adopted by LI-RADS v2018

Observation #: 1
Treatment modality: TACE
Location: Segment VIII
Pre-treatment category: LR-5
Pre-treatment size: 28mm
Enhancement in a nodular, mass-like or thick irregular pattern: yes, mass like
Size of enhancing component: N/A
Enhancement characteristics:
  • Arterial phase hyperenhancement: yes
  • Washout appearance: yes
  • Other: restricted diffusion
Category: LR-TR viable, (pre-treatment, LR-5, 28 mm).

Case 2: A 55-year-old male patient with chronic viral hepatitis C and elevated AFP level (1500) diagnosed as HCC involving right hepatic lobe segment V by triphasic CT-scan underwent TACE ablation with dropped AFP level to 50 followed up by DCE MRI with DWI for assessment of treatment response after 1 and 3 months following chemo-embolization showed tumoral non-viability.

Pre-treatment Triphasic CT-scan

Figure (b) Arterial phase showing right hepatic lobe segment V enhancing focal lesion, measuring about 5 cm in maximum diameter.

Figure (b) Delayed phase showing corresponding washout, suggestive of HCC.

Report as adopted by LI-RADS v2018
Observation #: 1
Location: Segment V
Size: 48 x 50 mm
Tumor in vein: No
Non-rim AP hyperenhancement: Yes
Non-peripheral washout appearance: Yes
Enhancing capsule appearance: No
Ancillary features: NAD
Favouring benignity: None
LI-RADS v2018 Category: LR-5

Follow-up post-treatment DCE MRI with DWI:

Figure (c): Axial T2 WIs revealed heterogeneous signals (predominantly bright) with peripheral hypo-intensity of the chemo-embolized segment V treated lesion.

Figure (d): Axial T1 WIs revealed iso-intense signals with peripheral hypo-intensity.

Figure (e): Late arterial and delayed phases of T1 LAVA showing faint rim enhancement.

Figure (f): Porto-venous and delayed phases of T1 LAVA showing faint persistent rim enhancement with no delayed wash out, suggestive of granulation tissue.
Figure (g): I. Diffusion weighted imaging (b value 800) and II. the corresponding ADC map showing facilitated central diffusion manifested by bright signals in DWI and corresponding bright signals in ADC mapping series with III. ADC value $= 2.1 \times 10^{-3}$ s/mm$^2$, with peripheral restricted rim impressive of expected post treatment response granulation tissue/hyperaemia.

Final diagnosis: LR-TR non-viable, (pre-treatment, LR-5, 50 mm).

Report as adopted by LI-RADS v2018

Observation #: 1

Treatment modality: TACE

Location: Segment V

Pre-treatment category: LR-5

Pre-treatment size: 50mm

Enhancement in a nodular, mass-like or thick irregular pattern: No

Size of enhancing component: N/A

Enhancement characteristics:

• Arterial phase hyperenhancement: No
• Washout appearance: No
• Other: Facilitated diffusion

Category: LR-TR non-viable, (pre-treatment, LR-5, 50 mm).