动态增强MRI在肝细胞癌肝动脉化疗栓塞术后评价中的应用

Application of Dynamic Contrast-Enhanced MRI in Evaluation of Hepatocellular Carcinoma after Transarterial Chemoembolization

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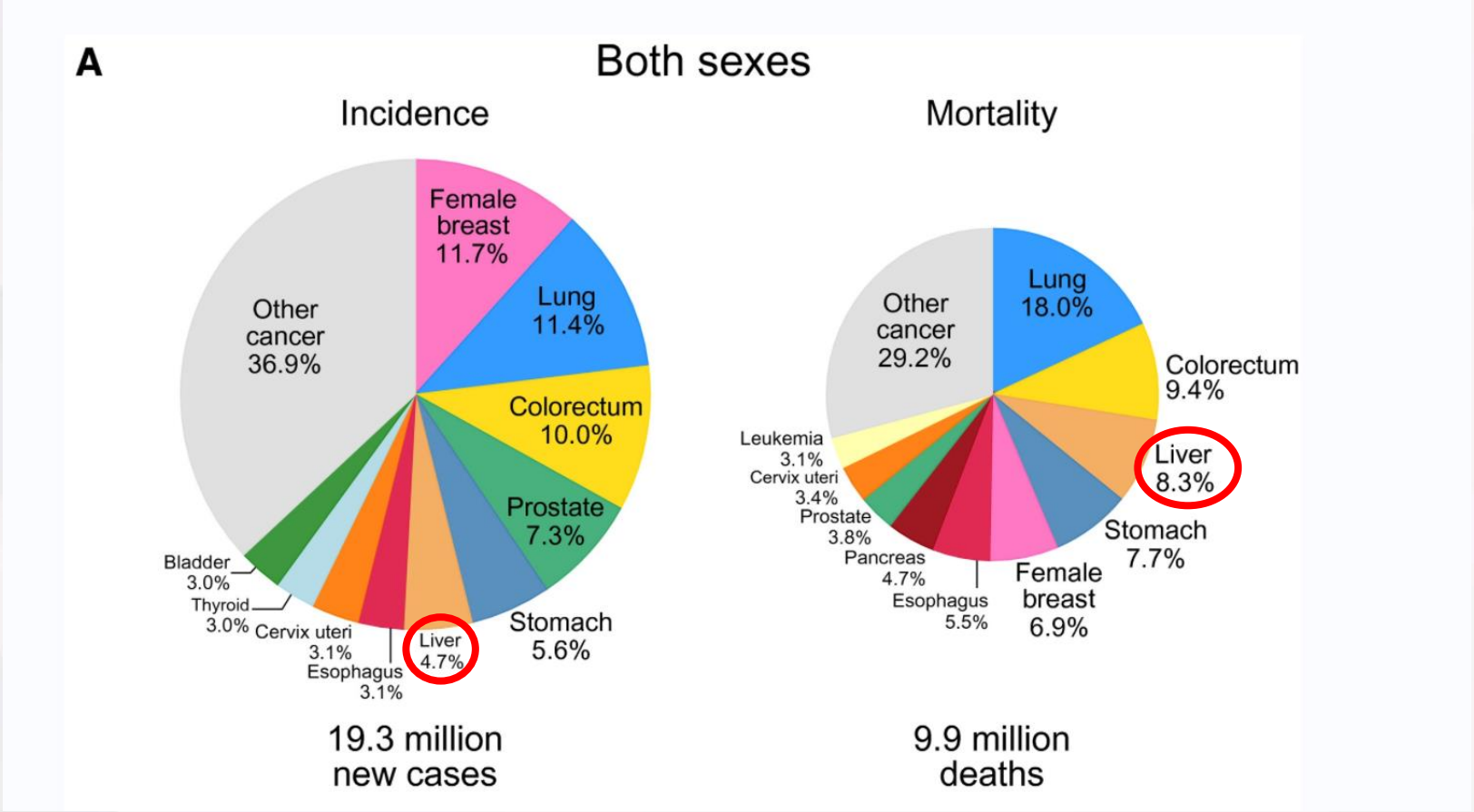
Background

Hepatocellular Carcinoma（HCC）



Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin. 2021 May;71(3):209-249. doi: 10.3322/caac.21660

Background

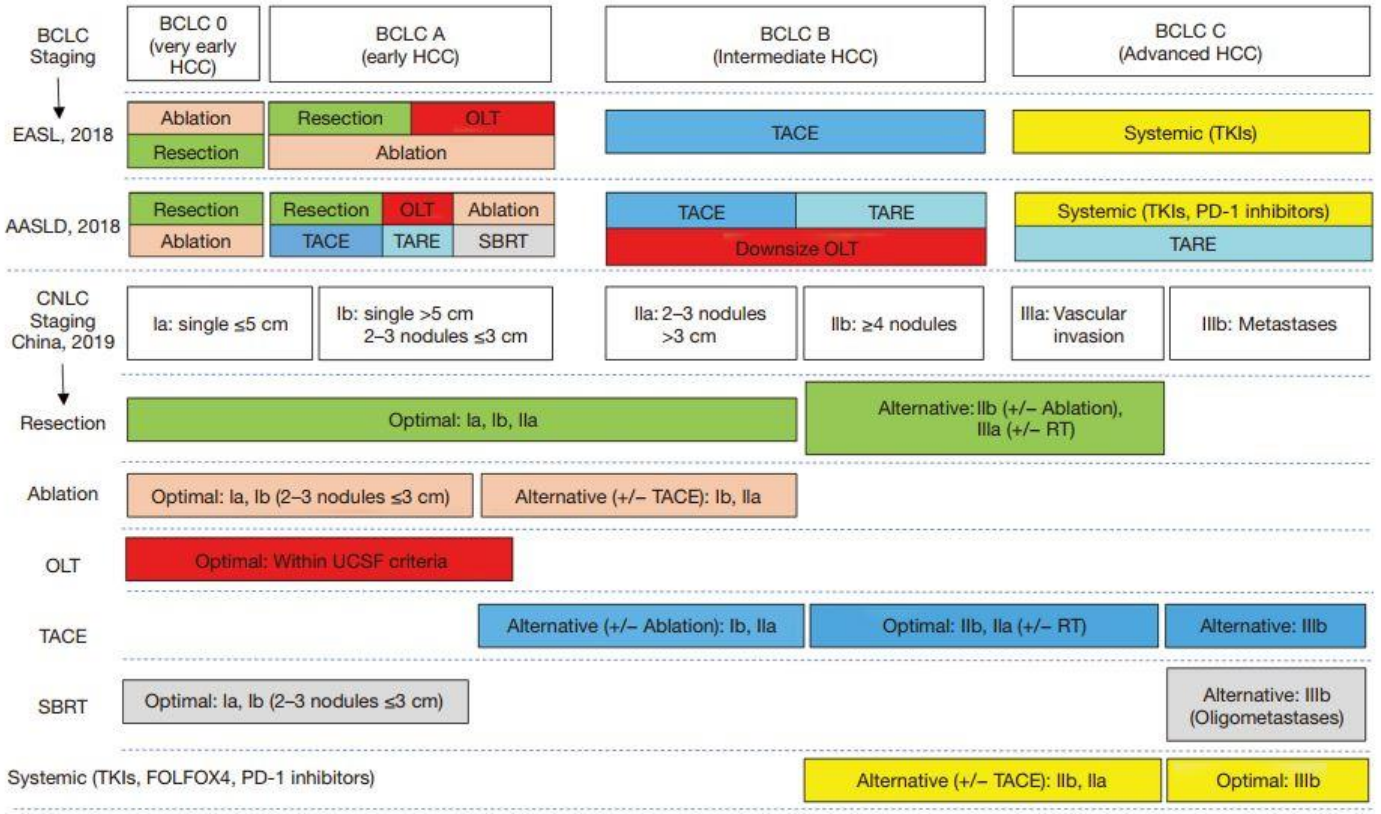


Figure 1 Comparisons of staging and treatment algorithms of HCC among 2018 EASL, 2018 AASLD, and 2019 Chinese guidelines. BCLC, Barcelona Clinic Liver Cancer; EASL, European Association for the Study of the Liver; AASLD, American Association for the Study of Liver Diseases; CNLC, China liver cancer staging; OLT, orthotopic liver transplantation; TACE, transarterial chemoembolization; TARE, transarterial radioembolization; TKIs, tyrosine kinase inhibitors; PD-1, programmed cell death-1; SBRT, stereotactic body radiation therapy; RT, radiation therapy; UCSF, University of California San Francisco; FOLFOX4, infusional fluorouracil, leucovorin, and oxaliplatin regimen.

Transarterial Chemoembolization (TACE) can prolong the survival of patients with unresectable HCC and is an important treatment for intermediate and advanced HCC.

Xie D Y, Ren Z G, Zhou J, et al. 2019 Chinese clinical guidelines for the management of hepatocellular carcinoma: updates and insights[J]. Hepatobiliary Surg Nutr, 2020, 9(4):452-463.

Background

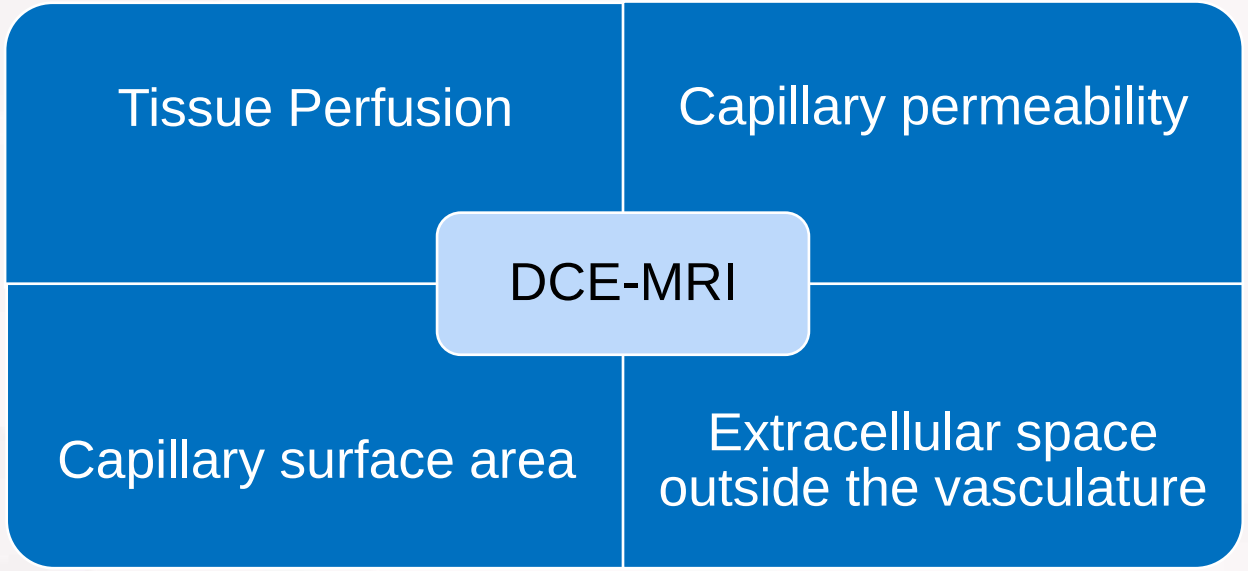
Conventional CT and MR enhanced scanning are commonly used examination methods after TACE

Disadvantages

- Respiratory artifacts, sclerosis artifacts
- Can only be observed morphologically
- Cannot be analyzed quantitatively

Affect diagnostic accuracy！

Background



Dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) is designed to characterize the absorption and elution of the gadolinium-based contrast agent in the target tissues and can directly display the physiological tissue characteristics, such as the tumor blood flow, interstitial and intravascular volumes and capillary permeability.

Purpose

Evaluate the application of DCE-MRI in HCC patients after TACE treatment, to provide a quantitative basis for the identification of different liver tissues, and to provide morphological and functional information for follow-up after HCC treatment.

Materials and Methods

Collected 30 patients with HCC who were reviewed TACE treatment in our hospital

Male：26

Female：4

Age：54±10

Inclusion Criteria

(i) diagnosed with HCC;

(ii) performed TACE treatment in the past 1-3 months;

(iii) need to be undergo TACE retreatment within 1 week after the MR review.

Exclusion Criteria

(i) could not hold their breath for 20s after training, leading to large motion artifacts, which resulted in poor image quality;

(ii) were unable to tested due to claustrophobia;

(iii) did not meet the required flow rate(3ml/s);

(iv) did not complete a TACE retreatment within 7 days after the MR examination or cannot accept the TACE retreatment due to contraindication ;

(v) TAA was not present on MR images and DSA images.

Materials and Methods

1 MRI Scan

The DCE-MRI examination was performed with a 1.5T MRI (MAGNETOM Aera, Siemens Healthineers, Germany) and an 18-channel phased array.

Sequence	Orientation	TR（ms）	TE（ms）	FOV（mm）	Slice thickness(mm)
T2 -weighted HASTE	Axial	1000	95	380×380	6
T1 -weighted FLASH	Axial	6.91	2.39	380×380	3
Diffusion-weighted imaging	Axial	4100	58	380×380	6
T1-weighted Mapping	Axial	3.87	1.39	380×380	3
Radial VIBE	Axial	3.57	1.69	380×380	3

Materials and Methods

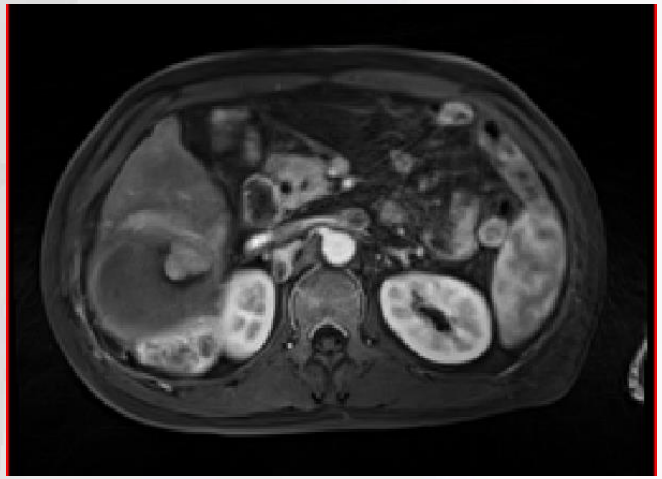
2 TACE Treatment

DSA exams were performed within 2 weeks of the MR scan

The right femoral artery was punctured using the Seldinger technique under local anesthesia, and a 5F contrast catheter was introduced into the celiac trunk, the intrinsic hepatic artery, the right and left hepatic arteries, and the superior mesenteric artery, respectively.

Materials and Methods

DCE-MRI imaging → Omni-Kinetics → Sketching standard arterial input curves → Outlining ROI → pseudo-color map



K^{trans}: volume transfer constant

Kep: exchange rate constant

Ve: volume fraction of extravascular extracel lular space

TTP: time to peak

Max Conc: maximum enhancement concentration

Max Slope: maximum enhancement slope

Materials and Methods

Statistical analyses

Measurement results are described as the mean ± standard deviation. Statistical software (GraphPad Prism; SPSS, and MedCalc) was used to execute all statistical analyses.

- The Kolmogorov-Smirnov test was performed on each variable that had normally distributed data.
- The intraclass correlation coefficient (ICC) test was used to evaluate consistency between the two measurements.
- The differences between TAA, TNA and ANHP parameters were examined by the Kruskal–Wallis H test
- The differential diagnostic efficacy of TAA, TNA and ANHP parameters was explained by drawing a receiver operating characteristic (ROC) curve.

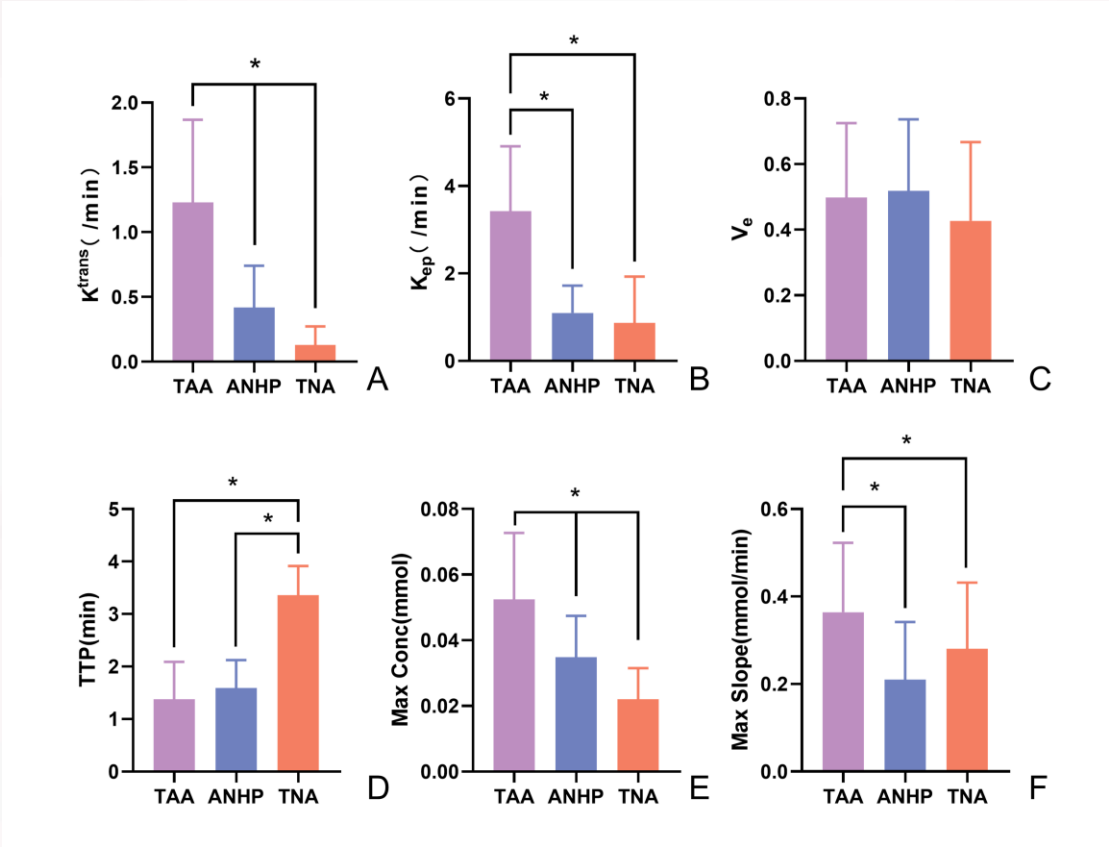
Results

Characteristics		N
Sex		
	Women	4
	Men	26
Age (y)		54±10
Etiology of HCC		
	Hepatitis B virus	24
	Hepatitis C virus	1
	Alcoholism	1
	Cryptogenic	7
No. of HCC lesions per patient		
	Multiple	7
	Single	23
No. of ROIs		
	ROIs of the TAA	40
	ROIs of the TNA	30
	ROIs of the ANHP	40

Data are described as the number of patients, lesions and mean ± standard deviation. HCC: hepatocellular carcinoma; ROIs: regions of interest; TAA: tumor active area; TNA: tumor necrotic area; ANHP: adjacent normal hepatic parenchyma.

Results

Mean values of various parameters of TAA, TNA and ANHP



TAA: tumor active area; TNA: tumor necrotic area; ANHP: adjacent normal hepatic parenchyma

Results

Diagnostic capability of DCE-MRI parameter in distinguishing of different tissues.

	Parameters	AUC	Youden index	Sensitivity	Specificity
TAA and ANHP	K^{trans}(/min)	0.888	0.700	90.00%	80.00%
	K_{ep}(/min)	0.944	0.775	82.50%	95.00%
	V_e	0.528	0.150	42.50%	72.50%
	TTP(min)	0.631	0.275	35.00%	92.50%
	Max Conc(mmol)	0.777	0.550	75.00%	80.00%
	Max Slope(mmol/min)	0.804	0.525	90.00%	62.50%
TAA and TNA	K^{trans}(/min)	0.978	0.908	97.50%	93.33%
	K_{ep}(/min)	0.926	0.767	90.00%	86.67%
	V_e	0.579	0.225	82.50%	40.00%
	TTP(min)	0.973	0.850	95.00%	90.00%
	Max Conc(mmol)	0.911	0.758	82.50%	93.33%
	Max Slope(mmol/min)	0.697	0.383	85.00%	53.33%

TAA: tumor active area; TNA: tumor necrotic area; ANHP: adjacent normal hepatic parenchyma

Conclusion

In conclusion, DCE-MRI can quantitatively analyze the information of different tissues in the liver of HCC patients after TACE, which has potential application value for more accurate evaluation of the curative effect after tumor treatment.

THANK YOU FOR YOUR ATTENTION