Med. J. Cairo Univ., Vol. 91, No. 1, March: 173-182, 2023
www.medicaljournalofcairouniversity.net

Dynamic Subtraction MRI Versus Diffusion Weighted Imaging in Assessment of Hepatocellular Carcinoma after Trans Arterial Chemoembolization (TACE)

SAHAR M. ABD ELSALAM, M.D.; GHADA M. ABD ELAZEEM, M.D.;
AHMAD HESHAM M. SAID, M.D. and AHMED A. ZIDAN, M.D.

The Department of Radiology, Faculty of Medicine, Beni-Suef University

Abstract

Background: Hepatocellular carcinoma (HCC) was found to be the 4th leading cause of cancer-related deaths. Guided by the Barcelona Clinic Liver Cancer (BCLC) classification system, trans-arterial chemoembolization (TACE) is the first line of treatment for HCC patients with intermediate stage and possibly those with sizable or multi-centric HCC.

Aim of Study: The current study aim was to compare subtraction dynamic contrast enhanced MRI to diffusion weighted imaging in assessment of HCC cases following TACE regarding their accuracy in detecting Tumoral activity.

Patients and Methods: The current study included 66 cases of Hepatocellular carcinoma (HCC) lesions underwent trans-arterial chemo-embolization procedure. Follow-up Dynamic contrast enhanced MRI study (DCE-MRI) of the liver, dynamic subtraction technique and diffusion WIs were obtained 1 to 1.5 months post trans-arterial chemo-embolization.

Results: Sensitivity of MRI subtraction in detection of the HCC recurrence=88.5%, with specificity in exclusion of recurrence=100%, PPV 100% and the NPV 70%. Regarding tumor activity there was a highly significant strong agreement between dynamic MRI and the MRI subtraction (p<0.001) and the k (Kappa)=0.765, Area of (95%CI) 0.942 ranging between (0.888-0.997). MRI diffusion Sensitivity of=71.2%, specificity=78.6%, PPV=92.5% and the NPV=42.3%. There was a significant weak agreement between the tumor activity by the dynamic MRI study and MRI diffusion (p=0.001) and the k=0.375, Area of (95%CI) 0.749 ranging between (0.604-0.893). The mean ADC value of the Residual/recurrence enhanced tissue=1.437±0.4058 and the mean ADC value of necrotic tissues was 1.701 ±0.4408. The increased mean ADC in the necrotic tissue was statistically significant (p-value <0.001) with Area of (95%CI) 0.651 (0.462-0.840). Acute off equal to 1.374 of ADC value was found to predict the recurrence with sensitivity=80.77%, specificity=57.14%, PPV= 87.5% and NP=44.4.

Conclusion: We believe that the addition of subtraction images to the dynamic study combined with Diffusion WIs would be useful for post TACE evaluation of HCC. The data they yieldedwere complementary and consensus between DCEMRI, subtraction and diffusion WIs data should be made by the reader before final decision to be made.

Key Words: *HCC – Post TACE – Dynamic MRI – DWI –Subtraction.*

Correspondence to: Dr. Sahar M. Abd Elsalam,
The Department of Radiology, Faculty of Medicine,
Beni-Suef University

Introduction

ACCORDING to stage, many treatment options for Hepatocellular Carcinoma (HCC) are available; these options rely on the size of the local tumor and the degree of liver damage that has been determined. Surgery, ablation, and liver transplantation are advised for HCC in its early stages. For HCC in the intermediate stage, trans-arterial chemoembolization (TACE) is recommended. Finally, the greatest supportive treatment is indicated for HCC in its latter stages **[1]**.

Trans-arterial chemoembolization (TACE), which is based on the Barcelona Clinic Liver Cancer (BCLC) categorization system, is the first line of treatment for HCC patients with intermediate stage disease as well as those with large size or multi-centric HCC **[2]**.

List of Abbreviations:

TACE	: Trans Arterial Chemoembolization.
HCC	: Hepatocellular carcinoma.
BCLC	: Guided by the Barcelona Clinic Liver Cancer classification system.
DCE MRI	: Dynamic contrast enhanced MRI.
MDCT	: Multi-detector computed tomography.
EASL	: The European Association for the Study of Liver Disease.
THRIVE	:T1 high resolution isotropic volume examination.
ROI	: Region of interest.

Evaluation of the results of TACE and the subsequent stage in the patient's treatment plan requires follow-up to determine the success of TACE using diagnostic imaging [3].

Multi-detector computed tomography is still the imaging method most frequently employed to characterize the appearance of hepatic cancers treated with loco-regional treatments (MDCT). Additionally, it enables us to assess tumor size, margins, necrosis, identification of residual or recurrent tumor viability, and newly developed tumor to determine the response to therapy [4].

Due to lipidol droplets inherent beam hardening imaging abnormalities, it can occasionally be challenging to identify augmentation of contrast in a well-treated lesion with partial retention of lipidol droplets during tri-phasic CT investigation [3].

Dynamic contrast enhanced MRI (DCE MRI) has been established as the reliable liver imaging technique due to multi-parametric capabilities as the lipidol droplets had no effect on MRI signals, making it easier to detect residual/recurrent or freshly acquired lesions using dynamic contrast enhanced (DCE) MRI. As a result, the radiological modality of choice for the hepatic lesions was the DCE MRI study [5].

The European Association for the Study of Liver Disease (EASL) suggests using lesion enhancement as the primary indicator of therapy response rather than size change. Dynamic contrast-enhanced imaging methods were used in 2001 to evaluate tumor necrosis in response to treatment, earning EASL accreditation [6].

Viable/residual tumor tissue after trans-arterial chemoembolization (TACE) therapy exhibits dynamic MRI arterial phase non-rim hyper-enhancement (APHE) as a nodular thick or mass-like area after contrast injection, which may be combined with necrotic patches [7]. The dynamic MRI-detected peri-lesional rim enhancement is not pathognomonic for the recurring lesions and may also occur in non-viable circumstances [8].

Data on the level of tumor vitality can be obtained through diffusion weighted MRI. Less hyper-intense signals in DWI are present in non-viable treated hepatic lesions, and the values of the ADC mapping series rise as a result. Relatively low ADC values and diffusion limitation are still present in viable treated hepatic focal lesions [8].

The elevated T1 signal brought on by coagulative necrosis can be eliminated by subtraction. Additionally, it can be used to distinguish between the nodular enhancement of a live tumor and the smooth, indistinct peri-tumoral enhancement observed in benign post-treatment hyperemia [7].

The current study objective was to analyze HCC lesions following trans-arterial chemoembolization and compare the accuracy of subtraction dynamic contrast enhanced MRI to that of diffusion weighted imaging in terms of their ability to detect residual tumor.

Patients and Methods

The current study was a prospective study that included 66 patients with HCC lesions and approved by the ethics board of our institution. All patients underwent TACE procedure over a period of 12 months (between September 2018 and September 2019) at our University Hospital. All patients were followed-up by dynamic MRI study after 1 to 1.5 months. All patients were subjected to the following:

- Full history and clinical assessment.
- Checking laboratory investigation (serum creatinine).
- Written consent obtained from all patients.

Inclusion criteria:

Patients with one or more HCC lesion, showing typical arterial enhancement/late wash out of contrast in multiphasic CT or MRI, who hadundergone TACE as therapeutic procedure either by beads or lipidol.

Exclusion criteria:

- Contraindications to magnetic resonance imaging, (e.g., patients with pace maker or non MR-compatible prosthesis).
- Liver tumors other than hepatocellular carcinoma.
- Patients who had other Procedures in addition to TACE (e.g. RFA, microwave ablation).
- Contraindications to contrast media, e.g. patients with impaired renal function, patients allergic to contrast media.

MRI examination:

All MRI examinations were performed using SIEMENS-AERA MRI scanner 1.5 Tesla (Siemens Healthcare AG, Bern, Switzerland), equipped with phased array torso surface coil with patients in supine position. Strict breathing instructions to patients were endorsed and monitored. MRI sequences with suboptimal quality due to breathing or motion were repeated, to minimize mis-registration errors.

MRI Sequences:

A- *Pre-contrast study:*

The following MR sequences were obtained (Imaging parameters are shown in Table 1): Gradient echo (GE) axial T1-, T2-, heavy T2-WIs, T2-WI with FAT SAT, In phase, Out phase & coronal T2-WI.

Sequences	TR (ms)	TE (ms)	FOV (ms)	Flip angle	Slice thickness
GE Axial T1	10	4.6	380	15	6.5mm
Axial T2	1210	112	380	156	6.5mm
Axial heavy T2	3020	296	380	144	6.5mm
In phase	1510	100	380	15	6.5mm
Out of phase	1500	232	380	15	6.5mm
Axial T2 FATSAT	1580	112	380	160	6.5mm
Coronal T2	1500	122	400	144	6.5mm

MRI sequences parameters. TE : Echo time.
TR: Repetition time. FOV: Field of view.

B- Diffusion weighted images:

DWI was performed using single-shot spin-echo echo-planar imaging during one or more breath holds in the axial plane. Imaging parameter were as follows: b50b400b800, Repetition time/echo time = 2500/82ms; Slice thickness/gap = 8/4 mm.

C- Dynamic study:

After bolus injection of 0.1mmol/kg body weight of Gd-DTPA in an antecubital vein and flushing with 20ml of sterile saline solution, a dynamic investigation was done.

3D fat-suppressed T1-weighted gradient echo sequence for dynamic imaging: T 1 high resolution isotropic volume analysis (THRIVE). A dynamic series was made up of one pre contrast series, four post contrast series that were spaced out by 19 to 21 seconds and included early arterial, late arterial, and portal phases. Imaging with a 5-min delayed phase was done after that. To reduce the chance of image misregistration, all patients were scanned toward the conclusion of expiration.

Analysis of the MR images:

- MRI Images were sent to the MR workstation for further image processing.
- The processing of Subtraction imaging was an automated process available on the workstation, as the an unenhanced T1-weighted sequence was digitally subtracted from the identical sequence performed after gadolinium administration in early angiographic and late arterial phases. By this process, the remaining signal on the subtracted images was due solely to enhancement.
- DWI was used to create ADC maps and subsequently ADC values were measured and recorded.

Dynamic study analysis:

Throughout the successive dynamic series, the pattern of enhancement was analyzed and recorded for every patient. This was applied to the dynamic images as well as to the subtracted images. The pattern of enhancement was compared and correlated to the typical HCC pattern (arterial enhancement with wash out of contrast in the porto-venous and delayed phases).

DWI:

- Give qualitative assessment of restricted and facilitated areas of the treated tumors, lesions with high signal or low signal were correlated to ADC maps, to exclude T2 shine-through effect or T2 black out (Figs. 2,3).
- ADC maps were assessed both qualitatively by recording the signal intensity and quantitatively by measuring ADC values in the areas of restriction that appeared pathologically enhancing in the late arterial images.

ADC measurement:

- ADC maps were processing on the workstation & ADC was automatically calculated.
- Areas of high signal intensity on DWI were correlated to T2 WI to exclude the T2 shine through or blackout effects.
- The restricted areas were correlated to dynamic images to confirm the presence of enhancement.
- A circular region of interest (ROI) was drawn at the suspected area, whether those with contrast enhancement and those with intra-lesional diffusion restriction. Otherwise, the whole lesion was measured if no high signal or no enhancement could be identified.

Interpretation of the MR image:

All images were evaluated and interpreted by expert radiologistin body imaging (20 and 25 years experience) in consensus.

A- *Dynamic study interpretation:*

The current study used the dynamic contrast enhanced MRI as the standard reference. Well chemo-embolized lesions were defined as “the absence of enhancement on the arterial phases of the dynamic study, while residual tumor activity was documented whenever there was enhancement at arterial phase and wash out of contrast at Porto-venous or delayed phase.

Diffusion weighted images, ADC value and subtraction MRI images were interpreted and correlated to the findings of dynamic MR images.

B- *Subtraction Dynamic studies interpretation:*

In the subtraction images, the high signal in the arterial phase was interpreted as tumoral enhancement. Post interventional reactive changes were defined as enhancement related to the embolized area on the surrounding liver parenchyma that persisted in the delayed phase.

We categorized the lesions into two groups:

- Well treated (not viable): No MRI signs of residual or recurrent viability.
- Residual/recurrent (viable): If there was evidence of residual or recurrent tumor.

Statistical analysis:

SPSS v. 25 (Statistical Package for Social Science) for Windows was used to analyze the data. When describing quantitative variables with properly distributed data, the mean, standard deviation (SD), and median and range were used (min-max). The qualitative factors were described using numbers (No.) and percentages (percent). The Kolmogorov-Smirnov test was used to examine the data for normalcy. The categorical variables were compared between the cases and controls using the chi-square test. The Mann-Whitney test was employed for the non-normally distributed data, while the *t*-test was utilized to compare cases and controls for the regularly distributed scale variable. The recurrence of HCC was predicted using the ROC curve and the ADC value. The *p*-value used to evaluate the findings was split into three categories: Non-significant when *p*-value is more than or equal 0.05, Significant when *p*-value is less than 0.05.

Results

A total of 66 patients 50 male (75.8%) & 16 female (24.2% were included in the study, whose ages ranged between 50 and 85 year old (mean age 64.2). All patients had liver cirrhosis due to chronic viral hepatitis (Table 2).

Table (2): Baseline characteristics of the studied patients.

Characteristics	Values (No=66) (%)
Age (years):	
Mean ± SD	64.2±7.1
Range (min-max)	50-85
Median	65
Sex:	
Males	50 (75.8%)
Females	16 (24.2%)

Table (3): Frequency distribution of the MRI characteristics of HCC post TACE in (subtraction, diffusion) WIs and the mean ADC value of necrotic tissue (either total or partial) and the residual/recurrent enhanced tissue

Tumor activity based on MRI Dynamic contrast enhancement	No (%)
(Well treated) (no recurrence)	14 (21.2%)
(Residual/recurrence)	52 (78.8%)
MRI "sequences	Values No=66(%)
Subtraction:	
Hypo-intense (treated /no recurrence)	20 (30.3%)
Enhancement (recurrence)	46 (69.7%)
Diffusion Restriction:	
Absent "Facilitated" (treated /no recurrence) (facilitated)	26 (39.4%)
Present "Restricted" (recurrence)	40 (60.6%)
ADC value of necrosis (either Total or partial) (No= 66) ($x10^{-3}$ mm^2/s):	
Mean±SD	1.6318±0.5064
Range (min-max)	0.398-2.789
Median	1.562
ADC value of residual/enhanced tissues in (No. of cases of recurrence only on stander DCE MRI=52 case):	
Mean ± SD	1.437±0.40578
Range (min-max)	0.381-2.320
Median	1.4295

Table (3) showed that there were 30.3% of cases with negative subtraction while 69.7% of cases ha a positive subtraction There were 39.3% of cases had enhanced diffusion while 60.6% of cases had restricted diffusion. The mean ADC value of necrosis was 1.6318±0.5064 $x10^{-3}$ mm^2/s, ranged from 0.398 to 2.789 with median 1.562 $x10^{-3}$ mm^2/s. The mean residual/enhanced tissue (index) was 1.437±0.40578, ranged from 0.381 to 2.320 with median 1.4295.

Showed that the sensitivity of the MRI subtraction in detection of the HCC recurrence was 88.5%, its specificity in exclusion the recurrence was 100%, PPV was 100% and the NPV was 70% when it compared to the arterial and portal washout. There was a highly significant strong agreement between the tumor activity by MRI with contrast and the MRI subtraction (*p*-value <0.001) and the kappa was 0.765.

Showed that the sensitivity of the MRI diffusion in detection of the HCC recurrence was 71.2%, its specificity in exclusion the recurrence was 78.6%, PPV was 92.5% and the NPV was 42.3% when it compared to the arterial and portal washout. There

was a significant weak agreement between the tumor activity by MRI with contrast and the MRI diffusion (p-value=0.001) and the kappa was 0.375 (Table 5).

Showed that the mean baseline ADC value of patients with recurrence was 1.437 ±0.4058 and the ADC value of residual tissues was 1.701 ±0.4408 and this increase was statistically significant (p-value <0.001).

Showed that at a cut off equal 1.374 of ADC value, it can predict the recurrence with sensitivity=80.77%, specificity=57.14%, PPV=87.5% and NPV=44.4%.

Table (4): Agreement between the Tumoral activity on standard DCE MRI and the MRI subtraction.

Subtraction	DCE (Arterial enhancement)		Total
	Negative (treated no recurrence)	Positive (recurrenc)	
Negative:			
Count	14	6	20
% within Subtraction	70.0%	30.0%	100%
% within Arterial enhancement	100.0%	11.5%	30.3%
Positive (recurrence):			
Count	0	46	46
% within Subtraction	0.0%	100.0%	100%
% within Arterial enhancement	0.0%	88.5%	69.7%
Total:			
Count	14	52	66
% within Subtraction	21.2%	78.8%	100%
% within Arterial enhancement	100.0%	100.0%	100%
p-value		<0.001 * *	
Kappa		0.765	

Table (5): Agreement between the Tumoral activity on standard DCE MRI and the MRI diffusion WIs.

Diffusion	DCE (Arterial enhancement)		Total
	Negative (no recurrence) facilitated	Positive (residual/ recurrenc)	
Negative:			
Count	11	15	26
% within Diffusion	42.3 %	57.7%	100%
% within Arterial enhancement	78.6%	28.8%	39.4%
Positive (recurrence):			
Count	3	37	40
% within Diffusion	7.5%	92.5%	100%
% within Arterial enhancement	21.4%	71.2%	60.6%
Total:			
Count	14	52	66
% within Diffusion	21.2%	78.8%	100%
% within Arterial enhancement	100.0%	100.0%	100%
p-value		0.001 **	
Kappa		0.376	

Table (6): Change of the ADC value in necrosis either (partial or total necrosis) and residual enhanced tissue.

ADC value (No=52)	Mean	SD	p-value
Residual "enhanced tissue "	1.437	0.4058	<0.001 * *
Necrotic tissue	1.701	0.4408	

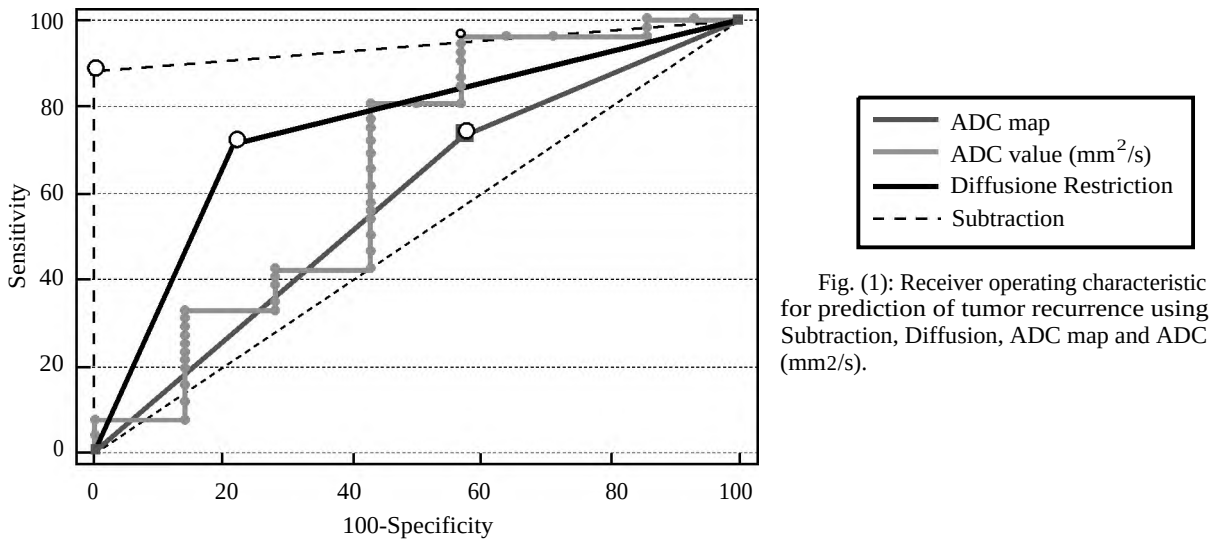
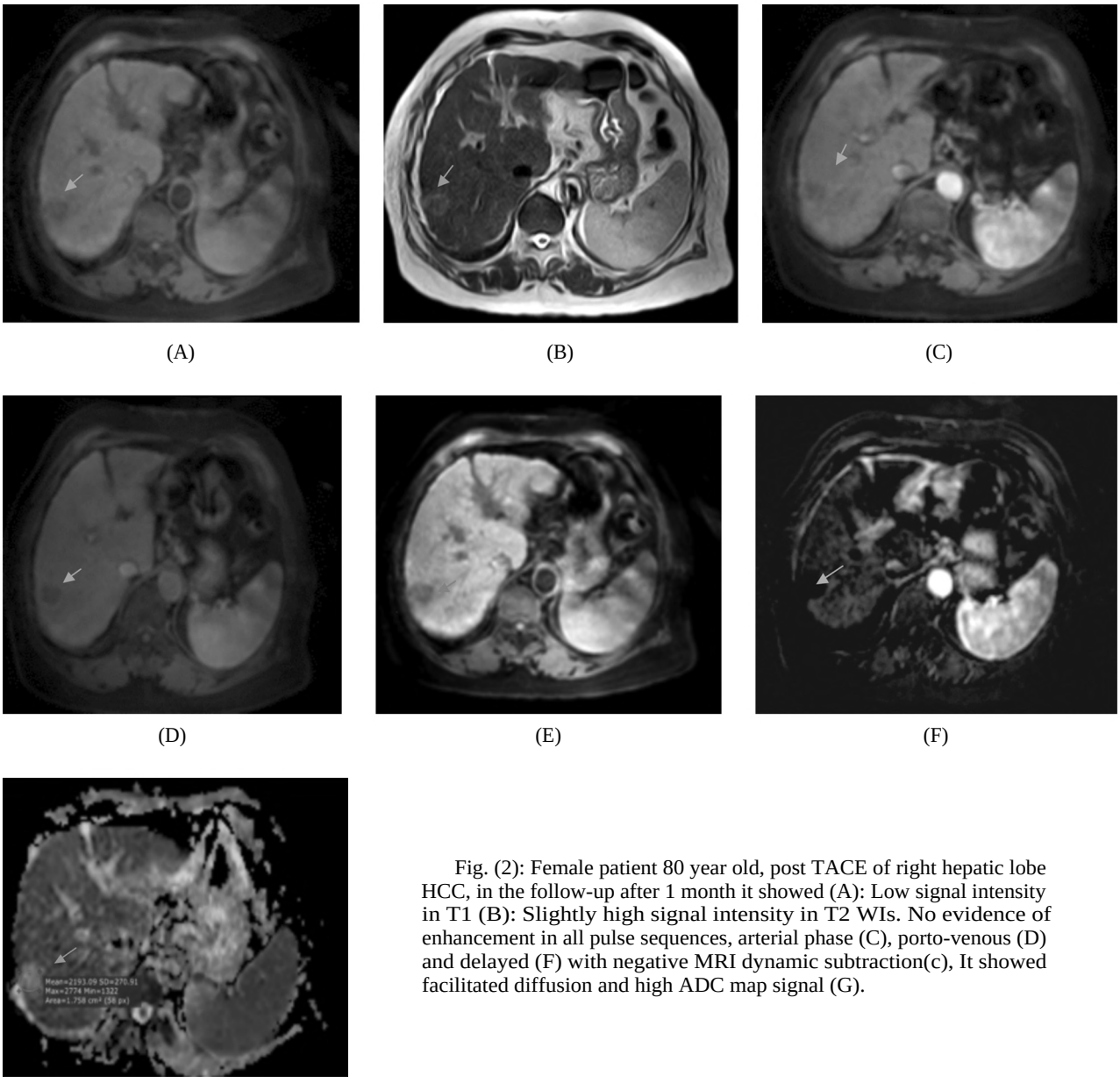


Fig. (1): Receiver operating characteristic curve for prediction of tumor recurrence using MRI Subtraction, Diffusion, ADC map and ADC value (mm2/s).

Table (7): Area under the curve, Sensitivity, specificity, PPV and NPV of Subtraction, Diffusion and ADC value.

Variables	Area (95%CI)	Std. Error	*p*-value	Sensitivity	Specificity	PPV	NPV
Subtraction	0.942 (0.888-0.997)	0.028	<0.001 **	88.5	100	100	70
Diffusion	0.749 (0.604-0.893)	0.074	0.005 *	71.2	78.6	92.5	42.3
ADC value (mm^2/s)	0.651 (0.462-0.840)	0.096	0.084	80.77	57.14	87.5	44.4



(A) (B) (C)

(D) (E) (F)

(G)

Fig. (2): Female patient 80 year old, post TACE of right hepatic lobe HCC, in the follow-up after 1 month it showed (A): Low signal intensity in T1 (B): Slightly high signal intensity in T2 WIs. No evidence of enhancement in all pulse sequences, arterial phase (C), porto-venous (D) and delayed (F) with negative MRI dynamic subtraction(c), It showed facilitated diffusion and high ADC map signal (G).

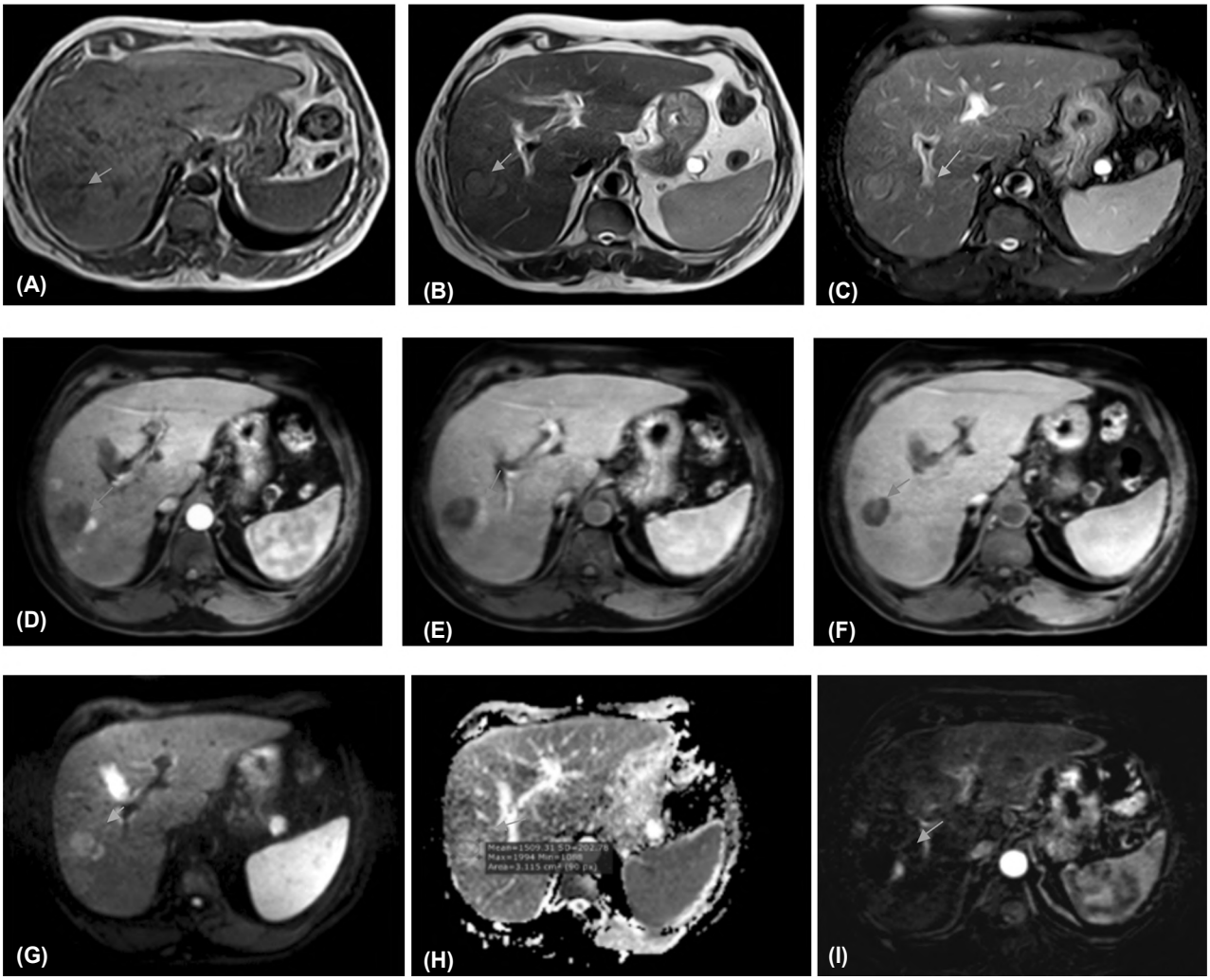


Fig. (3): Male patient 66 year old, post TACE of right hepatic lobe HCC, follow-up 1.5 month, showed low SI in T1WIs (A), iso intense in T2WIs (B) and SPIR WIs (C). It showed peripheral focal enhancement in the arterial (D) with wash out of contrast inporto-venous phases (E) and the delayed phase (F). It showed mild restricted diffusion at DWIs (G) and isointense in ADC map (H) with positive enhancement in the subtraction dynamic MRI (I).

Discussion

Follow-up post Trans-arterial chemo–embolization TACE with imaging is essential in evaluating the outcome of TACE and the next future step along the treatment plan of the patient [3].

The goal of this study was to test the logical-idea that subtraction technique would be more accurate in detecting residual/recurrent tumoral activity, since it would avoid the subjective misinterpretation by the reader and it detect the difference in pixel value digitally, rather than visually. High signal areas which may be mistakenly-considered as enhancement will be subtracted and nulled.

Meanwhile, we were aware that mis registration errors may take place, e.g. due to breathing or minor patient movement which may be reflected on its accuracy.

DWI has been found to be useful in detecting tumors with high cellularity, which is reflected as restriction of diffusion. It has a unique advantage that it does not require contrast injection, in addition to its relatively short duration. In the current study, we were not limited to qualitative detection of diffusion restriction (as depicted from high signal at DWI, and low signal at ADC map), but we extended it to quantitative assessment, through measuring ADC values of the treated areas and correlating it to the DCE study.

Our results showed that the sensitivity of subtraction in the detection of HCC recurrence was 88.5%, with 100% specificity in exclusion of re-

currence, 100% PPV and 70% NPV, when compared to DCE study. There was strong agreement between tumor activity at DCE and subtraction MRI (p-value <0.001, highly significant, kappa= (0.765) with Area of (95%CI) 0.942 ranging between (0.888-0.997).

On the other hand, wefound that the sensitivity of MRI DWI in the detection of the HCC recurrence =71.2%, with 78.6% specificity in exclusion of recurrence, 92.5% PPV and 42.3% NPV, when compared to DCE study. There was a moderate - but significant-agreement between tumor activity at DCE and MRI DWI (p-value=0.001), kappa (0.375) with Area of (95%CI) 0.749 ranging between (0.604-0.893).

The current study almost agrees with El Said et al., [7] regarding the specificity and PPV of subtraction dynamic MRI that were 100% for each. However their study showed higher sensitivity= 97%. They also found that diffusion weighted imaging showed lower accuracy than subtraction dynamic MRI.

Thecurrent study results were disagreed with Goshima et al., [9], who observed diffusion weighted imaging had a 100% sensitivity, a 65.5% specificity, a positive predictive value of 67.7%, and a negative predictive value of 100% and an overall agreement of 80%.

The results of the current investigation are consistent with those of Hassan et al., [10], who found that subtraction dynamic MRI had a sensitivity of 97.06 percent, a specificity of 100 percent, a positive predictive value of 100 percent, and a negative predictive value of 95 percent. Comparatively, diffusion weighted imaging yields results of 76.47 percent, 90 percent, 92.86 percent, and 69.23 percent, respectively. DWI substantial agreement (kappa=0.728) and Subtraction significant agreement (kappa=0.766) both had p-values below 0.001 and were statistically significant.

Thestudy done by Abd El Hak et al., [11] also reported that DWI had lower specificity than dynamic MRI. Diffusion-weighted imaging exhibited an overall agreement of 82 percent, sensitivity of 95.83 percent, specificity of 69.23 percent, positive predictive value of 74.19 percent, negative predictive value of 94.74 percent, and they discovered that the ADC factors were significantly different between the malignant and negative groups (p-value 0.006). The ROC curve displayed an area under the curve of 0.728 with a standard error of 0.075 and a 95 percent confidence interval of 0.582 to 0.874.

According to Metwally et al., [12], who supported the findings of the current investigation, the subtraction pictures exhibit sensitivity of 96%, specificity of 100%, positive predictive value (PPV) of 100%, and negative predictive value (NPV) of 96%, as opposed to sensitivity of 80% and specificity of 96% for ADC. In ADC, the AUC was 0.842 with a 95% confidence interval ranging from 0.712 to 0.930, generating a significant p-value of 0.001. The AUC of subtraction was 1 with a 95% confidence interval ranging from 0.929 to 1.00.

Kamel et al., [13], showed that there is significant difference in the ADC values for necrotic portions as compared to the viable tumors after TACE and that such difference appeared 1-2 weeks after TACE and is correlated to enhancing components. Our study agrees with their results, apart from that we did the follow-up after 1-1.5 months.

Limitations:

In general, the gold standard in the diagnosis of malignant tumors is histopathology. In the present study, no biopsies were obtained to ensure complete treatment response & necrosis or residual disease, The Standard of reference was not based on biopsy & histology due to ethical and practical difficulties in obtaining correctly targeted biopsies in all cases. From this perspective, it is prone to the limitations inherent to all studies of this design. current study did not take Alpha feto-protein (AFP) tumor marker into consideration due to its inconsistency, since AFP levels can be falsely raised in patients without HCC (e.g. hepatitis, cirrhosis), or it may not be elevated in patients with non-secreting HCC.

Outcome & Conclusion:

In conclusion, MRI is a main tool in detection of tumor viability and complications after TACE. Dynamic contrast enhanced study combined with both post processing subtraction images and diffusion WIs together were useful for HCC post TACE evaluation. The addition of subtraction to DCE has been found to increase the yield of positive lesions with tumoral activity. The agreement between DCE and DWI, though significant is less evident as compared to subtraction. Nevertheless, the addition of DWI to imaging protocol is advisable, since it does not add much to examination time, nor it needs contrast administration, while it can help decision making in equivocal cases, e.g. when motion or misregistration artifacts do exist. In clinical practice, if DWI and ADC figures are in contradiction with DCE, other helpful approaches may include rising AFP assay, progressive course

on close follow-ups, or even histopathology may be needed for confirmation.

References

1- THOENY H.C. and DE KEYZER F.: Extracranial applications of diffusion-weighted magnetic resonance imaging. Eur Radiol., 17 (6): 1385-93, 2007.

2- RAOUL J.L., FORNER A., BOLONDI L., et al.: Updated use of TACE for hepatocellular carcinoma treatment: How and when to use it based on clinical evidence. Cancer Treat. Rev., 72: 28-36, 2019.

3- EBRAHEEM EBEED A., ABD EL-HAMIED ROMEIH M., MOHAMED REFAT M., et al.: Role of dynamic contrast-enhanced and diffusion weighted MRI in evaluation of hepatocellular carcinoma after chemoembolization. Egypt J. Radiol. Nucl. Med., 48: 807-815, 2017.

4- MARIN D., CAPPABIANCA S., NICOLA SERRA, et al.: CT Appearance of Hepatocellular Carcinoma after Locoregional Treatments: AComprehensive Review Gastroenterology Research and Practice, 2015, ID670965, 10 pages. http://dx.doi.org/10.1155/2015/670965.

5- VAN BEERS B.E., DAIRE, et al.: Erratum to “New imaging techniques for liver diseases” J. Hepatol., 62: 690-700]. J. Hepatol., 63 (3): p. 774, 2015.

6- IOANITESCU S., MICU L., MIHAILA M., et al. (2013): Post-therapeutic follow-up and early detection of recurrence in hepatocellular carcinoma. In: Reeves H., editor. Liver Tumors - Epidemiology, Diagnosis, Prevention and Treatment [Internet]. InTech., 2015.

7- EL SAID N.A., KADDAH R.O., ABDEL FATTAH M.S., et al.: Subtraction MRI versus diffusion weighted imaging: Which is more accurate in assessment of hepatocellular carcinoma after trans arterial chemoembolization (TACE)? Egyp J. Radiol. Nucl. Med., 47 (4): 1251-1264, 2016.

8- ELSAYES K.M., HOOKER J.C., AGRONS M.M., et al.: Version of LI-RADS for CT and MR imaging: An update. RadioGraphics, 37: 1994-2017, 2017.

9- GOSHIMA S., KANEMATSU M., KONDO H., et al.: Evaluating local hepatocellular carcinoma recurrence post-transcatheter arterial chemoembolization: Is diffusion-weighted MRI reliable as an indicator? J. Magn Reson Imaging, 27: 834-9, 2008.

10- HASSAN M.S., ABDEL-MUTALEB M.G. and AHMED E.I.: The Role of Diffusion Weighted Magnetic Resonance Imaging and Subtraction Magnetic Resonance imaging in Assessing Treatment Response of Hepatocellular Carcinoma After Transarterial Chemoembolization .The Egyptian Journal of Hospital Medicine, July Vol. 72 (3): Page 4165-4174, 2018.

11- ABD EL HAK M.T., METWALLY N.A. and ABDRABO A.S.M.: Role of Diffusion-Weighted MRI in Hepatocellular Carcinoma Patients Following Transarterial Chemoembolization (TACE). The Egyptian Journal of Hospital Medicine, July Vol. 76 (1): Page 3380-3391, 2019.

12- METWALLY L.A., MAHMOUD B.E. and YEHIA M.: The value of dynamic subtraction MRI technique in the assessment of treatment response of hepatocellular carcinoma to transcatheter arterial chemoembolization. Egyptian Journal of Radiology and Nuclear Medicine, 50: 20, 2019, https://doi.org/10.1186/s43055-019-0024-9.

13- KAMEL I.R., BLUEMKE D.A., RAMSEY D., ABUSEDERA M., TORBENSON M, ENG J., SZARF G. and GESCHWIND J.F.: Role of diffusion-weighted imaging in estimating tumor necrosis after chemoembolization of hepatocellular carcinoma. AJR Am. J. Roentgenol., 181 (3): 708-10, 2003. doi: 10.2214/ajr.181.3.1810708. PMID: 12933464.

التصوير بالرنين المغناطيسى للطرح الديناميكى مقابل التصوير بالانتشار فى تقييم سرطان الخلايا الكبدية بعد الحقن الكيميائى عبر الشرايين

سرطان الخلايا الكبدية (HCC) يمثل السبب الرئيسى الرابع للوفيات المرتبطة بالسرطان. بناءً على نظام تصنيف سرطان الكبد فى برشلونة كلينيك (BCLC)، يعتبر الحقن الكيميائى عبر الشرايين (TACE) هو الخط الأول من العلاج لمرضى سرطان الكبد فى المرحلة المتوسطة وربما المصابين بسرطان الكبد الكبير أو متعدد المراكز. لهذا كان الهدف من الدراسة الحالية هو مقارنة التصوير بالرنين المغناطيسى المحسن بالتباين الديناميكى مع التصوير بالانتشار فى تقييم حالات سرطان الكبد بعد TACE فيما يتعلق بدقتها فى اكتشاف نشاط الورم. شملت الدراسة الحالية ٦٦ حالة من آفات سرطان الخلايا الكبدية (HCC) التى خضعت لعملية الحقن الكيميائى عبر الشرايين. تم الحصول على دراسةالتصوير بالرنين المغناطيسى المعززة للتباين الديناميكى (DCE-MRI) للكبد، وتقنية الطرح الديناميكى والانتشار من ١ إلى ١.٥ شهراً بعد الحقن الكيميائى عبر الشرايين. اثبتت الدراسة أن حساسية الطرح بالرنين المغناطيسى فى الكشف عن تكرار سرطان الكبد=٨٨.٥٪، مع خصوصية استبعاد التكرار=١٠٠٪، NPV 100 %و NPV 70%. فيما يتعلق بنشاط الورم، كان هناك اتفاق قوى ذو دلالة إحصائية بين التصوير بالرنين المغناطيسى الديناميكى وطرح التصوير بالرنين المغناطيسى (p<100.0) و k (Kappa)=0.765 منطقة 95) 0.942% CI) تتراوح بين (٠.٨٨٨–٠.٩٩٧). حساسية انتشار التصوير بالرنين المغناطيسى = ٧١.٢٪، النوعية = ٧٨.٦٪، PPV=92.5% وNPV=42.3%. كان هناك اتفاق ضعيف بين نشاط الورم من خلال دراسة التصوير بالرنين المغناطيسى الديناميكى والانتشار التصوير بالرنين المغناطيسى (p=0.001) وK=0.375، منطقة 95) 07.49% CI) تتراوح بين (٠.٦٠٤–٠.٨٩٣). كان متوسط قيمة ADC للأنسجة المحسنة المتبقية / التكرار = ١.٤٣٧ ± ٠.٤٠٥٨ ومتوسط قيمة ADC للأنسجة النخرية ١.٧٠١ ± ٠.٤٤٠٨ كان متوسط ADC المتزايد فى الأنسجة الميتة ذو دلالة إحصائية (قيمة p<0.001) مع مساحة 95)٪ 0.651 CI) (٠.٤٦٢–٠.٨٤٠) تم العثور على قطع يساوى ١.٣٧٤ من قيمة ADC للتنبؤ بتكرار الحساسية = ٨٠.٧٧٪، النوعية = ٥٧.١٤٪، PPV=87.5% و NPV = 44.4. لهذا يعد إضافة صور الطرح إلى الدراسة الديناميكية جنباً إلى جنب مع الانتشار مفيداً لتقييم الحالات كانت البيانات التى أسفرت عنها مكملة ويجب أن يتم عمل التقنيات نجمعة للحصول على نتائج معبرة عن الحالات.