

# World Journal of *Clinical Cases*

*World J Clin Cases* 2022 July 26; 10(21): 7187-7619



## OPINION REVIEW

- 7187 Effects of glucocorticoids on leukocytes: Genomic and non-genomic mechanisms  
*Jia WY, Zhang JJ*

## MINIREVIEWS

- 7195 Apheresis: A cell-based therapeutic tool for the inflammatory bowel disease  
*Yasmin F, Najeeb H, Naeem U, Moeed A, Koritala T, Surani S*
- 7209 *Helicobacter pylori* infection and small intestinal bacterial overgrowth—more than what meets the eye  
*Dharan M, Wozny D*
- 7215 Anatomy of the anterolateral ligament of the knee joint  
*Park JG, Han SB, Rhim HC, Jeon OH, Jang KM*

## ORIGINAL ARTICLE

## Clinical and Translational Research

- 7224 Molecular mechanisms of Biyu decoction as treatment for psoriasis: A network pharmacology and molecular docking study  
*Wang Z, Zhang HM, Guo YR, Li LL*
- 7242 Expression of hepatocyte nuclear factor 4 alpha, wingless-related integration site, and  $\beta$ -catenin in clinical gastric cancer  
*Hu Q, Li LL, Peng Z, Yi P*

## Case Control Study

- 7256 Improved Pittsburgh Sleep Quality Index scores on first postoperative night achieved by propofol anesthesia in patients undergoing ambulatory gynecologic surgery  
*Hu CH, Chou WY*
- 7265 Efficacy of Guhong injection *versus* Butylphthalide injection for mild ischemic stroke: A multicenter controlled study  
*Zhang WW, Xin J, Zhang GY, Zhai QJ, Zhang HM, Wu CS*

## Retrospective Study

- 7275 Clinical values of Barcelona Clinic Liver Cancer subgroup and up-to-7 criteria in intermediate stage hepatocellular carcinoma with transcatheter arterial chemoembolization  
*Lee SW, Peng YC, Lien HC, Ko CW, Tung CF, Chang CS*
- 7285 Intervention effect of encouraging mental and programmed nursing of patients in interventional operating room on their compliance and bad moods  
*Chi RB, Cai YY, Mao HP*

- 7293** Preoperative neoadjuvant chemotherapy in patients with breast cancer evaluated using strain ultrasonic elastography  
*Pan HY, Zhang Q, Wu WJ, Li X*
- 7302** Risk factors for delayed intracranial hemorrhage secondary to ventriculoperitoneal shunt: A retrospective study  
*Chen JC, Duan SX, Xue ZB, Yang SY, Li Y, Lai RL, Tan DH*
- 7314** Sequential treatment of severe pneumonia with respiratory failure and its influence on respiratory mechanical parameters and hemodynamics  
*Niu BY, Wang G, Li B, Zhen GS, Weng YB*
- 7324** Effects of alendronate sodium combined with InterTan on osteoporotic femoral intertrochanteric fractures and fracture recurrence  
*Wang KM, Wei SP, Yin XY, Meng QJ, Kong YM*
- 7333** Correlation of magnetic resonance imaging quantitative parameters and apparent diffusion coefficient value with pathological breast cancer  
*Wang Z, Ren GY, Yin Q, Wang Q*
- 7341** Risk factors for delirium after surgery for craniocerebral injury in the neurosurgical intensive care unit  
*Chen RY, Zhong CH, Chen W, Lin M, Feng CF, Chen CN*

**Observational Study**

- 7348** Effect of osteoarthritic knee flexion deformity correction by total knee arthroplasty on sagittal spinopelvic alignment in Indian population  
*Puthiyapura LK, Jain M, Tripathy SK, Puliappadamb HM*
- 7356** Imaging characteristics of orbital peripheral nerve sheath tumors: Analysis of 34 cases  
*Dai M, Wang T, Wang JM, Fang LP, Zhao Y, Thakur A, Wang D*

**Randomized Controlled Trial**

- 7365** Comparison of involved-field intensity-modulated radiotherapy combined with S-1 *vs* radiotherapy alone for elderly patients with esophageal cancer  
*Liu LH, Yan MH, Di YP, Fu ZG, Zhang XD, Li HQ*

**Randomized Clinical Trial**

- 7376** Dexmedetomidine in pediatric unilateral internal inguinal ring ligation  
*Liu G, Zhang L, Wang HS, Lin Y, Jin HQ, Wang XD, Qiao WN, Zhang YT, Sun JQ, Liu ZN*

**META-ANALYSIS**

- 7386** Impact of cancer on mortality rates in patients with sepsis: A meta-analysis and meta-regression of current studies  
*Xiang MJ, Chen GL*

## CASE REPORT

- 7397** Updated clinical and glycomic features of mannosyl-oligosaccharide glucosidase deficiency: Two case reports  
*Abuduxikuer K, Wang L, Zou L, Cao CY, Yu L, Guo HM, Liang XM, Wang JS, Chen L*
- 7409** Solitary necrotic nodules of the liver with "ring"-like calcification: A case report  
*Bao JP, Tian H, Wang HC, Wang CC, Li B*
- 7415** Corticosteroid-induced bradycardia in multiple sclerosis and maturity-onset diabetes of the young due to hepatocyte nuclear factor 4-alpha mutation: A case report  
*Sohn SY, Kim SY, Joo IS*
- 7422** Essential thrombocythemia with non-ST-segment elevation myocardial infarction as the first manifestation: A case report  
*Wang ZM, Chen WH, Wu YM, Wang LQ, Ye FL, Yin RL*
- 7429** Extranasopharyngeal angiofibroma in children: A case report  
*Yan YY, Lai C, Wu L, Fu Y*
- 7438** Deep Sylvian fissure meningiomas: A case report  
*Wang A, Zhang X, Sun KK, Li C, Song ZM, Sun T, Wang F*
- 7445** Acute pulmonary embolism originating from upper limb venous thrombosis following breast cancer surgery: Two case reports  
*Duan Y, Wang GL, Guo X, Yang LL, Tian FG*
- 7451** Managing spondylitis tuberculosis in a patient with underlying diabetes and hypothyroidism: A case report  
*Novita BD, Muliono AC, Wijaya S, Theodora I, Tjahjono Y, Supit VD, Willianto VM*
- 7459** Ovarian mucinous tumor with mural nodules of anaplastic carcinoma: Three case reports  
*Wang XJ, Wang CY, Xi YF, Bu P, Wang P*
- 7467** Transcatheter arterial infusion chemotherapy and embolization for primary lacrimal sac squamous cell carcinoma: A case report  
*Sun MH, Yi WD, Shen L, Zhou L, Lu JX*
- 7474** Programmed cell death-1 inhibitor combination treatment for recurrent proficient mismatch repair/microsatellite-stable type endometrial cancer: A case report  
*Zhai CY, Yin LX, Han WD*
- 7483** Novel compound heterozygous mutation of *SLC12A3* in Gitelman syndrome co-existent with hyperthyroidism: A case report and literature review  
*Qin YZ, Liu YM, Wang Y, You C, Li LN, Zhou XY, Lv WM, Hong SH, Xiao LX*
- 7495** Successful treatment of hyperglycemia with liraglutide in a hospitalized 27-year-old patient with schizophrenia: A case report  
*Zhang L, Yu WJ, Zhu H, Li HF, Qiao J*

- 7502** Refractory lymphoma treated with chimeric antigen receptor T cells combined with programmed cell death-1 inhibitor: A case report  
*Zhang CJ, Zhang JY, Li LJ, Xu NW*
- 7509** Median arcuate ligament syndrome with retroperitoneal haemorrhage: A case report  
*Lu XC, Pei JG, Xie GH, Li YY, Han HM*
- 7517** Novel frameshift mutation in the *AHDC1* gene in a Chinese global developmental delay patient: A case report  
*Lin SZ, Xie HY, Qu YL, Gao W, Wang WQ, Li JY, Feng XC, Jin CQ*
- 7523** Selective nerve block for the treatment of neuralgia in Kummell's disease: A case report  
*Zhang X, Li ZX, Yin LJ, Chen H*
- 7531** Traditional Chinese medicine manipulative reduction combined with percutaneous vertebroplasty for treating type III Kummell's disease: A case report  
*Hao SS, Zhang RJ, Dong SL, Li HK, Liu S, Li RF, Ren HH, Zhang LY*
- 7539** Differential diagnosis and treatment of foot drop caused by an extraneural ganglion cyst above the knee: A case report  
*Won KH, Kang EY*
- 7545** Effect of hydrogen intervention on refractory wounds after radiotherapy: A case report  
*Zhao PX, Luo RL, Dang Z, Wang YB, Zhang XJ, Liu ZY, Wen XH, Liu MY, Zhang MZ, Adzavon YM, Ma XM*
- 7553** Chronic urticaria associated with lung adenocarcinoma — a paraneoplastic manifestation: A case report and literature review  
*Jiménez LF, Castellón EA, Marengo JD, Mejía JM, Rojas CA, Jiménez FT, Coronell L, Osorio-Llanes E, Mendoza-Torres E*
- 7565** Spinal giant cell-rich osteosarcoma-diagnostic dilemma and treatment strategy: A case report  
*Tseng CS, Wong CE, Huang CC, Hsu HH, Lee JS, Lee PH*
- 7571** Primary clear cell sarcoma of soft tissue in the posterior cervical spine invading the medulla oblongata: A case report  
*Liu CC, Huang WP, Gao JB*
- 7577** *Pseudomonas aeruginosa*-related effusive-constrictive pericarditis diagnosed with echocardiography: A case report  
*Chen JL, Mei DE, Yu CG, Zhao ZY*
- 7585** Maternal peripartum bacteremia caused by intrauterine infection with *Comamonas kerstersii*: A case report  
*Qu H, Zhao YH, Zhu WM, Liu L, Zhu M*
- 7592** Considerations of single-lung ventilation in neonatal thoracoscopic surgery with cardiac arrest caused by bilateral pneumothorax: A case report  
*Zhang X, Song HC, Wang KL, Ren YY*

- 7599** Rare primary rectal mucosa-associated lymphoid tissue lymphoma with curative resection by endoscopic submucosal dissection: A case report and review of literature

*Tao Y, Nan Q, Lei Z, Miao YL, Niu JK*

- 7609** Differences in examination results of small anastomotic fistula after radical gastrectomy with afterward treatments: A case report

*Lu CY, Liu YL, Liu KJ, Xu S, Yao HL, Li L, Guo ZS*

### **LETTER TO THE EDITOR**

- 7617** Baseline differences may impact on relationship between dietary tryptophan and risk of obesity and type 2 diabetes

*Ren XH, Ye YW, He LP*

**ABOUT COVER**

Editorial Board Member of *World Journal of Clinical Cases*, Rajesh Kumar Rajnish, MBBS, MS, Assistant Professor, Department of Orthopaedics, All India Institute of Medical Sciences, Bilaspur, Bilaspur 174001, Himachal Pradesh, India. [duktiraj@gmail.com](mailto:duktiraj@gmail.com)

**AIMS AND SCOPE**

The primary aim of *World Journal of Clinical Cases* (WJCC, *World J Clin Cases*) is to provide scholars and readers from various fields of clinical medicine with a platform to publish high-quality clinical research articles and communicate their research findings online.

WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

**INDEXING/ABSTRACTING**

The WJCC is now abstracted and indexed in Science Citation Index Expanded (SCIE, also known as SciSearch®), Journal Citation Reports/Science Edition, Current Contents®/Clinical Medicine, PubMed, PubMed Central, Scopus, Reference Citation Analysis, China National Knowledge Infrastructure, China Science and Technology Journal Database, and Superstar Journals Database. The 2022 Edition of Journal Citation Reports® cites the 2021 impact factor (IF) for WJCC as 1.534; IF without journal self cites: 1.491; 5-year IF: 1.599; Journal Citation Indicator: 0.28; Ranking: 135 among 172 journals in medicine, general and internal; and Quartile category: Q4. The WJCC's CiteScore for 2021 is 1.2 and Scopus CiteScore rank 2021: General Medicine is 443/826.

**RESPONSIBLE EDITORS FOR THIS ISSUE**

Production Editor: *Ying-Yi Yuan*; Production Department Director: *Xiang Li*; Editorial Office Director: *Jin-Lei Wang*.

**NAME OF JOURNAL**

*World Journal of Clinical Cases*

**ISSN**

ISSN 2307-8960 (online)

**LAUNCH DATE**

April 16, 2013

**FREQUENCY**

Thrice Monthly

**EDITORS-IN-CHIEF**

Bao-Gan Peng, Jerzy Tadeusz Chudek, George Kontogeorgos, Maurizio Serati, Ja Hyeon Ku

**EDITORIAL BOARD MEMBERS**

<https://www.wjnet.com/2307-8960/editorialboard.htm>

**PUBLICATION DATE**

July 26, 2022

**COPYRIGHT**

© 2022 Baishideng Publishing Group Inc

**INSTRUCTIONS TO AUTHORS**

<https://www.wjnet.com/bpg/gerinfo/204>

**GUIDELINES FOR ETHICS DOCUMENTS**

<https://www.wjnet.com/bpg/GerInfo/287>

**GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH**

<https://www.wjnet.com/bpg/gerinfo/240>

**PUBLICATION ETHICS**

<https://www.wjnet.com/bpg/GerInfo/288>

**PUBLICATION MISCONDUCT**

<https://www.wjnet.com/bpg/gerinfo/208>

**ARTICLE PROCESSING CHARGE**

<https://www.wjnet.com/bpg/gerinfo/242>

**STEPS FOR SUBMITTING MANUSCRIPTS**

<https://www.wjnet.com/bpg/GerInfo/239>

**ONLINE SUBMISSION**

<https://www.f6publishing.com>



Retrospective Study

# Correlation of magnetic resonance imaging quantitative parameters and apparent diffusion coefficient value with pathological breast cancer

Zhe Wang, Guan-Ying Ren, Qian Yin, Qian Wang

**Specialty type:** Neuroimaging

**Provenance and peer review:**

Unsolicited article; Externally peer reviewed.

**Peer-review model:** Single blind

**Peer-review report's scientific quality classification**

Grade A (Excellent): 0  
Grade B (Very good): B  
Grade C (Good): C  
Grade D (Fair): 0  
Grade E (Poor): 0

**P-Reviewer:** Anemona L, Italy;  
Campos-da-Paz M, Brazil

**Received:** April 6, 2022

**Peer-review started:** April 6, 2022

**First decision:** May 11, 2022

**Revised:** May 18, 2022

**Accepted:** June 26, 2022

**Article in press:** June 26, 2022

**Published online:** July 26, 2022



**Zhe Wang, Qian Yin, Qian Wang,** Department of Medical Imaging, The No. 2 Hospital of Baoding, Baoding 071051, Hebei Province, China

**Guan-Ying Ren,** Department of Medical Oncology, Affiliated Hospital of Hebei University, Hebei Key Laboratory of Cancer Radiotherapy and Chemotherapy, Baoding 071000, Hebei Province, China

**Corresponding author:** Guan-Ying Ren, MD, Attending Doctor, Department of Medical Oncology, Affiliated Hospital of Hebei University, Hebei Key Laboratory of Cancer Radiotherapy and Chemotherapy, No. 648 Dongfeng Dong Lu, Baoding 071000, Hebei Province, China. [renguanying1982@163.com](mailto:renguanying1982@163.com)

## Abstract

### BACKGROUND

China ranks 120<sup>th</sup> worldwide for the incidence of breast cancer and 163<sup>rd</sup> for mortality. Early screening, diagnosis, and timely determination of the optimal treatment plan can help ensure clinical efficacy and prognosis.

### AIM

To investigate the relationship between quantitative magnetic resonance imaging parameters, apparent diffusion coefficient value, pathological immunohistochemical status, and patient prognosis.

### METHODS

A total of 108 patients with breast cancer (breast cancer group) and 110 patients with benign breast tumors (benign group) confirmed by pathological examination at our Hospital from September 2013 to August 2016 were selected. All patients had undergone preoperative magnetic resonance imaging (MRI) examinations, and the quantitative parameters of MRI and apparent diffusion coefficient (ADC) values for the two groups were compared. The MRI quantitative parameters and ADC values of patients with different estrogen receptor (ER), progesterone receptor, and human epidermal growth factor receptor-2 expression were statistically analyzed. The relationship between the quantitative parameters of MRI and ADC values and patient recurrence was analyzed using receiver operating curves.

### RESULTS



The measured values of the quantitative parameters of MRI- Ktrans, Kep, and Ve in the breast cancer group were higher than those in the benign group; the ADC value in the breast cancer group was lower than that in the benign group, and the difference was statistically significant ( $P < 0.05$ ). The Ktrans, Ve, and ADC values in patients with ER-positive breast cancer were significantly lower than those in patients with negative ER expression ( $P < 0.05$ ). After 5 years of follow-up, 22 patients with breast cancer experienced postoperative recurrence. The Kep, Ve, and ADC values of the recurrence group were significantly lower than those of the non-recurrence group, and the difference was statistically significant ( $P < 0.05$ ).

## CONCLUSION

MRI quantitative parameters and ADC are related to the expression of breast cancer-related immunological receptor factors and have certain clinical value in assessing postoperative recurrence in patients.

**Key Words:** Magnetic resonance; Apparent diffusion coefficient; Breast cancer; Immunohistochemistry; Prognosis

©The Author(s) 2022. Published by Baishideng Publishing Group Inc. All rights reserved.

**Core Tip:** The high sensitivity and repeatability of magnetic resonance imaging make it more widely used in disease screening and treatment. Its advantages in soft tissue resolution and radiation make it more meaningful for lesions that cannot be clarified by clinical and ultrasound techniques in breast examination. Especially, diffusion weighted imaging has more advantages in cell structure and cell membrane integrity.

**Citation:** Wang Z, Ren GY, Yin Q, Wang Q. Correlation of magnetic resonance imaging quantitative parameters and apparent diffusion coefficient value with pathological breast cancer. *World J Clin Cases* 2022; 10(21): 7333-7340

**URL:** <https://www.wjgnet.com/2307-8960/full/v10/i21/7333.htm>

**DOI:** <https://dx.doi.org/10.12998/wjcc.v10.i21.7333>

## INTRODUCTION

Breast cancer is one of the most common malignant tumors in women worldwide[1], and disease staging at the time of diagnosis is crucial for the prognosis of patients[2]. Studies have also found that different prognostic factors, such as human epidermal growth factor receptor-2 (HER-2); progesterone receptor (PR); estrogen receptor (ER); and cell proliferation antigen marker (Ki-67) also affect the treatment and prognosis of breast cancer[3,4]. The advantages that magnetic resonance imaging (MRI) has over the resolution and radiation of soft tissue make it extremely useful for lesions that cannot be clarified by clinical or ultrasonic breast examination techniques. In particular, diffusion-weighted imaging (DWI) has advantages in terms of cell structure and cell membrane integrity. Various influencing factors have different effects on the diagnosis and prognosis of the disease, and various quantitative parameters have different correlations with prognostic factors and cancer classification. Therefore, this study explored the relationship between MRI quantitative parameters and apparent diffusion coefficient (ADC) values of different prognostic factors in patients with breast cancer and benign breast tumors confirmed by pathological examination to provide clinical value for evaluating postoperative recurrence.

## MATERIALS AND METHODS

### General information

A total of 108 patients with breast cancer (breast cancer group) and 110 patients with benign breast tumors (benign group) confirmed by pathological examination in our hospital from September 2013 to August 2016 were selected.

The inclusion criteria were set according to the diagnostic criteria of the "National Comprehensive Cancer Network Breast Cancer Clinical Practice Guidelines 2010, First Edition". Patients aged 19–65 years, diagnosed with breast cancer and benign breast tumors, underwent surgical treatment in our hospital. The tumors were confirmed by postoperative pathological examination. Patients also underwent X-ray mammography, MRI examination, ultrasound examination, and complete

examination data before surgery. All patients were followed up for > 5 years. Exclusion criteria included: (1) Patients with recurrent breast cancer after surgery; (2) Patients with malignant tumors in other parts of the body, which had metastasized to the breast; (3) Patients who received preoperative chemoradiotherapy; (4) Patients who failed to receive postoperative follow-up; and (5) Patients with a lack of imaging data. This study was approved by the Medical Ethics Committee.

### **Immunohistochemistry detection**

The American Society for Clinical Oncology[5] has defined the invasive positive tumor nucleus < 1% as PR and ER negative, and vice versa. HER-2 expression scores of 0 and + were negative, 3+ was positive, and 2+ were further analyzed by Fluorescent *in situ* Hybridization (FISH). If FISH was positive, gene amplification was performed; otherwise, the results were negative.

### **MRI examination**

The patients were asked to take the prone position, put their arms on the side of their heads, and the positioning line was aligned with the patient's nipple. The conventional examination was performed using 3.0T MRI (Siemens Skyra, Germany), followed by DWI scanning. The transverse T2-weighted image parameters were: TR/TE, 4270/66 ms, layer thickness, 4.0 mm; layer spacing, 4.8 mm; fOV, 34 cm × 34 cm; and number of incentives, 2. The T1-weighted image parameters were: TR/TE, 6.02/2.43 ms; layer thickness, 1.2 mm; fOV, 34 cm × 34 cm; and number of incentives, 2. The DWI parameters were: TR/TE, 8070/82 ms; layer spacing, 6 mm; layer thickness, 4.0 mm; fOV, 34 cm × 34 cm; and number of incentives, 2; matrix, 10.2 cm × 19.2 cm. The two b values were: 0 s/mm<sup>2</sup> and 800 s/mm<sup>2</sup>. The 4D tissue processing software was used to correct the artifacts first and then input the T1 map image data to fit the image to obtain the quantitative T1 value. Transfusions such as the internal thoracic artery, obtain function, select ROI (obvious lesion area), and avoid necrotic area were combined with T1 value, using Tofls model to measure Ve, Ktrans, Kep, select ROI, and to calculate the average.

### **Statistical analysis**

In this study, the measurement indexes such as Ktrans, Kep, Ve, and ADC values were assessed whether they were normally distributed, and they were all in line with an approximately normal or normal distribution, which was represented by mean ± SD. A *t*-test was used to compare the two groups of data. The discrete data were expressed as percentages, and the comparison was performed using the  $\chi^2$  test. The receiver operating characteristic (ROC curve) was drawn to analyze the value of each index in predicting postoperative recurrence. The professional SPSS 21.0 software (IBM Corp., Armonk, NY, USA) was used for data processing, with a test level  $\alpha = 0.05$ .

## **RESULTS**

### **Comparison of patient characteristics**

The age, body mass index, distribution of affected side, comorbidities, and menopausal status were compared between the breast cancer and benign tumor groups, and the difference was not statistically significant ( $P > 0.05$ , Table 1).

### **Comparison of MRI parameters and ADC values of the two patient groups**

The Ktrans, Kep, and Ve values of the breast cancer group were higher than those of the benign group. The values of Ktrans, Kep and Ve in the breast cancer group were higher than those in the benign group, and the ADC value in the breast cancer group was lower than that in the benign group; the difference was statistically significant ( $P < 0.05$ ) (Table 2).

### **Comparison of MRI parameters and ADC values of breast cancer patients with different immunostaining and histochemical results**

The values of Ktrans, Ve, and ADC in patients with ER positive breast cancer were significantly lower than those in patients with negative expression, and the difference was statistically significant ( $P < 0.05$ ). The Kep value of patients with breast cancer with PR-positive expression was significantly lower than that of patients with negative expression, and the difference was statistically significant ( $P < 0.05$ ). The Kep value of HER-2 positive breast cancer patients was higher than that of negative breast cancer patients, and the difference was statistically significant ( $P < 0.05$ ). The Ve value of HER-2 positive breast cancer patients was significantly lower than that of HER-2 negative breast cancer patients, and the Kep value was significantly higher than that of HER-2 negative breast cancer patients; the difference was statistically significant ( $P < 0.05$ , Table 3).

### **Comparison of MRI parameters and ADC values in breast cancer patients with different prognoses**

After 5 years of follow-up, a total of 22 patients with breast cancer had postoperative recurrence. The measured values of Kep, Ve and ADC in the recurrence group were significantly lower than those in the

**Table 1 Comparison of general information of the two groups of patients, *n* (%)**

Factor	Breast cancer group ( <i>n</i> = 108)	Benign group ( <i>n</i> = 110)	<i>t</i> / $\chi^2$	<i>P</i> value
Age (mean $\pm$ SD, yr)	46.1 $\pm$ 7.0	47.5 $\pm$ 8.4	-1.336	0.183
Body mass index (mean $\pm$ SD, kg/m <sup>2</sup> )	24.6 $\pm$ 2.5	24.3 $\pm$ 2.6	0.868	0.386
Affected side distribution			0.902	0.342
Left side	58 (53.7)	52 (48.15)		
Right	50 (46.3)	58 (53.7)		
Hypertension			0.618	0.432
Yes	11 (10.19)	15 (13.89)		
No	97 (89.81)	95 (87.96)		
Diabetes			2.062	0.151
Yes	6 (5.56)	12 (11.11)		
No	102 (94.44)	98 (90.74)		
Hyperlipidemia			2.221	0.136
Yes	17 (15.74)	10 (9.26)		
No	91 (84.26)	100 (92.59)		
Menopause			0.930	0.335
Yes	18 (16.67)	24 (22.22)		
No	90 (83.33)	86 (79.63)		

**Table 2 Comparison of magnetic resonance imaging parameters and apparent diffusion coefficient values between the two groups (mean  $\pm$  SD)**

Groups	Ktrans (min <sup>-1</sup> )	Kep (min <sup>-1</sup> )	Ve	ADC ( $\times 10^{-3}$ mm <sup>2</sup> /s)
Breast cancer group ( <i>n</i> = 108)	0.481 $\pm$ 0.113	0.577 $\pm$ 0.120	0.764 $\pm$ 0.170	0.741 $\pm$ 0.184
Benign group ( <i>n</i> = 110)	0.264 $\pm$ 0.096	0.408 $\pm$ 0.113	0.528 $\pm$ 0.150	1.109 $\pm$ 0.241
<i>t</i> value	15.290	10.707	10.874	-12.655
<i>P</i> value	0.000	0.000	0.000	0.000

ADC: Apparent diffusion coefficient.

non-recurrence group. The difference between the two groups was statistically significant ( $P < 0.05$ , Table 4).

### **MRI parameters and ADC values for predicting patient recurrence**

The ROC curve was drawn using the Kep, Ve, and ADC values. The results showed that the area under the curve (AUC) value of the Kep, Ve, and ADC values for predicting postoperative recurrence were 0.599, 0.572, and 0.739, respectively. The AUC value of Kep + Ve + ADC value for predicting postoperative recurrence was 0.858 (Table 5, Figure 1).

## **DISCUSSION**

Angiogenesis, or the formation of new blood vessels, is essential for the occurrence and development of breast cancer. Vascular endothelial growth factor, which encourages angiogenesis, is released during hypoxic stress, resulting in increased capillary osmotic pressure. This allows small molecules to quickly pass through the vascular wall (along with any contrast agent) into the tissue gap, resulting in a shortened T1 value. At this time, early lesions can be significantly enhanced[6,7].

The high sensitivity and repeatability of MRI make it more widely used in disease screening and treatment determination[8]. There are two methods for the quantitative and semi-quantitative analysis of breast diseases. In particular, quantitative analysis has important value for identifying benign and

**Table 3 Comparison of magnetic resonance imaging parameters and apparent diffusion coefficient values in breast cancer patients with different immunostaining and histochemical results (mean  $\pm$  SD)**

Express the situation	<i>n</i>	Ktrans (min <sup>-1</sup> )	Kep (min <sup>-1</sup> )	Ve	ADC ( $\times 10^{-3}$ mm <sup>2</sup> /s)
ER					
Positive	74	0.462 $\pm$ 0.105	0.563 $\pm$ 0.112	0.740 $\pm$ 0.166	0.713 $\pm$ 0.170
Feminine	34	0.522 $\pm$ 0.100	0.607 $\pm$ 0.109	0.816 $\pm$ 0.154	0.802 $\pm$ 0.168
<i>t</i> value		-2.698	-1.912	-2.259	-2.536
<i>P</i> value		0.008	0.059	0.026	0.013
PR					
Positive	62	0.468 $\pm$ 0.108	0.542 $\pm$ 0.115	0.751 $\pm$ 0.165	0.721 $\pm$ 0.180
Feminine	46	0.499 $\pm$ 0.111	0.624 $\pm$ 0.116	0.782 $\pm$ 0.158	0.768 $\pm$ 0.178
<i>t</i> value		-1.458	-3.651	-0.983	-1.348
<i>P</i> value		0.148	0.000	0.328	0.180
HER-2					
Positive	34	0.461 $\pm$ 0.107	0.621 $\pm$ 0.116	0.713 $\pm$ 0.166	0.719 $\pm$ 0.181
Feminine	74	0.490 $\pm$ 0.110	0.557 $\pm$ 0.109	0.787 $\pm$ 0.162	0.751 $\pm$ 0.178
<i>t</i> value		-1.283	2.777	-2.188	-0.863
<i>P</i> value		0.202	0.006	0.031	0.390

ADC: Apparent diffusion coefficient; ER: Estrogen receptor; PR: Progesterone receptor; HER-2: Human epidermal growth factor receptor-2.

**Table 4 Comparison of magnetic resonance imaging parameters and apparent diffusion coefficient values in breast cancer patients with different prognosis (mean  $\pm$  SD)**

Recurrence	<i>n</i>	Ktrans (min <sup>-1</sup> )	Kep (min <sup>-1</sup> )	Ve	ADC ( $\times 10^{-3}$ mm <sup>2</sup> /s)
Relapse	22	0.457 $\pm$ 0.111	0.528 $\pm$ 0.109	0.698 $\pm$ 0.155	0.663 $\pm$ 0.181
No recurrence	86	0.487 $\pm$ 0.107	0.590 $\pm$ 0.112	0.781 $\pm$ 0.165	0.761 $\pm$ 0.176
<i>t</i> value		-1.165	-2.329	-2.130	-2.317
<i>P</i> value		0.247	0.022	0.035	0.022

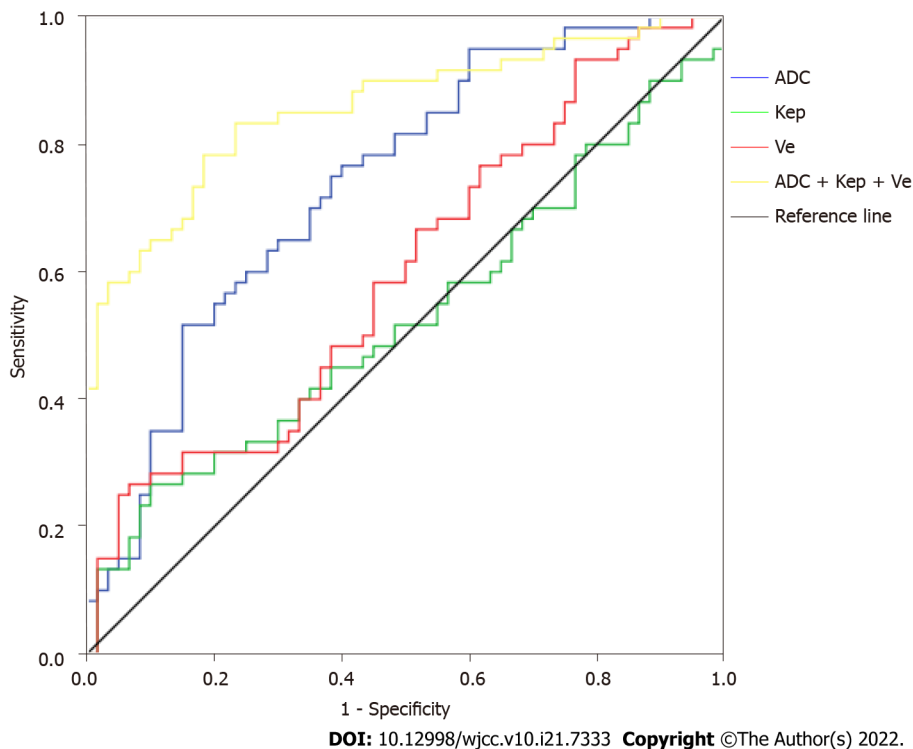
ADC: Apparent diffusion coefficient.

**Table 5 The value of magnetic resonance imaging parameters and apparent diffusion coefficient values in predicting patient recurrence**

Index	Critical value	AUC	Sensitivity (%)	Specificity (%)	Missed diagnosis rate (%)	Misdiagnosis rate (%)
Kep (min <sup>-1</sup> )	0.561	0.599	65.19	55.40	34.81	44.60
Ve	0.725	0.527	58.04	51.06	41.96	48.94
ADC ( $\times 10^{-3}$ mm <sup>2</sup> /s)	0.718	0.739	71.57	61.09	28.43	38.91
ADC + Kep + Ve	-	0.858	83.67	77.18	16.33	22.82

ADC: Apparent diffusion coefficient; AUC: Area under the curve.

malignant tumors, prognosis, and evaluation of chemotherapy effects. However, due to research limitations, the current MRI experiments mainly focus on semi-quantitative parameters[9,10]. The research on quantitative parameters is relatively small, and the research results of various studies are different[10]. In this study, quantitative MRI parameters and ADC values of different prognostic factors in patients with breast cancer or benign breast tumors confirmed by pathological examination were compared, and the MRI quantitative parameters and ADC values of patients with different expressions



**Figure 1** The receiver operating characteristic curve of Kep, Ve, apparent diffusion coefficient measurement value predicting patient recurrence. ADC: Apparent diffusion coefficient.

of ER, PR, and HER-2 were statistically analyzed. The relationship between the quantitative parameters of MRI and ADC values and the recurrence of patients was analyzed using the ROC curve, with the aim of providing a reference for clinical diagnosis and treatment.

The results showed that the measured values of Ktrans, Kep, and Ve of the breast cancer group were higher than those of the benign group, while the ADC value was lower than that of the benign group, which was consistent with the results of Martincich *et al*[11]. In this study, the Ktrans, Ve, and ADC values of patients with ER-positive breast cancer were significantly lower than those of patients with ER-negative breast cancer. The Kep values of patients with HER-2 positive breast cancer were significantly higher than that of patients with HER-2 negative breast cancer[12]. In contrast, the Ve values of patients with HER-2 positive breast cancer were significantly higher than that of patients with HER-2 negative breast cancer. The Kep value of patients with PR-positive breast cancer was significantly lower than that of patients with negative expression, consistent with Lee *et al*[13]. In contrast to previous experiments, we found that after 5 years of follow-up, the Kep, Ve, and ADC values of patients in the recurrence group were significantly lower than those of patients without recurrence. The ROC curve results showed that the AUC values of Kep, Ve, and ADC values for predicting postoperative recurrence were 0.599, 0.572, and 0.739, respectively. The AUC value of the Kep + Ve + ADC value for predicting postoperative recurrence was 0.858. The reason for this may be that the sample size was not large enough, resulting in a decrease in the estimation accuracy of the data. In addition, the influence of blood flow factors, such as hypertension, was not considered.

The sensitivity of patients with breast cancer with PR and ER-positive expression to endocrine therapy was significantly higher than that of patients with negative expression, and their survival rate was also higher, therefore the prognosis was relatively better[14-16]. HER-2, as a growth factor receptor with tyrosine kinase activity, is less expressed in normal tissues, and its expression can be used as an important indicator of breast cancer and prognosis in the clinical setting[17,18]. Ki-67, a nuclear antigen, can effectively mark cell proliferation. In this study, when the expression of Ki-67 was higher, the possibility of tumor recurrence was greater. Previous studies have found that Ki-67 is inversely proportional to the ADC value, and AUC can more intuitively compare the predictive value of other parameters[19,20]; in other words, when the expression of Ki-67 is higher, the ADC value is lower, which also has a certain effect on our prediction of recurrence.

## CONCLUSION

In summary, this study shows a correlation between MRI quantitative parameters, ADC, and the expression of immune receptor factors related to breast cancer. Therefore, the prognosis of patients can

be evaluated by detecting  $K_{ep}$ ,  $V_e$ , and ADC values, which have clinical significance.

## ARTICLE HIGHLIGHTS

### Research background

It has been reported that the 5-year survival rate of patients with breast cancer in stage I is 100% but is only 20% in stage IV; with the evolution of the disease, the total survival period gradually decreases.

### Research motivation

This study analyzed the magnetic resonance imaging (MRI) quantitative parameters and apparent diffusion coefficient (ADC) values of patients with different estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor-2 (HER-2) expression.

### Research objectives

This study aimed to investigate the relationship between quantitative MRI parameters.

### Research methods

A total of 108 patients with breast cancer and 110 patients with benign breast tumors confirmed by pathological examination were selected. All patients had undergone preoperative MRI examinations, and the MRI quantitative parameters and ADC values of patients with different ER, PR, and HER-2 expression were statistically analyzed.

### Research results

The measured values of the quantitative parameters of MRI-  $K_{trans}$ ,  $K_{ep}$ , and  $V_e$  in the breast cancer group were higher than those in the benign group.

### Research conclusions

MRI quantitative parameters and ADC are related to the expression of breast.

### Research perspectives

This study explored the relationship between MRI quantitative parameters and ADC values of different prognostic factors in patients with breast cancer and benign breast tumors confirmed by pathological examination to provide clinical value for evaluating postoperative recurrence.

## FOOTNOTES

**Author contributions:** Wang Z and Ren GY contributed equally to this study, and should be considered as co-first authors; Wang Z and Ren GY design the experiment; Wang Z drafted the manuscript; Wang Z, Ren GY, Yin Q, and Wang Q collected the data; Yin Q and Wang Q analysed and interpreted data; Wang Z and Ren GY revised the manuscript.

**Supported by** Baoding Science and Technology Support Plan Project, No. 17ZF211.

**Institutional review board statement:** The study was reviewed and approved by The No. 2 Hospital of Baoding Institutional Review Board.

**Informed consent statement:** All study participants, or their legal guardian, provided informed written consent prior to study enrollment.

**Conflict-of-interest statement:** The authors have no conflict of interests.

**Data sharing statement:** No additional data are available.

**Open-Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <https://creativecommons.org/licenses/by-nc/4.0/>

**Country/Territory of origin:** China

**ORCID number:** Zhe Wang 0000-0002-6240-1796; Guan-Ying Ren 0000-0002-0835-0326; Qian Yin 0000-0003-0317-1510;



Qian Wang 0000-0002-3913-989X.

S-Editor: Wang JL

L-Editor: A

P-Editor: Wang JL

## REFERENCES

- 1 **Torre LA**, Islami F, Siegel RL, Ward EM, Jemal A. Global Cancer in Women: Burden and Trends. *Cancer Epidemiol Biomarkers Prev* 2017; **26**: 444-457 [PMID: 28223433 DOI: 10.1158/1055-9965.EPI-16-0858]
- 2 **Lauby-Secretan B**, Scoccianti C, Loomis D, Benbrahim-Tallaa L, Bouvard V, Bianchini F, Straif K; International Agency for Research on Cancer Handbook Working Group. Breast-cancer screening--viewpoint of the IARC Working Group. *N Engl J Med* 2015; **372**: 2353-2358 [PMID: 26039523 DOI: 10.1056/NEJMs1504363]
- 3 **Goldhirsch A**, Winer EP, Coates AS, Gelber RD, Piccart-Gebhart M, Thürlimann B, Senn HJ; Panel members. Personalizing the treatment of women with early breast cancer: highlights of the St Gallen International Expert Consensus on the Primary Therapy of Early Breast Cancer 2013. *Ann Oncol* 2013; **24**: 2206-2223 [PMID: 23917950 DOI: 10.1093/annonc/mdt303]
- 4 **Deniz F**, Dilek K, Hande M, Umit UM, Handan K. Ki-67 and caspase expression in breast carcinoma: does variance in locational sampling exist? *Int J Clin Exp Pathol* 2015; **8**: 11305-11313 [PMID: 26617854]
- 5 **Partovi S**, Sin D, Lu Z, Sieck L, Marshall H, Pham R, Plecha D. Fast MRI breast cancer screening - Ready for prime time. *Clin Imaging* 2020; **60**: 160-168 [PMID: 31927171 DOI: 10.1016/j.clinimag.2019.10.013]
- 6 **Negrão EMS**, Souza JA, Marques EF, Bitencourt AGV. Breast cancer phenotype influences MRI response evaluation after neoadjuvant chemotherapy. *Eur J Radiol* 2019; **120**: 108701 [PMID: 31610321 DOI: 10.1016/j.ejrad.2019.108701]
- 7 **Leithner D**, Moy L, Morris EA, Marino MA, Helbich TH, Pinker K. Abbreviated MRI of the Breast: Does It Provide Value? *J Magn Reson Imaging* 2019; **49**: e85-e100 [PMID: 30194749 DOI: 10.1002/jmri.26291]
- 8 **Hu X**, Huang W, Fan M. Emerging therapies for breast cancer. *J Hematol Oncol* 2017; **10**: 98 [PMID: 28454587 DOI: 10.1186/s13045-017-0466-3]
- 9 **Li SP**, Padhani AR, Taylor NJ, Beresford MJ, Ah-See ML, Stirling JJ, d'Arcy JA, Collins DJ, Makris A. Vascular characterisation of triple negative breast carcinomas using dynamic MRI. *Eur Radiol* 2011; **21**: 1364-1373 [PMID: 21258931 DOI: 10.1007/s00330-011-2061-2]
- 10 **Koo HR**, Cho N, Song IC, Kim H, Chang JM, Yi A, Yun BL, Moon WK. Correlation of perfusion parameters on dynamic contrast-enhanced MRI with prognostic factors and subtypes of breast cancers. *J Magn Reson Imaging* 2012; **36**: 145-151 [PMID: 22392859 DOI: 10.1002/jmri.23635]
- 11 **Martincich L**, Deantoni V, Bertotto I, Redana S, Kubatzki F, Sarotto I, Rossi V, Liotti M, Ponzone R, Aglietta M, Regge D, Montemurro F. Correlations between diffusion-weighted imaging and breast cancer biomarkers. *Eur Radiol* 2012; **22**: 1519-1528 [PMID: 22411304 DOI: 10.1007/s00330-012-2403-8]
- 12 **Makhat S**, Luybaert R, Stadnik T, Bourgain C, Sourbron S, Dujardin M, De Greve J, De Mey J. Deconvolution-based dynamic contrast-enhanced MR imaging of breast tumors: correlation of tumor blood flow with human epidermal growth factor receptor 2 status and clinicopathologic findings--preliminary results. *Radiology* 2008; **249**: 471-482 [PMID: 18780825 DOI: 10.1148/radiol.2492071147]
- 13 **Lee HS**, Kim SH, Kang BJ, Baek JE, Song BJ. Perfusion Parameters in Dynamic Contrast-enhanced MRI and Apparent Diffusion Coefficient Value in Diffusion-weighted MRI: Association with Prognostic Factors in Breast Cancer. *Acad Radiol* 2016; **23**: 446-456 [PMID: 26852247 DOI: 10.1016/j.acra.2015.12.011]
- 14 **Ali SH**, O'Donnell AL, Balu D, Pohl MB, Seyler MJ, Mohamed S, Mousa S, Dandona P. Estrogen receptor-alpha in the inhibition of cancer growth and angiogenesis. *Cancer Res* 2000; **60**: 7094-7098 [PMID: 11156416]
- 15 **Suo S**, Zhang D, Cheng F, Cao M, Hua J, Lu J, Xu J. Added value of mean and entropy of apparent diffusion coefficient values for evaluating histologic phenotypes of invasive ductal breast cancer with MR imaging. *Eur Radiol* 2019; **29**: 1425-1434 [PMID: 30116958 DOI: 10.1007/s00330-018-5667-9]
- 16 **Kim JY**, Kim SH, Kim YJ, Kang BJ, An YY, Lee AW, Song BJ, Park YS, Lee HB. Enhancement parameters on dynamic contrast enhanced breast MRI: do they correlate with prognostic factors and subtypes of breast cancers? *Magn Reson Imaging* 2015; **33**: 72-80 [PMID: 25179138 DOI: 10.1016/j.mri.2014.08.034]
- 17 **Sun J**, Wang Q, Wang L, Gui L, Li Q, Luo Y, Zhang S, Zhang P. [A prospective study of bone loss in early stage postmenopausal breast cancer treated with aromatase inhibitors]. *Zhonghua Zhong Liu Za Zhi* 2020; **42**: 403-407 [PMID: 32482030 DOI: 10.3760/cma.j.cn112152-112152-20191112-00728]
- 18 **Tofts PS**. Modeling tracer kinetics in dynamic Gd-DTPA MR imaging. *J Magn Reson Imaging* 1997; **7**: 91-101 [PMID: 9039598 DOI: 10.1002/jmri.1880070113]
- 19 **Park EK**, Cho KR, Seo BK, Woo OH, Cho SB, Bae JW. Additional Value of Diffusion-Weighted Imaging to Evaluate Prognostic Factors of Breast Cancer: Correlation with the Apparent Diffusion Coefficient. *Iran J Radiol* 2016; **13**: e33133 [PMID: 27127582 DOI: 10.5812/iranjrad.33133]
- 20 **Thompson JL**, Wright GP. The role of breast MRI in newly diagnosed breast cancer: An evidence-based review. *Am J Surg* 2021; **221**: 525-528 [PMID: 33339617 DOI: 10.1016/j.amjsurg.2020.12.018]



Published by **Baishideng Publishing Group Inc**  
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA

**Telephone:** +1-925-3991568

**E-mail:** [bpgoffice@wjgnet.com](mailto:bpgoffice@wjgnet.com)

**Help Desk:** <https://www.f6publishing.com/helpdesk>

<https://www.wjgnet.com>

