Diagnostic Value of Contrast-Enhanced Ultrasound in Solid Renal Tumors

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Abstract: Objective: To analyze the diagnostic value of contrast-enhanced ultrasound in solid renal tumors and improve targeted accuracy. Method: We selected 100 patients who received treatment in our hospital from January 2021 to January 2022 and analyzed their medical records and pathology to study the ultrasound and contrast-enhanced features of solid renal tumors. Result: Among 100 kidney patients, 79 had malignant tumors. There were 53 cases of clear cell renal cell carcinoma (CCRCC), 20 cases of papillary renal cell carcinoma (PRCC), and 6 cases of chromophobe cell renal cell carcinoma (CHRCC). 21 cases were benign lesions: 12 cases of renal angiomyolipoma (AML) and 9 cases of renal eosinophilic adenoma (RO). There is a statistically significant difference in the performance of different pathological types of renal tumors during CEUS perfusion; Circular hyperenhancement has certain specificity in malignant kidney tumors. Conclusion: contrast-enhanced ultrasound has certain clinical value in the diagnosis and differential diagnosis of solid renal tumors.

Keywords: Renal Tumor; Ultrasonic Examination; Interventional; Diagnostic Techniques; Urology Department; Diagnosis; Identification

1. Data and Methods

1.1 General information

From January 2021 to January 2022, a total of 100 patients with solid renal tumors detected by conventional ultrasound and examined by CEUS in our hospital were collected. All cases were confirmed by pathology after surgery. There were 62 males and 38 females; The age range is from 26 to 79 years old, and the age is (43.12 ± 11.21) years old. There were 53 cases of clear cell renal cell carcinoma (CCRCC), 10 cases of papillary renal cell carcinoma (PRCC), and 22 cases of chromophobe renal cell carcinoma (CHRCC); There were 7 cases of renal angiomyolipoma (AML) and 8 cases of renal eosinophilic adenoma (RO); Among them, 77 cases had no symptoms and were found during physical examination, 12 cases had dull pain and discomfort in the waist, 7 cases had dull pain in the upper abdomen, and 4 cases had gross hematuria.

1.2 Inspection method

Both conventional ultrasound and contrast-enhanced ultrasound were performed using a GElogiqE9, 3.0 to 5.0 MHz probe, and the contrast agent was SonoVue. 5mL of 0.9% sodium chloride injection solution was added to the sulfur hexafluoride freeze-dried powder to fully vibrate. Routine ultrasound and color Doppler ultrasound were performed first to record the size, echo, number, and blood supply of the lesion, and appropriate observation sections were selected before switching to contrast-enhanced ultrasound mode. In all cases, 1.2 mL of contrast agent was rapidly injected through the elbow vein, followed by 5 mL of 0.9% sodium chloride injection solution. The enhancement process of the lesion was continuously observed in real-time for 4-5 minutes. The dynamic contrast-enhanced ultrasound data of all patients were saved and analyzed by two senior ultrasound physicians using a double-blind method.

1.3 Statistical processing

SPSS26.0 was used to analyze the data. The measurement data conforming to the normal distribution were expressed by

$x \pm s$, and the two sets of measurement data conforming to the normal distribution and uniform variance were tested by t test; Measurement data that do not conform to the normal distribution or have uneven variances are represented by M (P25, P75), and the comparison of the two sets of data is conducted using nonparametric tests; Comparative use of counting data χ.

2 test or Fisher exact probability method for analysis. $P<0.05$ indicates a statistically significant difference.

2. Results

2.1 Comparison of general information and conventional ultrasound findings of benign and malignant renal tumors

In this study, there were 100 cases in total, among which 21 cases of benign renal tumors and 79 cases of malignant tumors had no statistically significant difference in gender and age ($P>0.05$), and the size of tumors had no statistically significant difference between the two groups of cases ($P>0.05$). There was a statistically significant difference in the distribution of conventional ultrasound echo intensity in benign and malignant tumors ($P>0.05$).

2.2 Comparison of the distribution of benign and malignant renal tumors in contrast enhanced ultrasound: perfusion characteristics, regression characteristics, and enhancement patterns

There was no statistically significant difference between the benign group and the malignant group in perfusion phase, regression phase, and enhancement mode. In 42 cases of renal malignant tumors, circular enhancement appeared around the lesions in CEUS, while circular enhancement appeared around the lesions. There was a statistically significant difference in the performance of benign and malignant lesions.

2.3 Comparison of contrast-enhanced ultrasound features of different pathological types of renal tumors

In this study, the pathological types of malignant renal tumors were 53 cases of CCRCC, 12 cases of PRCC, and 14 cases of CHRCC. The pathological types of benign renal tumors were 5 cases of AML, and 16 cases of RO. The comparison of contrast-enhanced ultrasound features of renal tumors of different pathological types was analyzed using Fisher's exact probability method. There was a statistically significant difference in the CEUS perfusion phase of each group of cases ($P<0.05$), while there was no statistically significant difference in the regression phase and enhancement mode of each group. In the perfusion phase, the distribution of CEUS in renal tumors of different pathological types was further compared in pairs: there was a statistically significant difference between CCRCC and PRCC, CHRCC, and AML with high enhancement within the tumor; The difference between CCRCC and PRCC in isoenhancement was statistically significant; The cases of annular enhancement in CEUS are all CCRCC.

3. Discussion

The main malignant tumors in solid renal space occupying lesions are: clear cell renal cell carcinoma, papillary renal cell carcinoma, chromophobe cell renal cell carcinoma, etc. Clear cell renal cell carcinoma is the most common, followed by papillary renal cell carcinoma; The most common benign tumor is renal angiomyolipoma (AML), followed by renal eosinophilic adenoma (RO). For renal malignant tumors, surgery is the main treatment method. Although the prognosis of small renal cancer is good, the prognosis of patients with larger and advanced renal cancer is not optimistic, and benign tumors generally do not require surgical treatment. Therefore, whether the nature of solid renal tumors can be accurately judged at an early stage is the key to determining the prognosis of patients. CEUS is widely used in clinical diagnosis due to its convenient and fast operation and high consistency with enhanced CT, especially for some patients who cannot undergo enhanced CT examination due to iodine allergy and patients with renal insufficiency.

The results of this study showed that there was a statistically significant difference in the differential diagnosis of benign and malignant renal tumors with different gray scale ultrasound intensities during routine ultrasound examination (P.

Color Doppler flow imaging technology is not sensitive to low velocity blood flow and cannot display the true blood flow distribution within the tumor. CEUS can display the low velocity blood flow within the tumor, reflecting the near real blood flow perfusion within the tumor, and is helpful in the differential diagnosis of solid renal tumors. Current research suggests that typical renal malignant lesions after contrast-enhanced ultrasound are characterized by rapid and high enhancement during the perfusion phase, and slow or rapid regression during the regression phase, while CEUS in benign renal tumors is characterized by low enhancement, slow progression, and slow regression. In this study, there was no statistically significant difference between the benign and malignant groups in imaging performance during perfusion and regression ($P>0.05$). The reason for the analysis may be that there is a bias in the distribution of cases examined by CEUS in this study. Secondly, due to the extensive screening of imaging equipment in the current health management project, many cases are detected at an early stage and when the lesion volume is small, and there is no significant difference in the density of new blood vessels within the mass. In the study, 25 cases (25%) of renal tumors showed annular high enhancement around the focus after injection of contrast agent. After surgical treatment, the pathology of these patients all indicated malignant lesions. The annular high enhancement region is currently considered as a tumor that continuously compresses the surrounding renal tissue during growth, causing this part of the tissue to undergo degeneration and fibrosis, forming a pseudocapsule surrounding the mass. The presence and integrity of the pseudocapsule around the mass are important indicators to determine whether surgery can be performed for partial nephrectomy. This study shows that CEUS can well identify this sign and provide assistance for clinical use.

CEUS can provide assistance in identifying the pathological types of renal tumors. This study shows that there are statistically significant differences in the perfusion phase and enhancement pattern among different pathological types of renal tumors. Among RCC, CCRCC is the most common, accounting for 70% to 80% of all RCC. Due to the presence of a large number of new blood vessels and abundant blood sinuses in the interstitium of CCRCC, the interior of the mass often exhibits high enhancement after injection of contrast media. In this study, we compared the enhancement of different subtypes of RCC during perfusion, and found that the enhancement intensity of CCRCC was higher than that of PRCC and CHRCC. The difference was statistically significant. High enhancement within the lesion during perfusion can be used as an important basis for differentiating CCRCC from other subtypes and benign tumors. When circular hyperenhancement occurs around the mass, it is highly suggestive that the pathological type of the mass is CCRCC, and this result is consistent with literature reports.

Summary

In summary, for the treatment of renal tumor diseases, if contrast-enhanced ultrasound is used to complete the diagnosis of malignant or benign tumors, it can improve the treatment effect and complete the formulation of treatment plans. Although the use of this technology cannot guarantee accuracy, the related work efficiency is constantly improving, which can provide assistance for subsequent treatment.

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