APPLICATION OF MR COMBINED WITH DWI IN THE QUALITATIVE DIAGNOSIS OF PANCREATIC TUMORS

Mei Zhang[1#], Changcheng Li[2#], Bo Han[3], Lijun Bai[4], Jisheng Li[5], Wenyan Zhang[6], Xingjun Song[7], Zhiqiang Liu[8*]

[1]Department of Radiology, Shandong First Medical University & Shandong Academy of Medical Sciences, Taian, Shandong 271016, China - [2]Medical imaging center, Taian city Central Hospital , Taian, Shandong 271099, China - [3]Department of Radiology, Weihai Third Hospital of Shandong Province, Weihai, Shandong 264200, China - [4]Department of Geriatrics, Penglai Hospital of Traditional Chinese medicine, Yantai City, Shandong Province, Yantai, Shandong 265699, China - [5]Department of Imaging, Penglai Hospital of Traditional Chinese medicine, Yantai City, Shandong Province, Yantai, Shandong 265699, China - [6]Gynecology department, The 960th Hospital of PLA joint logistics Support Force,Taian, Shandong 271000, China - [7]Department of Imaging, The Second Affiliated Hospital of Shandong First Medical University, Taian, Shandong 271001, China - [8]Department of medical imaging, Laizhou people's Hospital, Laizhou, Shandong 261400, China

ABSTRACT

Objective: This study aims to investigate the application value of magnetic resonance (MR) combined with diffusion-weighted imaging (DWI) in the qualitative diagnosis of pancreatic tumors.

Methods: Seventy-six patients with pancreatic tumors referred to our hospital from January 2019 to December 2020 were selected for the study. All patients underwent MR and DWI examinations; further, the sensitivity, specificity, accuracy, malignant predictive value, and benign predictive value of MR and DWI examinations alone and in combination were analyzed using the results of puncture biopsy as the "gold standard."

Results: According to the results of the puncture biopsy, 34 of 76 pancreatic tumor patients enrolled were diagnosed as malignant (44.74%), and 42 were benign (55.26%). The accuracy (94.74%), sensitivity (94.12%), specificity (95. 24%), malignant predictive value (94. 12%), and benign predictive value (95. 24%) of the combined MR and DWI examination were higher than those of MR (88.16%, 88.24%, 88.10%, 85.71%, 90.24%) and DWI (81.58%, 82.35%, 80. 95%, 77. 78%, 85. 00%) examinations alone. There was a definitive agreement between MR diagnosis and puncture biopsy findings (Kappa = 0.630), excellent agreement between DWI diagnosis and puncture biopsy findings (Kappa = 0.761), and excellent agreement between combined MR and DWI diagnosis and puncture biopsy findings (Kappa = 0.894).

Conclusion: The application of MR combined with DWI in the diagnosis of pancreatic tumor patients has high sensitivity, specificity, and accuracy, providing a reliable basis for the early clinical determination of benign and malignant pancreatic tumors and a guiding basis for the formulation of treatment plans for patients, which is worthy of clinical promotion and application.

Keywords: Pancreatic tumors, MRI, DWI, diagnostic value.

DOI: 10.19193/0393-6384_2022_1_94

Introduction

Pancreatic cancer is a malignant tumor of the pancreas. It is a gastrointestinal tract disease with a high degree of malignancy, which starts insidiously and often does not have typical symptoms in the early stages. As the disease progresses, patients have a high mortality rate[1]. However, there are many similarities in clinical symptoms between malignant and benign tumors of the pancreas. Therefore, accurate identification and diagnosis of benign

and malignant pancreatic tumors at an early stage can provide a basis for the formulation of clinical treatment plans, maximize patient survival time, and improve cure rates. Both magnetic resonance (MR) and diffusion-weighted imaging (DWI) are commonly used for the qualitative diagnosis of pancreatic tumors in the early stages of clinical practice. However, studies have found limitations in the application of these single modalities due to missed diagnoses and misdiagnoses[2-4]. In this study, Seventy-six patients with pancreatic tumors referred

to our hospital from January 2019 to December 2020 were selected to investigate the value of combined MR and DWI examination in the qualitative diagnosis, as reported below.

Materials and methods

General data

For the study, seventy-six patients with pancreatic tumors referred to our hospital from January 2019 to December 2020 were selected, including 39 males and 37 females, aged 51-74 (62.14±5.63) years with body mass 48-79 (63.49±5.68) kg. The patients' comorbidities included 26 cases with hypertension, 21 cases with diabetes mellitus, 16 cases with hyperlipidemia, and 13 cases with coronary heart disease. All patients had varying degrees of upper abdominal pain, abdominal distention, nausea, and vomiting. All patients had MR and DWI examinations, and the results of the puncture biopsy were used as the "gold standard." This study was in accordance with the Declaration of Helsinki.

Selection criteria

Inclusion criteria included not having mental illnesses, being able to communicate normally, and not involving with systemic infectious diseases, as well as cooperating knowingly with the study and signing the relevant informed consent forms. Exclusion criteria included having severe dysfunction of vital organs such as the brain, liver, and lungs, iodine allergy, other malignancies, and hematological disorders in combination.

Treatment

All patients underwent MR and DWI examinations using an MRI scanner (HDXT, GE, USA). They were required to fast for 8 h before the study and remove all metal objects worn before the start of the scan; they were informed of the relevant examination precautions.

This was done as the following

The patient was given 15 ml of contrast agent, and after the intravenous hyperbaric injection, the MRI scanner used an 8-channel body phased-array coil to perform a multi-sequence scan in order to collect the patient's MR signal.

The scanned area included the entire pancreas and the location of the lesion. The scan sequence settings were: T1WI: TR of 3000 ms, TE of 72 ms;

T2WI: TR of 5454 ms, TE of 86 ms, FOV of 38 cm × 38 cm. The patient was instructed to breathe freely during the scan for a total of 5 min. After completion, the scan was switched to DWI imaging mode with a TR of 8000 ms and a TE of 68 ms. The layer thickness was 5 mm, the layer spacing was 1 mm, and the matrix was 128 × 128. Once all the scans were completed, the patient data were transferred to a workstation for post-processing using the image processing software that comes with the MRI scanner.

All images obtained were independently reviewed by two experienced pancreatic surgeons at the hospital, and the final results were discussed when opinions differed.

Evaluation indicators

Using puncture biopsy results as the "gold standard," the sensitivity, specificity, accuracy, malignant predictive value, and benign predictive value of MR and DWI single and combined examinations were analyzed.

Statistical methods

SPSS 19. 0 statistical software was used to analyze and process the data. The χ^2 test was used for qualitative data (%), and the Kappa test was used for consistency (Kappa>0.75 indicates excellent consistency, 0.4-0.75 indicates better consistency, <0.4 indicates poor consistency). P<0.05 was considered statistically significant.

Results

The results of the puncture biopsy showed that 34 of the 76 pancreatic tumor cases (44.74%) were diagnosed as malignant, w 42 cases (55.26%) were benign.

The accuracy (94.74%), sensitivity (94.12%), specificity (95.24%), malignancy prediction value (94.12%), and benign prediction value (95.24%) of MR and DWI combined examinations were higher than those of MR (81.58%, 82. 35%, 80.95%, 77.78%, 85.00%) and DWI (88.16%, 88.24%, 88.10%, 85.71%, 90.24%) examinations alone.

There was an ideal agreement between MR diagnosis and puncture biopsy results (Kappa = 0. 630), excellent agreement between DWI diagnosis and puncture biopsy results (Kappa = 0. 761), and excellent agreement between combined MR and DWI diagnosis and puncture biopsy findings (Kappa = 0.894); See Tables 1 to 4.

Puncture biopsy results			
MR	Malignant	Benign	Total
Malignant	28	8	36
Benign	6	34	40
Total	34	42	76

Table 1: MR findings (cases).

Puncture biopsy results			
DWI	Malignant	Benign	Total
Malignant	30	5	35
Benign	4	37	41
Total	34	42	76

Table 2: DWI findings (cases).
Note: DWI is diffusion-weighted imaging.

Puncture biopsy results			
Combined MR, DWI	Malignant	Benign	Total
Malignant	32	2	34
Benign	2	40	42
Total	34	42	76

Table 3: Combined MR and DWI findings (cases).
Note: DWI is diffusion-weighted imaging.

Inspection methods	Accuracy	Sensitivity	Specificity	Malignant predictive value	Benign predictive value
MR	81.58 (62/76)	82.35 (28/34)	80.95 (34/42)	77.78 (28/36)	85.00 (34/40)
DWI	88.16 (67/76)	88.24 (30/34)	88.10 (37/42)	85.71 (30/35)	90.24 (37/41)
Combined MR, DWI	94.74 (72/76)	94.12 (32/34)	95.24 (40/42)	94.12 (32/34)	95.24 (40/42)

Table 4: Comparison of the diagnostic value of MR and DWI single examination and combined examination for the characterization of pancreatic tumors [% (cases/cases)].
Note: DWI is diffusion-weighted imaging.

Discussion

Pancreatic cancer is a common malignant disease of the gastrointestinal system, with a high incidence. The cause of the disease is unclear and is thought to be related to poor dietary habits and lifestyles. Its clinical symptoms are mostly manifested as abdominal pain, jaundice, weakness, abdominal mass, and ascites. If left untreated, it can metastasize to important organs such as the liver, gallbladder, and kidney, posing a serious threat to the patient's life safety[5-7]. At present, there are many clinical diagnostic methods for benign and malignant tumors of the pancreas; however, the effectiveness of these methods has not yet been standardized. Therefore, the search for an efficient and accurate diagnostic method is of positive significance for the early treatment of pancreatic tumor disease and the improvement of patient survival.

In the past, puncture biopsy was mainly used to characterize pancreatic tumors with high accuracy. However, this is an invasive test, which causes some damage to the patient's body and has a long detection period, thus limiting its application. The results of this study showed that 34 (44.74%) of the 76 cases enrolled with pancreatic tumors were diagnosed as malignant and 42 (55.26%) as benign by puncture biopsy. The MR diagnosis was in ideal agreement with the puncture biopsy results (Kappa = 0.630), and the DWI diagnosis was in excellent agreement with the puncture biopsy results (Kappa = 0.761), indicating that MR combined with DWI has a high diagnostic value for the characterization of pancreatic tumors. The reason for this is that MR examinations all have the advantages of simple operation, non-invasiveness, and short examination period, presenting the structural and morphological characteristics of different tissue regions, thus improving the accuracy of clinical identification of benign and malignant pancreatic tumors[8-11]. DWI is an imaging technique based on the MRI flow effect. The principle of DWI is based on the irregular mobility of water molecules in the patient's body by means of non-invasive scanning, which can effectively present the exchange of water molecules between systems in the body on the image and provide feedback on the state of blood circulation and vascular meshwork, providing a diagnostic basis for clinicians[12-14]. In addition, DWI examination shows a low signal in the muscle and fat of normal pancreatic tissue. In contrast, patients with malignant tumors show signal deficit during DWI imaging due to changes in both vascular structure and tissue, which enhances the flow-space effect of large blood vessels, thus leading to a high signal in pancreatic tumors; clinicians can focus on this[15-18].

It is evident that the combined application of MR and DWI has a high clinical value and is worth being promoted and applied.

Conclusion

The use of MR combined with DWI in the diagnosis of pancreatic tumor patients has high sensitivity, specificity, and accuracy, which can provide a reliable basis for early clinical

determination of benign and malignant pancreatic tumors and a guiding basis for the formulation of treatment plans for patients, making it worthy of clinical promotion and application.

References

1) Chen N. Application of diffusion-weighted imaging parameters in the diagnosis of pancreatic cancer [J]. Journal of Clinical Radiology, 2017, 36 (6): 910-914.

2) Wang Z, Ma C, Zhao N, et al. Diagnostic value of diffusion-weighted imaging B threshold for pancreatic cancer [J]. Chinese Journal of pancreatic diseases, 2018, 18 (6): 380-383.

3) Liu YB, Li Q, Zhao X, et al. Application value of whole-body diffusion-weighted magnetic resonance imaging in tumor screening [J]. Image research and medical application, 2020, 4 (6): 109-110.

4) Yu Q and Yang XL. Application value of 3.0T diffusion-weighted magnetic resonance imaging signal intensity in the diagnosis of pancreatic ductal adenocarcinoma [J]. Guizhou medicine, 2019, 43 (6): 966-967.

5) Ganesan P, Kishore B, Javadi M, et al. Novel tumor necrosis factor-α induced protein eight (TNFAIP8 /TIPI) family: Functions and downstream targets involved in cancer progression [J]. Cancer Lett, 2018, 432(2): 360-271.

6) Yumei G, Junling, Xiaoou L, et al. Simultaneous quantification of serum multi-phospholipids as potential biomarkers for differentiating different pathophysiological states of lung, stomach, intestine, and pancreas [J]. Eur J Cancer, 2017, 8(12): 2191-2204.

7) Xu HX, Huang XH, Liu ML, et al. Evaluation of acute pancreatitis and its severity grading by diffusion kurtosis imaging[J]. Radiology practice, 2019, 34 (2): 167-173.

8) Li ZH, Zeng JY, Chen ZQ, et al. The value of diffusion-weighted imaging in evaluating the short-term efficacy of cryotherapy for pancreatic cancer[J]. Journal of interventional radiology, 2017, 26 (2): 142-146.

9) Han GF, Wei YB, Zhang C, et al. Diagnostic value of diffusion-weighted magnetic resonance imaging combined with CT in acute pancreatitis[J]. China Medical equipment, 2019, 16 (1): 61-64.

10) Bai LG and Tian GL. Evaluation of diffusion-weighted MRI in tumor imaging diagnosis[J]. Chinese medical guidelines, 2020, 18 (7): 105-106.

11) Liu ZQ and Liu AL. Application progress of MR diffusion-weighted imaging in pancreatic lesions[J]. Chinese Journal of clinical medical imaging, 2017, 28 (9): 669-672.

12) Chen J and Mo ZL. Value of magnetic resonance DWI and 3D VIBE sequences in preoperative evaluation of T stage and respectability of pancreatic cancer[J]. Chinese clinical research, 2019, 32 (4): 439-442.

13) Yan C, Ni XY, Yao XZ, et al. application of diffusion-weighted magnetic resonance imaging in the diagnosis of autoimmune pancreatitis and pancreatic cancer[J]. Surgical theory and practice, 2019, 24 (3): 230-235.

14) Fang X, Bian Y, Wang L, et al. 3.0T diffusion-weighted imaging in the diagnosis of pancreatic cancer lymph node metastasis[J]. Chinese Journal of pancreatic diseases, 2017, 17 (5): 311-315.

15) Chen HG. Application value of 3.0T MR diffusion-weighted imaging in pathological grading of pancreatic neuroendocrine tumors[J]. China Digital Medicine, 2018, 13 (3): 89-91, 95.

16) Lin XZ, Xie HH, Wang QR, et al. Preoperative diagnosis of pancreatic neuroendocrine tumors by computed tomography and magnetic resonance imaging[J]. Chinese Journal of digestion, 2017, 37 (5): 308-312.

17) Cui J. To evaluate the value of diffusion-weighted MRI in the diagnosis of head malignant tumors[J]. Electronic Journal of clinical medical literature, 2019, 6 (32): 162164.

18) Tan FQ, Li Z, Wang QX, et al. Clinical value of small field diffusion-weighted imaging in the diagnosis of pancreatitis and pancreatic cancer[J]. Magnetic resonance imaging, 2018, 9 (9): 655-659.

Corresponding Author:
Zhiqiang Liu
Email: shu4233727@126.com
(China)