10.70711/mhr.v2i3.4904

Evaluation of Value of Contrast-enhanced Ultrasound in Preoperative Staging of Bladder Cancer

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Abstract: **Objective:** To explore the diagnostic value of contrast-enhanced ultrasound in preoperative staging of bladder cancer. **Methods:** Fifty-five patients with bladder cancer treated in our hospital from March 2023 to March 2024 were retrospectively selected as study samples. Contrast-enhanced ultrasound was used for staging diagnosis, and pathological staging was taken as the gold standard to analyze the coincidence rate, sensitivity and specificity of contrast-enhanced ultrasound for staging diagnosis of bladder cancer. **Results:** In the CEUS group, the staging accuracy of T1 ~ T4 bladder cancer was 85.00%, 93.75%, 73.33% and 75.00%, respectively, and the sensitivity, specificity, negative predictive value and positive predictive value of CEUS for T2 stage bladder cancer were 86%, 88%, 72% and 75%, respectively. **Conclusion:** Contrast-enhanced ultrasound has a high level of conformity rate in the stage diagnosis of T1 ~ T4 bladder cancer, and has high sensitivity and specificity in the diagnosis of T2 stage, and has significant application value.

Keywords: Contrast-enhanced ultrasound; Patients with bladder cancer; Preoperative staging diagnosis

Bladder cancer (BC) is a common clinical malignancy of the urinary system, which mainly occurs in the elderly population and has a high morbidity and mortality. According to the global cancer statistics in 2020, there are about 573, 000 new cases and 213, 000 deaths worldwide, which has become the tenth most common malignant tumor in the world, and the prevalence and mortality of male population are about four times that of female population, and it is the seventh most common malignant tumor in Chinese male population [1]. The higher the grade of the tumor, the greater the cell and structural atypia and the higher the degree of malignancy. The stage of the tumor is closely related to its recurrence and aggressiveness. Compared with low-stage bladder cancer, high-grade cancer has higher aggressiveness and greater possibility of progression [2]. In addition, for bladder cancer, insufficient staging may lead to incomplete tumor resection, recurrence or metastasis, while excessive staging may lead to over-treatment, which may reduce patients' quality of life or shorten their survival [3]. Therefore, different surgical protocols are required for different stages of bladder cancer. In clinical practice, the determination of tumor stage mainly relies on medical imaging, such as enhanced spiral CT scan. Although this type of examination can provide a certain basis for tumor staging, the overall coincidence rate is low. With its advantages of convenient operation and economical cost, contrast-enhanced ultrasound is suitable for the staging diagnosis of bladder cancer. Therefore, this paper mainly selected 55 patients with bladder cancer to determine the diagnostic value of contrast-enhanced ultrasound in preoperative staging of bladder cancer patients.

1. Data and methods

1.1 General information

A total of 55 patients with bladder cancer who were treated in this hospital from March 2023 to March 2024 were retrospectively selected as study samples. Contrast-enhanced ultrasound was used for staging diagnosis, including 40 males and 15 females, aged 45-75 years, with an average age of (58.21±10.33) years. Postoperative pathological diagnosis stage: T1 stage 20 cases, T2 stage 16 cases, T3 stage 15 cases, T4 stage 4 cases; The course of disease ranged from 3 months to 4 years, with an average course of (2.10±0.44) years. Inclusion criteria: (1) All patients were diagnosed with bladder cancer by pathological examination; (2) Informed consent of the patient; (3) No hearing or speech impairment. Exclusion criteria: (1) other malignant tumors; (2) Patients with mental diseases who can not communicate normally.

1.2 Research method

All patients in the group underwent contrast-enhanced ultrasound for staging diagnosis. Color Doppler ultrasound diagnostic equipment (Philips EPIQ7 type) and sulfur hexafluoride microbubble contrast agent (Shanghai Bleke Xinyi Pharmaceutical Co., LTD.) were used. Before examination, the patient should drink more water to fill the bladder, and scan in the supine position. After applying coupling agent, the probe was placed above the pubic bone, and the bladder walls were scanned with multi-section ultrasonography to determine the size, number

and location of the lesions. Then color Doppler was used to observe the blood flow in the lesions. Subsequently, 1ml of sulfur hexafluoride microvesicles for injection and 5ml 0.9% sodium chloride solution were rapidly transfused through the superficial veins of the forearm. The dynamic imaging process was recorded and the lesions were collected.

1.3 Observation indicators and judgment criteria

Taking the pathological diagnosis stage as the gold standard, the diagnostic coincidence rate of each stage before bladder cancer was observed. To observe the sensitivity and specificity of contrast-enhanced ultrasound in diagnosing the staging of T2 bladder cancer. The staging criteria were as follows: T1 stage: the tumor enhancement was obvious, and the myometria between the tumor base and the bladder wall with low enhancement was complete, and the mucosa did not invade the myometria. At T2 stage, the low enhanced muscle layer between the tumor base and the bladder wall was discontinuous but did not break through the serosal layer. Stage T3: mass and deep muscle of bladder were enhanced by contrast agent, which invaded deep muscle. Stage T4: Simultaneous enhancement of internal and external bladder masses invading the entire bladder wall.

1.4 Statistical analysis

SPSS 26.0 software was used for data processing, and t test was used for comparative analysis among different groups. Counting data was expressed as percentage, measurement data was expressed as mean ± standard deviation, and differences among groups were compared by 2 test. In this study, if $P < 0.05$, the difference was considered statistically significant.

2. Result

2.1 The diagnostic coincidence rate of contrast-enhanced ultrasound in each stage of bladder cancer before operation

The diagnostic coincidence rates of CEUS in T1, T2, T3 and T4 were 85.00%, 93.75%, 73.33% and 75.00%.

Table 1. Diagnostic coincidence rate of contrast-enhanced ultrasound in each stage of bladder cancer before operation [n, %]

way	Number of cases	T1	T2	T3	T4
Pathological diagnosis	55	20	16	15	4
Contrast ultrasound	55	17(85.00%)	15(93.75%)	11(73.33%)	3(75.00%)
χ^2		4.351	8.617	5.418	3.274
*P*value		0.008	0.021	0.004	0.043

2.2 Sensitivity and specificity of contrast-enhanced ultrasound in the diagnosis of T2 and T3 bladder cancer

The sensitivity and specificity of CEUS at T2 stage were 86% and 88%, which were high levels, while the sensitivity and specificity at T3 stage were 64% and 72%, which were low levels.

Table 2. Sensitivity and specificity of contrast-enhanced ultrasound in the diagnosis of T2 and T3 bladder cancer

Contrast ultrasound	T2	T3
sensitivity(%)	86%	64%
specificity(%)	88%	72%
Negative predictive value	72%	75%
Positive predictive value	75%	80%
AUC	0.741	0.642
Standard error	0.124	0.137
95%*CI*	0.463~0.925	0.402~0.857

3. Discuss

There are significant differences in treatment strategies and prognosis between benign bladder lesions and bladder cancer. Early diagnosis and determination of stages of bladder cancer not only help to provide a reliable basis for the formulation of clinical treatment strategies, but also improve prognosis and avoid unnecessary overtreatment or inadequate treatment [4]. Therefore, it is very important to define the nature of bladder space-occupying lesions through routine imaging characteristics before surgery to provide a favorable basis for clinicians to choose the appropriate treatment. In this study, with pathological diagnosis as the gold standard, the postoperative staging of patients with bladder cancer was diagnosed by contrast-enhanced ultrasound. It was found that the diagnostic conformity rates of T1, T2, T3 and T4 were 85.00%, 93.75%, 73.33% and 75.00%, showing a high diagnostic rate and a high level of specificity and sensitivity at T2 stage. The use of CEUS technology can monitor the blood perfusion status of normal and diseased tissues in real time, and achieve continuous imaging under the condition of low mechanical index, so as to further obtain the change characteristics of tumor vascular microvesicle perfusion, so as to comprehensively evaluate the bladder health status of patients. In addition, in patients with bladder cancer at

T2 stage, there was invasion of the base and thickening of the bladder wall, and enhanced signals could be obviously detected by contrast of bladder sensitivity after filling with CEUS.

In summary, CEUS has a high coincidence rate in the postoperative staging of bladder cancer, and has high sensitivity and specificity in the T2 stage.

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