Correlation between Ultrasound and CT in the Diagnosis of Bladder Cancer

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Abstract: Introduction: Effective and early diagnosis of bladder cancer is very important to achieve potential treatment and improve the survival rate of affected patients. Objectives: To describe the ultrasonographic and computerized tomography (CT) findings of bladder malignant tumors. Method: An observational, descriptive and cross-sectional study was conducted from January 2013 to December 2017 on 250 patients with bladder cancer who previously underwent ultrasound and CT examinations in the Imaging Department of Saturnino Lora Provincial clinical surgery teaching hospital in Santiago, Cuba. Result: In this series, men over the age of 60 were more commonly diagnosed with bladder cancer. Ultrasound examination showed that in addition to the characteristics of calcification, necrosis, adenosis and infiltration of adjacent structures were observed. Ultrasound examination also showed dominant sonographic structures and clear tumors larger than 3 cm and vascularized tumors. On CT, the mixed structure, space occupying tumor and ultrasonic features were almost identical between the two diagnostic methods. Conclusion: Compared with CT, the sonogram of bladder cancer is mixed and ultrasonic, which makes the diagnosis of the bladder cancer more feasible. However, the features and details displayed by CT were consistent with other imaging techniques. Keywords: Bladder cancer, Ultrasound diagnosis, CT diagnosis, Bladder metastasis

1. Introduction

Cancer is a major burden of disease worldwide. Its high frequency makes it a priority for all health systems on earth. The complexity of diagnosis, treatment and control requires close coordination between different specialties and nursing levels[1].

The bladder is a hollow organ located in the pelvis with a soft muscle wall. Its main function is to store urine produced by the kidneys and then transported to the bladder through the ureter before excretion. In an ordinary adult, the capacity of the bladder is about two cups of urine.

Most types of bladder cancer begin in the urothelium. Bladder cancer is the most common urothelial carcinoma, which is formed in the urothelial tissue layer covering the bladder, urethra, ureter and renal pelvis[2]. When cancer grows into or through other layers in the bladder wall, it has a higher stage, becomes more advanced and can be harder to treat.

Worldwide, about 263,000 people are diagnosed with bladder cancer every year, and about 115,000 deaths from bladder cancer. In 2012, about 430,000 new cases were recorded and 165,000 deaths from this malignant tumor[3].
In 2017, bladder cancer is the second leading cause of death in Cuba. It ranked 13th out of all cancers in Cuba, accounting for 2.4%. In 2004, the incidence of bladder cancer was 2.1%, 2.9% for men and 0.9% for women, accounting for 2.4%. In 2004, the incidence of bladder cancer was 2.1%, 2.9% for men and 0.9% for women, accounting for 2.4%

Hematuria is the most common symptom of bladder cancer. According to literature, 85% cases have hematuria[3]. Hematuria may be directly visible to the naked eye, or is detected under a microscope via urinalysis. However, the degree of hematuria is not associated with the degree of bladder cancer.

Ultrasonography is helpful to identify the tumor mass in the bladder and the extent to which it passes through the muscle layer in the fat around the bladder. This technique can inform the invasion of the prostate or seminal vesicle and distinguish benign prostatic hyperplasia from real bladder tumors.

Computerized tomography (CT) axial scanning is the preferred imaging technique to study patients with hematuria. It also applies to cases of bladder cancer and suspected muscle invasion. Contrast scan is helpful to detect metastasis, but may not be sufficient to identify and stage local urothelial lesions. In addition, CT is also effective in evaluating the range of perivesical fat invasion in bladder cancer, local wall thickening and loss of fat plane clarity. Similarly, invasion of adjacent organs, such as the prostate or seminal vesicle, and calcification can also be detected quickly by CT scan. The lymph nodes in the presacral region, inferior gastric region and obturator chain are difficult to observe on CT, which enables us to estimate the size of these lymph nodes[2].

Multi-slice spiral CT with virtual cystoscopy program is a very promising technique for the detection of bladder lesions. This approach which uses software allows virtual scanning of bladder by simulating traditional cystoscopy, and the results are equivalent to the latter. Nevertheless, bladder probe and contrast agent need to be used before examination. Multiple reconstruction can better evaluate the anterior wall of bladder and the interior of bladder diverticulum, which is inaccurate in traditional cystoscopy. It is the preferred method for young patients or patients at risk of bleeding, urethral structure, prostatic hypertrophy, infection or bladder perforation[6].

Three dimensional, sagittal and sagittal reconstruction angiography (UroTAC) and urography were performed at the initial stage. Intravenous contrast agent is helpful to describe the characteristics of pelvic, cup or renal pelvis, ureter an/or bladder mass. If the increase after contrast is more than 20 uh (Hounsfield unit), the mass is classified as malignant; however, it is doubtful when the altitude between 10 and 20 uh cannot be described. In the absence of baseline venography, the excretion phase can be used as an important stage to assess elevated uptake during renography[7].

The assessment of bladder cancer by positron emission tomography (PET) with fluoro18 deoxyglucose is limited by renal excretion of radioisotopes in the collection system and bladder. At present, the main function of PET-CT is to detect metastases. In addition to the above methods, there are other approaches to diagnose bladder tumors that include intravenous urography, cystography and pyelography. Cystoscopy is a key point of diagnosis. It informs about tumor size, location, appearance (superficial or invasive) and allows biopsy for histological examination[8,9].

Invasive vessels and lymph node infiltration have independent prognostic significance because of the greater likelihood of recurrence[10].

So far, surgery is the only treatment for bladder cancer patients, but it needs appropriate staging to determine the most effective treatment.

In recent years, the number of patients with bladder cancer has increased, which proves the rationality of this study. It should be emphasized that population ageing occurs not only in developed countries, but also in countries such as Cuba, where health policies are aimed at prolonging people’s life expectancy and quality of life.

As mentioned earlier, rapid, effective and accurate diagnosis of bladder tumors is very important to determine the best treatment for patients. Also, it is essential to ensure that the quality of life of people affected by cancer is significantly improved.

Based on the above arguments, the study was conducted to address the needs for accurate and clear imaging diagnosis of bladder cancer.

2. Method

An observation, descriptive and case series study was conducted on 250 patients with bladder cancer confirmed by echocardiography, CT axial scanning and histopathology. These patients were randomly selected in the Imaging Department of Saturnino Lora teaching provincial clinical surgery hospital in Santiago de Cuba from January 2013 to December 2017, in order to describe its CT and ultrasound findings.

UroTAC examination is performed via siemens sensitivity 64 computed tomography scanner. As long as the patient is not allergic to iodine, a simple iodinography scan was performed through the vein. In this case, only the first scan was performed. These images were obtained through axial slices and multiplanar reconstruction views, which enables us to obtain more information about tumor characteristics, scope and metastasis, of which failed to be recognized on ultrasound images.

Abdominal ultrasound is performed using Aloka alpha 5 brand equipment, which allows coronal, sagittal and oblique sections of the whole abdomen, which makes it possible not only to diagnose bladder tumors and
evaluate the urinary tract, but also to detect changes in different organs that may metastasize. These images were taken on Sony’s ultrasonic printer.

The data were encoded into SPSS/PC program version 21.0 for processing. Absolute and relative frequencies (percentages) were used as indicators to summarize variable information, and the results are tabulated.

### 3. Result

In this series, patients over 60 years old dominated (63.6%) the group with suspected bladder malignancies, followed by patients in the 51-60 age group, and men were more commonly diagnosed with bladder malignancies (69.6%) (Table 1).

| Age group (year) | Masculine | | Feminine | | Total |
|-----------------|-----------|-----------|-----------|-----------|--------|
| No.             | %         | No.       | %         | No.       | %      |
| 30-40 years old| 3 1.2     | 3 1.2     | 6 2.4     | 15 6.0    |
| 41-50 years old| 7 2.8     | 2 0.8     | 9 3.6     |
| 51-60 years old| 67 26.8   | 12 4.8    | 79 31.6   |
| Over 60 years old| 97 38.8  | 62 24.8   | 159 63.6 |
| **Total**       | 174 69.6  | 76 30.4   | **250 100.0** |

Source: medical history

### Table 2. Patients suspected of bladder malignancy according to CT findings

| CT findings          | No. | %  |
|----------------------|-----|----|
| Density              |     |    |
| Mixed                | 132 | 52.8|
| High density         | 88  | 35.2|
| Low density          | 30  | 12.0|
| Homogeneous density  | 62  | 38.2|
| Variable density     | 188 | 61.8|
| Contrast uptake      |     |    |
| Captain              | 153 | 61.2|
| No captain           | 97  | 38.8|

Source: medical history

### Table 3. Patients suspected of bladder malignancy based on common ultrasound and CT findings

| Common ultrasonic and CT findings | No. | %  |
|-----------------------------------|-----|----|
| Outline                           |     |    |
| Clear definition                  | 187 | 67.6|
| Unclear definition                | 63  | 32.4|
| Contour                           |     |    |
| Less than 3 cm                    | 68  | 27.2|
| 3 cm and above                    | 182 | 72.8|
| Other features                    |     |    |
| Bladder wall fat                  | 171 | 68.4|
| Tumor necrosis                    | 82  | 32.8|
| Calcification                     | 72  | 28.8|
| Expansion of excretory system     | 68  | 27.2|
| Infiltration of excretory system  | 25  | 10.0|
| Adjacent organ infiltration       | 12  | 4.8 |
| Deep indifference                 | 11  | 4.4 |

Source: medical history

With regards to CT images (Table 2), the features related to tumor density were first described. It had been found that mixed images account for 52.8%. Variable tumor density was observed in 188 patients, accounting for 61.8%. Also, 61.2% of contrast agent was absorbed.

Different common features were evaluated by ultrasound and CT (Table 3) The tumor contour of 187 patients was clear, accounting for 67.7%. In terms of size, 72.8% of cases were 3 cm tall and above. The incidence of bladder wall thickening, intra-tumoral necrosis and calcification was the highest. In addition to the characteristics of the tumor, there were other distant complications, such as expansion of the excretory system (27.2%) and deep gland lesions (4.4%).
4. Discussion

In this study, there was no significant difference in the effectiveness of the two techniques in the diagnosis of intravesical lesions, whether it was to confirm the existence of malignant tumors or to detect local thickening specific to flat tumors or carcinoma in situ. These two techniques have high sensitivity in the diagnosis of bladder cancer. Therefore, basic imaging research in this field is necessary.

Ultrasound has become the first choice for these cases because of its low cost and can be used in all hospitals and safety centers. It has sensitivity more than 95%, and its effectiveness in detecting millimeter tumors makes it an important pillar of diagnosis. However, its specificity depends on the observer (or operator), so radiologists must strive to obtain high-quality ultrasound reports, and to look for direct and indirect signs related to bladder tumors, and make the best staging.

This imaging technique defines bladder tumor as an echo formation growing inward from the wall, which is exogenous according to its nature. It is necessary to clarify its characteristics and implantation basis in order to understand its malignant potential; the bladder wall should also be accurately examined to determine whether there is stiffness, poor structure and abnormal pelvic echo. It is important to evaluate the liver parenchyma (the origin of the metastasis), the prostate and seminal vesicles in men, and the uterus and vagina in women. In addition, we should also examine the pelvic adenosis which shown by ultrasound as an extracapsular addition, we should also examine the pelvic adenosis in men, and the uterus and vagina in women. In (the origin of the metastasis), the prostate and seminal echo. It is important to evaluate the liver parenchyma that is stiffness, poor structure and abnormal pelvic echo. However, its specificity depends on the observer (or operator), so radiologists must strive to obtain high-quality ultrasound reports, and to look for direct and indirect signs related to bladder tumors, and make the best staging.

Bladder is the most common site of transitional cell tumor, and the lesion is usually in the cavity. The tumor cells usually do not exceed the bladder wall until they become larger[7-12].

CT is an examination method for patients with invasive bladder tumor and pelvic and abdominal lymph node metastasis. It helps to predict the local extent of the disease by visualizing the tissue around the bladder, which may be abnormal due to the inflammatory process caused by previous transurethral resection and may lead to higher staging. CT will be mainly used to detect adenomatous adenoma and potential liver metastasis[11].

Ruiz et al.[13] found that the incidence of mixed images was higher, about 78%. They also believed that extensive evaluation of tumor vascularization and infiltration is deemed necessary because 62.9% of the samples had good vascularization on color doppler ultrasound and good contrast uptake on CT. These authors also reported that when determining the diagnosis, 80% of bladder tumors are more than 3 cm in size. When the tumor is small or has thrombus and thick calcification, ultrasonography is difficult to stage, which will damage the deepening and actual measurement of the tumor.

In addition, Joe et al.[14] showed that 85% of the patients have well-defined tumors. This explains intratumoral necrosis and perirenal fat infiltration.

These features are matched. With regards to calcification, the difference is that calcification has little value in the description of tumor, because the margin of error is quite large when dealing with residual stones and calcification of tumor epithelial fragments caused by insufficient bladder emptying.

Rodríguez Luna et al.[15] explained the value of feature combination in better evaluating and describing the diagnostic methods of tumors. They also recognized the authenticity of staging in estimating the extent and prognosis of cancer, especially using the TNM staging system proposed by the American Joint Cancer Committee, which combines tumor size and invasion of adjacent tissues (t), invasion of lymph nodes (n) and metastasis (m).

Most series reported that large tumors are more likely to invade other structures, grow deeply, have a poor prognosis, and have a trend of progression and distant metastasis[16].

Patients with multiple tumors may have an increased risk of poor prognosis due to the increased possibility of incomplete resection[17].

Understanding the type and stage of cancer is important to estimate the prognosis. However, many other factors may also affect prognosis, such as potential health problems, cancer degree and good treatment response. Depending on the stage of cancer, a single type of treatment or a combination of treatments can be used. In most cases, only surgery or a combination of other treatments is used to treat bladder cancer[1].

At present, campaigns are being carried out to promote the timely diagnosis of breast and cervical cancer; however, there are no such strategies related to prostate cancer, skin cancer and urothelial tumors[18]. There is no doubt that early and accurate diagnosis can develop the most feasible and favorable treatment strategy for each patient.

In conclusion, the ultrasound images of bladder cancer patients were mixed with CT images, which makes the diagnosis of the disease possible; however, the features and details displayed by CT were consistent with the results provided by other imaging techniques.

Conflicts of interest

The authors declare that they have no conflict of interest.

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