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EDITORIAL

Sun HY, Li ZC, Wang HL. Current mechanisms and techniques for placement of self-expandable metal stents in acute colonic obstruction. *World J Gastrointest Surg* 2025; 17(11): 110512 [DOI: [10.4240/wjgs.v17.i11.110512](https://doi.org/10.4240/wjgs.v17.i11.110512)]

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FIELD OF VISION

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MINIREVIEWS

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ORIGINAL ARTICLE

Case Control Study

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SYSTEMATIC REVIEWS

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CASE REPORT

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ABOUT COVER

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The primary aim of *World Journal of Gastrointestinal Surgery* (*WJGS*, *World J Gastrointest Surg*) is to provide scholars and readers from various fields of gastrointestinal surgery with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJGS mainly publishes articles reporting research results and findings obtained in the field of gastrointestinal surgery and covering a wide range of topics including biliary tract surgical procedures, biliopancreatic diversion, colectomy, esophagectomy, esophagostomy, pancreas transplantation, and pancreatectomy, etc.

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Retrospective Study

Quantitative evaluation for preoperative clinical stage of colorectal cancer using dynamic contrast-enhanced magnetic resonance imaging

Li-Hong Guo, Wei Qin, Xin-Hua Ou-Yang, Ye-Xing Wang

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Abstract

BACKGROUND

The management of patients with colorectal cancer (CRC) mainly lies on the use of magnetic resonance imaging (MRI) technique as a diagnostic tool for both staging and restaging.

AIM

To explore the preoperative value of quantitative parameters of dynamic contrast-enhanced MRI (DCE-MRI) in evaluating clinical stages of CRC.

METHODS

A total of 86 CRC patients undergoing DCE-MRI examinations were included and then classified into CRC group ($n = 46$) and benign tumor group ($n = 40$) according to surgical and pathological results. Quantitative parameters of DCE-MRI, including volume transfer constant (K_{trans}), rate constant (K_{ep}) and extravascular extracellular volume fraction (V_e), were analyzed between two groups and among CRC at different stages. Receiver operating characteristic (ROC) curves with of quantitative parameters of DCE-MRI for clinical diagnosis and preoperative staging of CRC were plotted.

RESULTS

The CRC group had 9 cases with tumor in the upper segment, 21 cases in the middle segment, 16 in the low segment, 10 cases with well differentiation, 27 cases with moderate differentiation, and 9 cases with poor differentiation. The K_{trans},

Kep, and Ve in the CRC group were higher than those in the benign tumor group ($P < 0.05$). The ROC curves indicated that the optimal cutoff values of Ktrans, Kep and Ve for diagnosing CRC were 0.905 minute⁻¹, 0.225 minute⁻¹ and 0.585%, respectively. The Ktrans, Kep and Ve as a combined tool to diagnose CRC yielded 0.863 of area under the curve and 82.60% of sensitivity, and both values were higher than those yielded by Ktrans, Kep, or Ve alone ($P < 0.05$). The Ktrans, Kep and Ve in CRC patients at T3-T4 stage or N1-N2 stage were higher than those at T1-T2 stage or N0 stage ($P < 0.05$). Results of Spearman correlation analysis showed that the Ktrans, Kep and Ve were correlated with advanced T and N stages in CRC patients ($P < 0.05$). The ROC results indicated that the Ktrans produced a higher specificity (81.48%) and sensitivity (94.70%) in evaluating preoperative T stage of CRC. The Kep generated a higher specificity (96.00%) and sensitivity (81.00%) in evaluating preoperative N stage of CRC.

CONCLUSION

The study suggests that the values of Ktrans, Kep and Ve of DCE-MRI exhibit good performance in diagnosing CRC and preoperative assessment of clinical stages. However, relatively small sample size should be considered for data interpretation.

Key Words: Dynamic contrast-enhanced magnetic resonance imaging; Colorectal cancer; Volume transfer constant; Rate constant; Extravascular extracellular volume fraction

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Core Tip: Patients with colorectal cancer exhibited higher values of quantitative parameters [volume transfer constant (Ktrans), rate constant (Kep) and extravascular extracellular volume fraction (Ve)] of dynamic contrast-enhanced magnetic resonance imaging than those with benign tumor. Increased values of Ktrans, Kep, and Ve were correlated with more advanced primary tumor and lymph node stages. The values of Ktrans, Kep and Ve exhibited good performance in diagnosing colorectal cancer and preoperative assessment of clinical stages.

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INTRODUCTION

Colorectal cancer (CRC) is the world's third most frequently diagnosed cancer with almost 1.8 million new cases and the world's second most deadly cancer with an estimated number of 881000 deaths in 2018[1]. Rising trends in the incidence and mortality of early-onset CRC (age under 50 years) have been noted globally[2]. In addition to advanced ageing and dietary patterns, unfavorable risk factors, such as obesity, lack of physical exercise, and smoking, may contribute to the development of CRC[3]. Among new diagnoses of CRC, 20% of patients are affected by metastatic CRC and 25% of patients manifested with localized disease likely evolving into metastases[4]. The 1-year survival rate of patients diagnosed with metastatic CRC ranges from 70% to 75%, the 3-year survival rate ranges from 30% to 35%, and the 5-year survival rate is fewer than 20%[5]. The current standard treatment options for CRC are including but not limited to endoscopic and surgical excision of tumors, preoperative radiotherapy and systemic therapy, targeted therapy, and immunotherapy[6]. Preoperative assessment of T-staging is very important for selection of optimal treatment methods for CRC. There are multimodal approaches for preoperative assessment of CRC patients, including endoscopic evaluation and clinical, radiographic, and biochemical assessment, besides to impart valuable information about tumor grade through a diagnosis, histologic review of biopsy specimens, also to offer other key prognostic characteristics for treatment choice[7].

Over the last two decades, magnetic resonance imaging (MRI) has received much attention in the prediction and management of human cancers[8]. Dynamic contrast-enhanced MRI (DCE-MRI), as an emerging imaging technique based on MRI, allows functional characterization of tissue perfusion and vascularity, which serves as a surrogate biomarker of tumor angiogenesis and has been widely utilized in oncology[9]. With regarding to the application of DCE-MRI in CRC, recent studies increasingly focus on its evaluation on distant disease-free survival and response to treatment in locally advanced CRC[10,11]. A previous study demonstrated a higher diagnostic value conferred by DCE-MRI than conventional MRI in predicting extramural vascular invasion in patients with CRC[12]. The temporal signatures of DCE-MRI data are interpreted through qualitative, semi-quantitative, and quantitative approaches[13]. The quantitative DCE-MRI parameters, volume transfer constant (Ktrans) and apparent diffusion coefficient values, may serve as independent predictors of extramural vascular invasion in CRC prior to surgery[14]. To the best of our knowledge, previous studies mainly analyzed preoperative therapy response and prognostic assessment in CRC by DCE-MRI[15,16]. In this study, we performed DCE-MRI examinations prior to surgical pathology to investigate the preoperative value of quantitative

parameters of DCE-MRI in evaluating clinical stages of CRC.

MATERIALS AND METHODS

Patients

A total of 86 CRC patients who were admitted into Xiangyang Central Hospital from January 2022 to January 2024 were recruited. The inclusion criteria were: The primary diagnosis of CRC or benign tumors was confirmed by surgical pathology; patients aged not less than 18 years; and patients underwent DCE-MRI examinations with detailed imaging data. The exclusion criteria were: Patients received radiotherapy, chemotherapy, or any anti-tumor treatments prior to DCE-MRI examinations; patients had contraindications to DCE-MRI examinations; patients had other diagnosis of malignant tumors; patients had too poor-quality images to meet diagnostic criteria; and patients had heart, liver and kidney dysfunction or autoimmune diseases. Eligible patients were split into CRC group ($n = 46$) and benign tumor group ($n = 40$) according to surgical and pathological results. There were 28 males and 18 females in the CRC group, and their age ranged from 20 years to 68 years old, with an average age of (51.67 ± 6.28) years. The CRC group had 9 cases with tumor in the upper segment, 21 cases in the middle segment, 16 in the low segment, 10 cases with well differentiation, 27 cases with moderate differentiation, and 9 cases with poor differentiation. There were 22 males and 18 females in the benign tumor group; and their age ranged from 21 years to 69 years old, with an average age of (52.03 ± 7.09) years. No significant difference in gender distribution, age, tumor location, and histological grade was noted between the two groups of patients ($P > 0.05$).

DCE-MRI examinations

All patients were examined with the aid of the MRI scanner (Siemens Avanto, 1.5T), before which all of them should be fasted (water and food both) for at least 6 h, and their bladder and bowels should be empty. The patients were placed in a supine position with the head in front. The line connecting the bilateral anterior superior iliac spines of the patient as the positioning line was selected to complete the following 4 sequence scans: (1) Sagittal turbo spin echo (TSE) T1 weighted images T1W1 (repetition time: 3200 milliseconds, echo time: 85 milliseconds, field of view: 260 mm \times 260 mm, excitation frequency: 2, matrix: 256 \times 320, layer thickness: 5 mm, and interlayer spacing: 1 mm); (2) Axial TSE T2 weighted images (repetition time: 6450 milliseconds, echo time: 105 milliseconds, field of view: 268 mm \times 385 mm, excitation frequency: 2, matrix: 320 \times 320, layer thickness: 3 mm, and interlayer spacing: 1 mm); (3) Axial TSE T1 weighted images (repetition time: 4600 milliseconds, echo time: 20 milliseconds, field of view: 380 mm \times 380 mm, excitation frequency: 1, matrix: 320 \times 320, layer thickness: 3 mm, and interlayer spacing: 1 mm); and (4) Coronal TSE compression T2 weighted images (repetition time: 2800 milliseconds, echo time: 90 milliseconds, field of view: 380 mm \times 380 mm, excitation frequency: 1, matrix: 256 \times 256, layer thickness: 5 mm, and interlayer spacing: 1 mm). During DCE-MRI examinations, a three-dimensional vibration imaging sequence was used, with repetition time: 3.25 milliseconds, echo time: 90 milliseconds, field of view: 360 mm \times 360 mm, excitation frequency: 1, matrix: 155 \times 195, spacing: 1.0 mm, and thickness: 1.2 mm. A total of 35 scans were performed, 8 seconds per scan. During the third scan, the patient was given a push injection of contrast agents (Gadopentetic acid Dimeglumine Salt Injection) *via* the elbow vein, with an injection dose of 0.1 mmol/kg and an injection rate of 3 mL/second. Once the contrast injection was completed, normal saline was injected at the same speed with an injection dose of 15 mL. DCE-MRI image analysis was performed.

Image analysis

The scanned images were transferred into the working station, and the region of interest (ROI) was delineated with an area ranging from 5-15 mm², with the time-signal curve of the ROI obtained. Two physicians with 5 years or more of diagnostic experience independently analyzed the DCE-MRI images. Three ROIs with 4 mm² for each were manually delineated at the maximum lesion level while avoiding liquefaction, cystic necrosis, bleeding, and other areas. The quantitative values of DCE-MRI were obtained, mainly including Ktrans, rate constant (Kep), and extravascular extracellular volume fraction (Ve). The final result was the average of three independent measurements.

Preoperative evaluation of clinical stage

According to the surgically pathological results and clinical staging criteria of CRC 29616422, T stages are graded as T1, T2, T3, and T4. T1 stage suggests tumor cell invasion of the submucosal layer, T2 stage suggests invasion of the intrinsic muscle layer by tumor cells, T3 stage suggests tumor cell invasion of intestinal tissues and subserosal layer, and T4 stage suggests tumor cell invasion of adjacent organs. N staging reflects the status of regional lymph node metastasis and is graded as N0, N1, and N2 stages, with N0 stage indicating no lymph node metastasis, N1 stage indicating 1-3 of extraintestinal lymph node metastases, and N2 stage indicating more than 4 of extraintestinal lymph node metastases.

Outcome variables

The Ktrans, Kep, and Ve values were compared between CRC patients and those with benign tumors. The diagnostic performance of Ktrans, Kep, and Ve values for CRC was evaluated. The Ktrans, Kep, and Ve values of CRC patients with different T and N stages were compared. The Spearman correlation between Ktrans, Kep, Ve values and T and N stages of CRC was analyzed. The diagnostic performance of Ktrans, Kep, and Ve values for T and N stages of CRC was assessed.

Statistical analysis

We performed data analysis by using the SPSS version 22 (IBM, New York, NY, United States). Results included qualitative variables (summarized as percentages) and quantitative variables (summarized as mean \pm SD). Student's *t* test was carried out to examine statistical differences of quantitative variables. Fisher's exact test was carried out for qualitative variables. Spearman correlation analysis was employed to identify the correlation between Ktrans, Kep, Ve, and clinical stages. Receiver operating characteristic (ROC) curves and its summary statistics [area under the curve (AUC)] was analyzed to assess the diagnostic performance of Ktrans, Kep, and Ve in clinical stages of CRC. A significant difference by statistical analysis was indicated by $P < 0.05$.

RESULTS

Values of Ktrans, Kep, or Ve between CRC and benign tumors

The mean values of Ktrans, Kep, or Ve in the CRC group were 1.03, 2.31, and 0.59, respectively. The mean values of Ktrans, Kep, or Ve in the benign tumor group were 0.72, 2.02, and 0.50, respectively. The CRC group exhibited notably higher values of Ktrans, Kep, or Ve than the benign tumor group ($P < 0.001$, [Table 1](#)).

The diagnostic performance of Ktrans, Kep, or Ve for CRC

The ROC results showed that the optimal cutoff values for Ktrans, Kep, or Ve in diagnosing CRC are 0.905 minute^{-1} , 0.225 minute^{-1} , and 0.585%, respectively. The Ktrans, Kep and Ve as a combined tool to diagnose CRC yielded 0.863 of AUC and 82.60% of sensitivity, and both values were higher than those yielded by Ktrans, Kep, or Ve alone ($P < 0.05$, [Table 2](#)).

Values of Ktrans, Kep, and Ve in CRC patients with different T and N stages

The mean values of Ktrans, Kep, and Ve in CRC patients with T1-T2 in the CRC group were 0.87, 2.10, and 0.53, respectively. The mean values of Ktrans, Kep, and Ve in CRC patients with T3-T4 were 1.24, 2.61, and 0.67, respectively. The CRC patients with T3-T4 exhibited notably higher values of Ktrans, Kep, and Ve than CRC patients with T1-T2 ($P < 0.05$). The mean values of Ktrans, Kep, and Ve in CRC patients with N0 in the CRC group were 0.92, 2.05, and 0.52, respectively. The mean values of Ktrans, Kep, and Ve in CRC patients with N1-N2 were 1.16, 2.63, and 0.67, respectively. The CRC patients with N1-N2 displayed notably higher values of Ktrans, Kep, and Ve than CRC patients with N0 ($P < 0.05$, [Table 3](#)).

Spearman correlation between Ktrans, Kep, Ve, T and N stages of CRC

As shown in [Table 4](#), Spearman correlation analysis showed the values of Ktrans, Kep, and Ve were positively correlated with advanced T stages of CRC. Similar correlations were noted between the values of Ktrans, Kep, Ve, and advanced N stage of CRC.

Preoperative evaluation of Ktrans, Kep, and Ve for T and N stages of CRC

The ROC results demonstrated that the AUC of Ktrans, Kep, and Ve for evaluating preoperative T stages of CRC are 0.930, 0.828, and 0.872, respectively. Among them, the Ktrans exhibited high specificity (81.48%) and sensitivity (94.70%), as shown in [Table 5](#). The AUC of Ktrans, Kep, and Ve for evaluating preoperative N stages of CRC were 0.773, 0.927, and 0.649, respectively. Among them, the Kep exhibited higher specificity (96.00%) and sensitivity (81.00%), as shown in [Table 6](#).

DISCUSSION

It is reported that the risk factors of CRC are complex and multiple, mainly including heredity, dietary habits, and living environment[17]. Due to inability to diagnose it at an early stage, most of CRC patients usually missed their best opportunity for surgery at the time of diagnosis, ultimately with poor prognosis[18]. Accurate preoperatively assessment on the pathological staging of CRC patients before surgery is a key step for treatment plans, and it is of great significance for improving lesion resection rate and anal preservation rate, as well as reducing the risk of recurrence[19]. Conventional MRI imaging examinations only can reflect the morphological changes of patients' tumors, while DCE-MRI examinations can accurately reflect the microcirculation status of lesions, combine tumor morphology with hemodynamics to provide high insights to distinguish benign and malignant lesions and evaluate T or N staging[20]. This study demonstrated the three quantitative parameters of DCE-MRI, Ktrans, Kep and Ve, as a combined tool exhibited high value in diagnosing CRC and preoperative assessment of T or N staging of CRC.

DCE-MRI can quantitatively analyze the distribution and diffusion of contrast agents inside and outside the blood vessels of patients, which has three main quantitative parameters include Ktrans, Kep and Ve[21]. The Ktrans represents the diffusion rate of contrast agents entering the blood vessels, which is closely related to the permeability of the lesion microvessels[22]. The Kep represents the rate at which contrast agent returns from outside the blood vessels, and this parameter level is positively correlated with the malignancy of the lesion[23]. The Ve, on the other hand, represents the ratio of extracellular space to unit volume, which can indirectly reflect the metabolic capacity of the lesion[24]. The results of this study showed that the CRC group exhibited notably higher values of Ktrans, Kep, or Ve than the benign tumor group, indicating that the DCE-MRI quantitative parameters, Ktrans, Kep, or Ve, in CRC patients were abnormally

Table 1 The values of volume transfer constant, rate constant, or extravascular extracellular volume fraction in the colorectal cancer and benign tumor group

Group	Case	Ktrans (minute ⁻¹)	Kep (minute ⁻¹)	Ve (%)
CRC	46	1.03 ± 0.28	2.31 ± 0.34	0.59 ± 0.11
Benign tumor	40	0.72 ± 0.24	2.02 ± 0.30	0.50 ± 0.06
<i>t</i>		5.469	4.165	4.610
<i>P</i> value		< 0.001	< 0.001	< 0.001

Ktrans: Volume transfer constant; Kep: Rate constant; Ve: Extravascular extracellular volume fraction; CRC: Colorectal cancer.

Table 2 The diagnostic performance of volume transfer constant, rate constant, and extravascular extracellular volume fraction alone or as a combined tool for colorectal cancer

Parameter	Cutoff value	AUC	SE	Sig	95%CI	Youden index	Specificity (%)	Sensitivity (%)
Ktrans (minute ⁻¹)	0.905 minute ⁻¹	0.814	0.045	0.000	0.725-0.903	0.496	80.00	69.60
Kep (minute ⁻¹)	2.225 minute ⁻¹	0.765	0.051	0.000	0.665-0.866	0.396	70.00	69.60
Ve (%)	0.585%	0.795	0.048	0.000	0.701-0.889	0.497	97.50	52.20
Combine	-	0.863	0.043	0.000	0.779-0.947	0.726	90.00	82.60

Ktrans: Volume transfer constant; Kep: Rate constant; Ve: Extravascular extracellular volume fraction; AUC: Area under the curve; SE: Standard error; Sig: Significance; CI: Confidence interval.

Table 3 Values of volume transfer constant, rate constant, and extravascular extracellular volume fraction in colorectal cancer patients with different T and N stages

Stage	Case	Ktrans (minute ⁻¹)	Kep (minute ⁻¹)	Ve (%)	
T stage	T1-T2	27	0.87 ± 0.20	2.10 ± 0.29	0.53 ± 0.12
	T3-T4	19	1.24 ± 0.25	2.61 ± 0.37	0.67 ± 0.13
	<i>t</i>	-	5.570	5.239	3.765
	<i>P</i> value	-	< 0.001	< 0.001	0.001
N stage	N0	25	0.92 ± 0.18	2.05 ± 0.36	0.52 ± 0.11
	N1-N2	21	1.16 ± 0.22	2.63 ± 0.39	0.67 ± 0.14
	<i>t</i>	-	4.071	5.240	4.069
	<i>P</i> value	-	< 0.001	< 0.001	< 0.001

Ktrans: Volume transfer constant; Kep: Rate constant; Ve: Extravascular extracellular volume fraction.

upregulated, which is similar to the results of Yang *et al*[25]. This may be explained by the fact that the vascular development of benign tumors is similar to that of normal blood vessels, showing similar permeability[26]. However, patients with CRC, due to poor vascular development and fewer muscle layers, exhibit abnormally increased vascular permeability[27]. After injecting the contrast agents into the interstitial space of the patient's lesion tissue, the diffusion rate of the contrast agent is faster, and the vascular perfusion at the tumor site is more vigorous, resulting in higher values of Ktrans, Kep, and Ve[28]. The ROC curves indicated that the optimal cutoff values of Ktrans, Kep and Ve for diagnosing CRC were 0.905 minute⁻¹, 0.225 minute⁻¹ and 0.585%, respectively. The Ktrans, Kep and Ve as a combined tool to diagnose CRC yielded 0.863 of AUC and 82.60% of sensitivity, and both values were higher than those yielded by Ktrans, Kep, or Ve alone, indicating that the DCE-MRI quantitative parameters Ktrans, Kep, and Ve can complement each other and improve the clinical diagnostic efficiency of CRC. DCE-MRI has the advantage of repeated and rapid imaging, based on the microvascular system of the lesion, and can be used for clinical evaluation of tissue lesions and related physiological properties, with potential value in reflecting preoperative staging of CRC[29]. Additionally, The Ktrans, Kep and Ve in CRC patients at T3-T4 stage or N1-N2 stage were higher than those at T1-T2 stage or N0 stage. The ROC results indicated that the Ktrans produced a higher specificity (81.48%) and sensitivity (94.70%) in evaluating

Table 4 Spearman correlation analysis of volume transfer constant, rate constant, and extravascular extracellular volume fraction with T and N stages of colorectal cancer

Parameter	T stage		N stage	
	r	P value	r	P value
Ktrans (minute ⁻¹)	0.528	0.002	0.519	0.002
Kep (minute ⁻¹)	0.503	0.004	0.602	0.001
Ve (%)	0.496	0.005	0.520	0.002

Ktrans: Volume transfer constant; Kep: Rate constant; Ve: Extravascular extracellular volume fraction.

Table 5 Preoperative evaluation of volume transfer constant, rate constant, and extravascular extracellular volume fraction for T stage of colorectal cancer

Parameter	Cutoff value	AUC	SE	Sig	95%CI	Youden index	Specificity (%)	Sensitivity (%)
Ktrans (minute ⁻¹)	0.935 minute ⁻¹	0.930	0.036	0.000	0.859-1.000	0.762	81.48	94.70
Kep (minute ⁻¹)	2.135 minute ⁻¹	0.828	0.062	0.000	0.707-0.950	0.546	70.37	84.20
Ve (%)	0.580%	0.872	0.051	0.000	0.772-0.973	0.620	77.78	84.20

AUC: Area under the curve; SE: Standard error; Sig: Significance; CI: Confidence interval; Ktrans: Volume transfer constant; Kep: Rate constant; Ve: Extravascular extracellular volume fraction.

Table 6 Preoperative evaluation of volume transfer constant, rate constant, and extravascular extracellular volume fraction for N stage of colorectal cancer

Parameter	Cutoff value	AUC	SE	Sig	95%CI	Youden index	Specificity (%)	Sensitivity (%)
Ktrans (minute ⁻¹)	0.935 minute ⁻¹	0.773	0.072	0.002	0.633-0.914	0.530	72.00	81.00
Kep (minute ⁻¹)	2.470 minute ⁻¹	0.927	0.042	0.000	0.826-1.000	0.770	96.00	81.00
Ve (%)	0.585%	0.649	0.081	0.085	0.489-0.808	0.171	60.00	57.10

AUC: Area under the curve; SE: Standard error; Sig: Significance; CI: Confidence interval; Ktrans: Volume transfer constant; Kep: Rate constant; Ve: Extravascular extracellular volume fraction.

preoperative T stage, and the Kep generated a higher specificity (96.00%) and sensitivity (81.00%) in evaluating preoperative N stage. The main reason is that, as T stage and N stage advanced, the growth and malignant behavior of tumor cells in the patient’s body are enhanced, followed by accumulating new blood vessels, enhanced microvascular density, and increased permeability, thereby accelerating the diffusion rate of contrast agents, manifested as an increase in Ktrans value[30]. On the other hand, with the improvement of tumor staging, the local blood flow perfusion and permeability of the tumor increase, thereby promoting the increase of contrast agent reflux rate[31]. At the same time, more contrast agents flow into the extracellular space, resulting in an increase in Kep and Ve values[32]. The ROC results indicated that the Ktrans produced a higher specificity (81.48%) and sensitivity (94.70%) in evaluating preoperative T stage, and the Kep generated a higher specificity (96.00%) and sensitivity (81.00%) in evaluating preoperative N stage, indicating that DCE-MRI quantitative parameters have good efficacy in evaluating preoperative T staging and N staging of CRC.

CONCLUSION

In conclusion, DCE-MRI could reflect tumor blood flow perfusion and local microcirculation status. Its quantitative parameters, Ktrans, Kep and Ve, exhibit good performance in diagnosing CRC and preoperative assessment of clinical stages, which helps to evaluate CRC progression and provide reference for clinical selection and treatment planning. However, we must admit there is relatively small size for this study, which create a future requirement for larger cohort studies.

FOOTNOTES

Author contributions: Guo LH and Qin W designed the research and wrote the first manuscript, they contributed equally to this article, they are the co-first authors of this manuscript; Guo LH, Qin W, Ou-Yang XH, and Wang YX contributed to conceiving the research and analyzing data; Ou-Yang XH and Wang YX contributed equally to this article, they are the co-corresponding authors of this manuscript; Guo LH and Qin W conducted the analysis and provided guidance for the research; and all authors reviewed and approved the final manuscript.

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