

# ULTRASONOGRAPHIC FINDINGS RELATED TO BLADDER NEOPLASIA: NARRATIVE REVIEW

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## ABSTRACT

**INTRODUCTION:** Bladder cancer is usually diagnosed by chance or due to the investigation of its typical symptoms. Hematuria is the most frequent symptom, occurring in approximately 85% of patients, as well as pollakiuria and dysuria, findings that are also present in benign situations such as urinary tract infection, nephrolithiasis, benign prostatic hyperplasia and other inflammatory conditions. It is estimated that each year in Brazil more than ten thousand new cases of bladder cancer are diagnosed, about 70% in men and 30% in women, being the seventh most frequent cancer in the male population.

**OBJECTIVE:** This research aims to study the sonographic findings related to bladder cancer.

**MATERIAL AND METHODS:** This is a narrative review with emphasis on the collection of images. The databases were MEDLINE via PubMed, LILACS and Scielo via BVS (Virtual Health Library). The health descriptors (MeSH terms) in English used: were urinary bladder neoplasms, ultrasonography, ultrasound, in the following search strategy: (ultrasonography or ultrasound) and (urinary bladder neoplasms). Studies published in the last five years were included.

**RESULTS AND DISCUSSION:** The applicability of imaging tests has been increasingly important for the diagnosis, staging and follow-up of neoplasms, especially for cancers with clinical characteristics similar to several other pathologies, such as bladder cancer. Despite its relatively high incidence, bladder cancer is often under-diagnosed and the appearance of bladder cancer can be confused with other pathologies. Thus, the importance and advantage of ultrasonography as a dynamic imaging modality, capable of optimizing the distinction of bladder cancer from entities of similar appearance, is highlighted. Thus, the work discusses the additive role of ultrasound images for patients with bladder cancer, presenting the most frequent subtypes and their respective ultrasound images and distinguishing their differential diagnoses: urothelial carcinoma, urothelial papilloma and fibroepithelial polyps, rhabdomyosarcoma, leiomyoma, adenocarcinoma of urachus, paraganglioma and lymphoma of the bladder.

**CONCLUSION:** From the exposure and description of the ultrasound images, the importance of the applicability of ultrasound for the detection and distinction of bladder cancer is reiterated, and its use should be encouraged when the patient presents a compatible clinical condition, since this diagnosis can be confused with other frequent pathologies of the genitourinary tract, consequently causing late discovery of the disease and a worse prognosis.

**KEYWORDS:** ULTRASONOGRAPHY; BLADDER; NEOPLASM; UROLOGY; DIAGNOSTIC IMAGING

## INTRODUCTION

The applicability of imaging tests has been increasingly important for the diagnosis, staging and follow-up of neoplasms, especially for cancers with clinical characteristics that may be similar to other pathologies, such as bladder cancer.

Bladder cancer is usually diagnosed incidentally or as a result of investigating its typical symptoms. Hematuria is the most frequent symptom, occurring in approximately 85% of patients, as well as pollakiuria and dysuria, findings that are also present in benign situations such as urinary tract infection, nephrolithiasis, benign prostatic hyperplasia and other inflammatory conditions. As these conditions are quite common, misinterpretations of hematuria and irritative symptoms can result in a late diagnosis of bladder cancer, when they are already at a more advanced stage of the disease.<sup>1</sup>

The National Cancer Institute (INCA) estimates that

each year in Brazil more than ten thousand new cases of bladder cancer are diagnosed, about 70% in men and 30% in women, being the seventh most frequent cancer in the male population. The estimates, according to the American Cancer Society, for bladder cancer in the United States, for the year 2019, was 80,470 new cases, 61,700 in men and 18,770 in women.<sup>2</sup>

Despite its relatively high incidence, bladder cancer is often underdiagnosed and, as seen, even when bladder abnormalities are identified, the appearance of bladder cancer can be confused with other pathologies. Thus, we emphasize the importance and advantage of ultrasonography as a dynamic imaging modality, with the capacity to optimize the distinction of bladder cancer from entities of similar appearance.<sup>3</sup>

In this review, we will discuss the additive role of ultrasound images for patients with bladder cancer, presenting

the most frequent subtypes and their respective ultrasound images to better identify their characteristics.

## OBJECTIVE

This work aims to study ultrasonographic findings related to bladder cancer.

## METHODS

This is a narrative review with emphasis on the collection of images. The databases were MEDLINE via PubMed, LILACS and Scielo via BVS (Virtual Health Library). The health descriptors (MeSH terms) in English used were urinary bladder neoplasms, ultrasonography, ultrasound, in the following search strategy: (ultrasonography or ultrasound) and (urinary bladder neoplasms).

Studies were included (clinical trials, pictorial essays, literature reviews, case reports, among others), which had images of diagnostic methods, which were in accordance with the research objective and available online in full text, published in the last five years, in English, Spanish and Portuguese.

## RESULTS AND DISCUSSION

The main subtypes of bladder cancer and their respective ultrasound images as well as their differential diagnoses are presented below.

### UROTHELIAL NEOPLASMS

#### Urothelial carcinoma

Urothelial carcinoma is the most common urinary tract malignancy in adults. Potentially lethal, it can present as main symptoms hematuria, polyuria and later, urinary obstruction, evolving with pain and infectious symptoms. On imaging, there are no specific features that differentiate urothelial carcinomas from other bladder lesions, however, they tend to occur in the bladder trigone and ureteral orifices<sup>4</sup> – see figures 1-3.

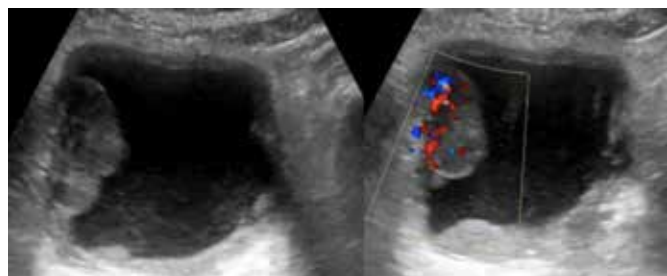


Figure 1. (a) Large well-defined echogenic mass (4.0×2.0×3.7cm) on the right lateral wall of the bladder. (b) Color Doppler ultrasonography detected the presence of vascularization in this mass. Urothelial carcinoma was confirmed.<sup>3</sup>

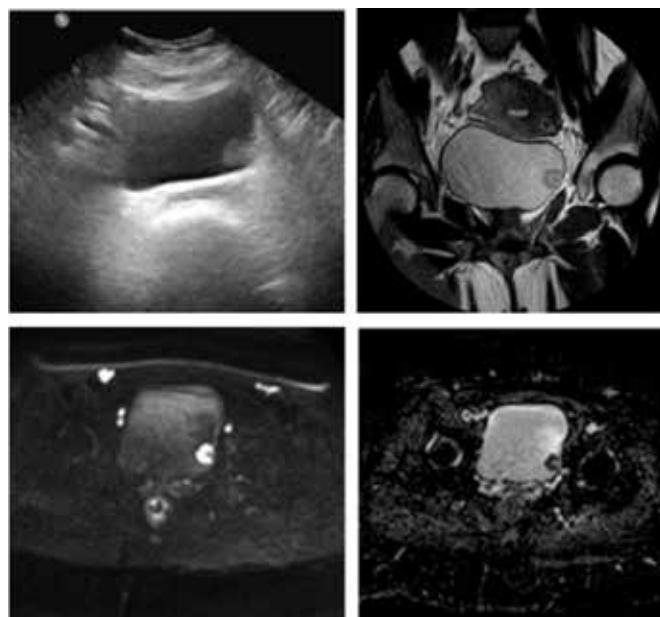


Figure 2. Stage T1 urothelial carcinoma: (a) Echogenic soft tissue mass on the left lateral wall. (b) Superficial soft tissue mass on the left lateral wall with arc-shaped tumor. (c) restricted signs of the tumor and not of the submucosal peduncle. (d) Note remaining intact muscular wall of the urinary bladder.<sup>3</sup>

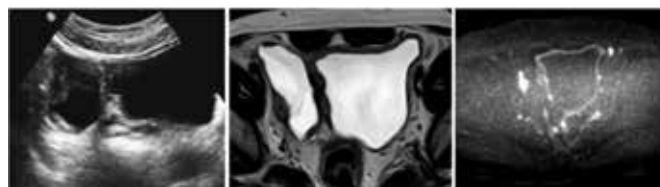


Figure 3. Male patient, 60 years old, with stage T2 urothelial carcinoma (a) ultrasound image of the right bladder diverticulum with intradiverticular soft tissue lesion. (b) intradiverticular mass on the right. (c) intradiverticular mass on the right.<sup>3</sup>

Patients with a history of augmentation cystoplasty have a higher risk of developing urothelial carcinoma, which in this setting occurs more frequently at bladder-bowel anastomosis sites and is more likely to be of high grade and to have an aggressive clinical course. For this reason, some clinicians recommend endoscopic surveillance of patients with this history. This surveillance should begin 10 years after the initial surgery because of the considerable time required for the lesion to develop.

#### Urothelial papilloma and fibroepithelial polyps

Urothelial papillomas are benign polypoid neoplasms, typically seen in males younger than 50 years of age. Microscopically, these lesions demonstrate a fibrovascular nucleus covered by normal urothelium and without cytological atypia. Occasionally, large papillary structures may arise, giving rise to anastomoses of papillae, which help to distinguish these tumors from fibroepithelial polyps on pathological analysis.

Urothelial papillomas have been described with a frondlike appearance on imaging (although this feature is not pathognomonic) and occurring near the ureteral orifices or along the posterior bladder wall.

On ultrasound, they usually appear as a hypo- or hyperechogenic soft-tissue mass on the lateral walls of the bladder (Figures 4-5).



Figure 4. Bilateral bladder papillomas in a six-year-old girl. (a) Cross-sectional midline US image showing bilateral lobulated soft tissue masses at the vesicoureteric junctions. (b) Voiding cystourethrogram shows multiple filling defects in the urinary bladder along the lateral walls.<sup>4</sup>



Figure 5. Fibroinflammatory polyp of the urinary bladder in an eight-year-old boy. The polyp was initially identified incidentally on MRI of the lumbar spine. (a) Sagittal T2-weighted MR image of the lumbar spine shows an incidentally discovered bladder lesion in the urethral orifice. (b) Sagittal color Doppler US image of the urinary bladder shows the lobulated lesion with slight internal vascularization.

Fibroepithelial polyps are benign urothelial lesions, most commonly seen in the upper urinary tract. It has a strong male predilection and can manifest during childhood. Manifestations of fibroepithelial polyps include gross hematuria and flank pain that may be due to torsion of the polyp if it reaches a substantial size. However, most of these lesions are solitary and smaller than 5 cm. Some of them may have focal areas of ulceration.<sup>4</sup>

## MESENCHYMAL NEOPLASMS

### Rhabdomyosarcoma

Rhabdomyosarcomas are the most common malignant

tumors of the urinary bladder in children younger than 10 years and represent 5% of all solid childhood cancers. Although rhabdomyosarcomas can arise anywhere in the body where primitive muscle cells exist, they manifest in the bladder and prostate in approximately 20% of cases. Bladder and prostate rhabdomyosarcomas have a bimodal age distribution, with a peak incidence in the first two years of life and another peak in adolescence.

Approximately 10% to 20% of patients with rhabdomyosarcoma (regardless of site of origin) have metastatic disease at the time of diagnosis. Dissemination is typically to the lungs, cortical bone and/or regional lymph nodes, with the incidence and pattern of disease differing according to the site and histological features of the tumour.

On ultrasound images, bladder rhabdomyosarcomas are typically large and nodular and often associated with urinary tract obstruction. The mass is usually well defined and slightly hypoechoic and homogeneous. The botryoid subtype of rhabdomyosarcoma can look like a bunch of grapes. These lesions are commonly located in the bladder trigone and bladder neck (figure 6).

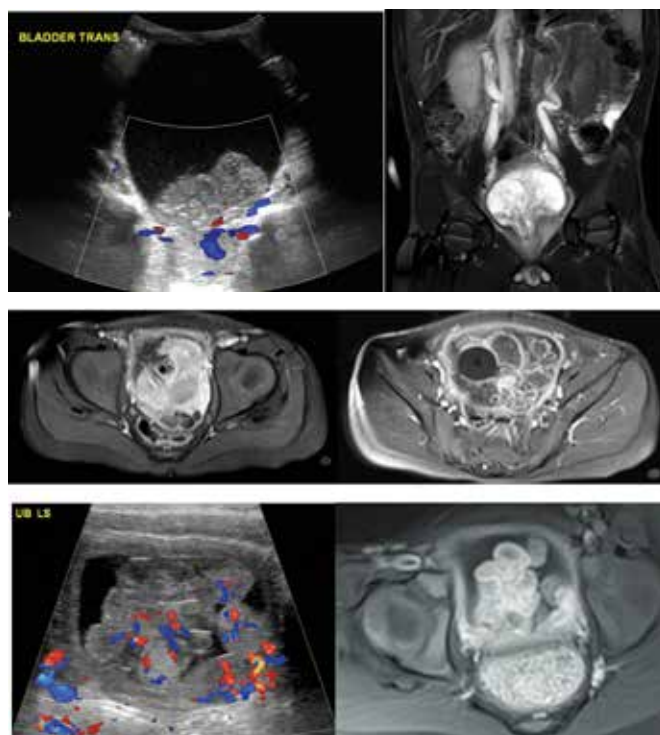


Figure 6. Embryonal rhabdomyosarcoma of the urinary bladder in children. (a) Color Doppler longitudinal section of the bladder shows a multilobulated mass with internal vascularity. (b-d) Mass is the base of the bladder. (e) similar lesion in another patient. (f) the lobulated lesion has high signal intensity.<sup>4</sup>

### LEIOMYOMA

Bladder leiomyomas are rare, representing 0.43% of all bladder mesenchymal tumor subtypes. These tumors are commonly found in women between the ages of 30



and 60. General manifestations of bladder leiomyomas include frequent urination, urinary obstruction, dysuria, and hematuria.

Regarding location, bladder leiomyomas can be endovesical (in 86% of cases), intramural (in 11% of cases) or extravesical (in 11% of cases), with the endovesical subtype being the most likely to cause obstructive urinary symptoms. The imaging features of these tumors are very similar to those of uterine fibroids: a typically solitary solid mass, homogeneously attenuated, with variable enhancement characteristics on cross-sectional images, with intermediate to low signal intensity on T1- and T2-weighted MR images (figures 7-8). However, histopathologic analysis is required to confirm the diagnosis and exclude an underlying leiomyosarcoma. Excision is curative, with no risk of recurrence or spread.<sup>6</sup>



Figure 7. Bladder leiomyoma in an 18-year-old woman. (a) Right sagittal US image showing a hypoechoic lesion of the anterior bladder wall. (b) Coronal T2-weighted MR image shows a round bladder mass that is isointense to the muscle.<sup>4</sup>



Figure 8. Leiomyoma in a 44-year-old Asian woman. CT scan reveals solitary homogeneous round tumor projecting into the urinary bladder and lobulated enlargement of the uterus consistent with uterine leiomyoma: (A) bladder leiomyoma, (B) bladder, (C) uterine leiomyoma, (D) uterus.<sup>6</sup>

### OTHER FINDINGS

#### Urachal adenocarcinoma

The urachus is a structure that communicates the allantois to the embryonic bladder, measuring between 5-10 cm. It is located on the anterosuperior surface of the bladder extending to the umbilicus region. The urachus regresses throughout life to become the median umbilical ligament. Only 3% of the population has a remnant of this structure.

Urachal carcinoma represents < 1% of bladder neoplasms, with adenocarcinoma being the most frequent. In 90% of cases, urachal carcinoma begins in the urachus adjacent to the dome of the bladder, as the cancer grows it extends cranially towards the umbilicus.

Urachal carcinoma is most often seen in middle-aged and elderly men. Urachal carcinoma can cause abdominal pain, hematuria, purulent or bloody discharge from the umbilicus. Furthermore, as the mass is typically extravesical in location, the patient is often asymptomatic initially, resulting in a late presentation. Urachal carcinoma is highly malignant, which often requires an en bloc resection of the mass as well as the umbilical ligament for long-term disease-free survival. Urachal carcinoma will appear ultrasonographically complex and heterogeneous in echotexture. Calcifications are present in 70% of cases, often along the periphery of the mass. Early urachal carcinomas, limited to the dome of the bladder, can look identical to invasive bladder cancer. The cystic components of the mass, when present, are hypo- or anechoic on ultrasound (Figures 9-10).<sup>4</sup>

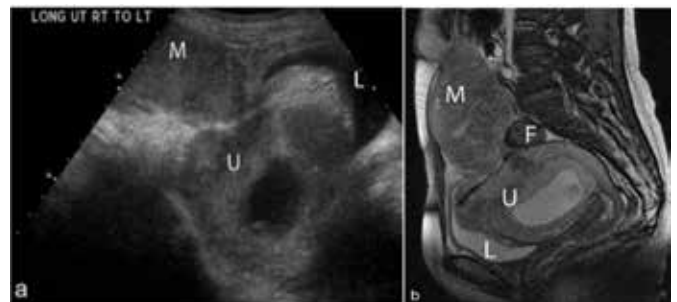


Figure 9. (a) 36-year-old pregnant woman with urachal carcinoma. Longitudinal ultrasound of the pelvis shows a large mass superior to the bladder and anterior to the gravid uterus. (b) Sagittal MRI of the pelvis shows the heterogeneous mass superior to the bladder and extending to the umbilicus.<sup>7</sup>

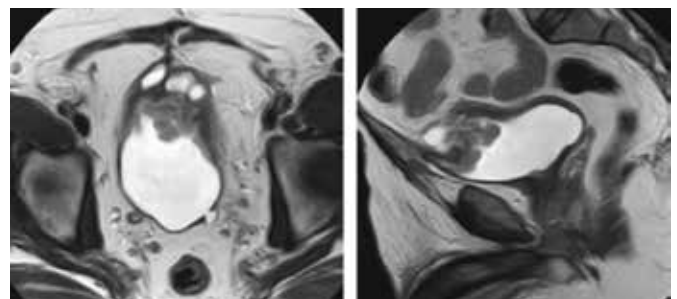


Figure 10. A case of urachal adenocarcinoma (enteric type) in a 60-year-old male patient, complaining of hematuria. (a and b) Heterogeneous midline mass of mixed cystic and soft tissue components, infiltrating the bladder dome and connected superiorly to the umbilicus with a pathway, representing the fibrous remnants of the urachus.<sup>3</sup>

## PARAGANGLIOMA

A paraganglioma is a pheochromocytoma outside the adrenal gland. Of pheochromocytomas, 18% are paragangliomas, 10% of which are located in the bladder. Paragangliomas represent 0.06% of all bladder tumors. An interesting and classic presentation of patients with bladder paragangliomas is acute hypertension during urination due to catecholamine release. This transient release of catecholamines may manifest as headache, blurred vision, or flushing with urination, however, 27% of patients may not have any symptoms associated with bladder paraganglioma.

Bladder paragangliomas appear as a soft tissue mass arising from the bladder wall and protruding into the lumen. These tumors are often indistinguishable from urothelial cells or other bladder cancers. Potential distinguishing features of other bladder tumors include intense enhancement on contrast-enhanced CT or MRI, or the presence of necrosis or hemorrhage within the lesion (Figures 11-12). If bladder paraganglioma is suspected due to history and imaging appearance, further evaluation with an iodine-123-MIBG nuclear medicine study may be performed. On pathology, a paraganglioma has an epithelioid appearance. The architecture is characteristically nested. Immunohistochemistry can be used to confirm the neuroendocrine origin of the mass.<sup>7</sup>

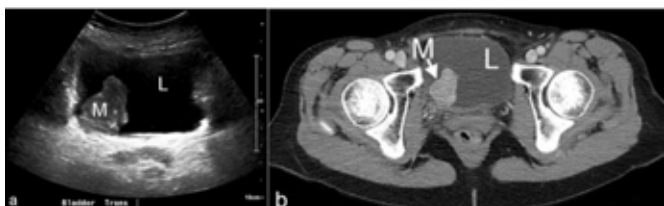


Figure 11. 60-year-old woman with bladder wall paraganglioma. (a) Transverse ultrasound of the bladder shows a mass arising from the right posterior wall of the bladder. (b) Axial contrast-enhanced CT images show that the right posterior bladder wall mass is avidly enlarging.<sup>7</sup>

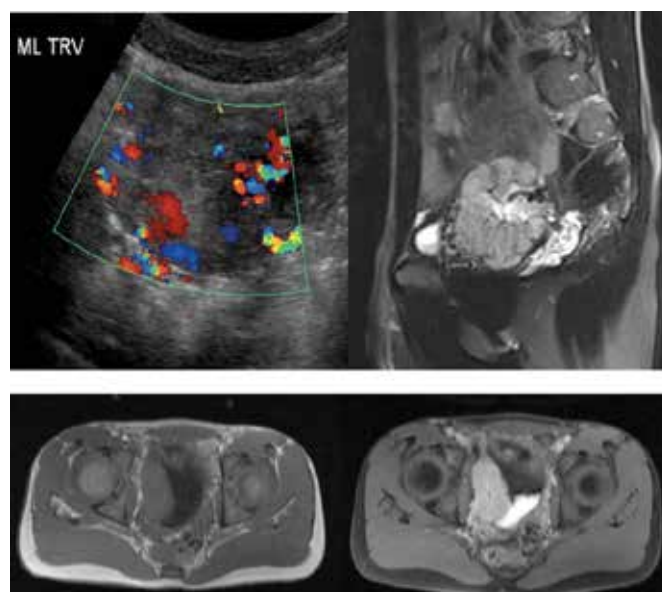


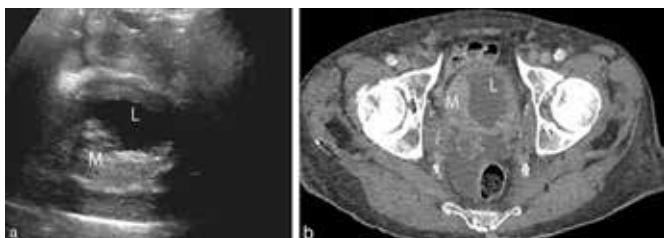
Figure 12. Imaging findings in a 15-year-old boy with hypertension secondary to bladder paraganglioma. (a) Midline color Doppler US image of a moderately full urinary bladder shows a round soft tissue mass on the right lateral wall of the bladder, with marked vascularity. (b) Sagittal fat-saturation T2-weighted MR image shows a tortuous vessel leading to the lesion. (c, d) Axial without contrast (c) and saturated fat with contrast (d) T1-weighted MRI images obtained at the level of the urinary bladder show hypersignal of bladder wall injury.<sup>4</sup>

## LYMPHOMA

Bladder lymphoma is rare and more common in middle-aged women, who may have hematuria as their main symptom. By definition, primary bladder lymphoma occurs in the absence of known lymphoma elsewhere.

Most commonly, the bladder is secondarily involved with a known primary extravesical lymphoma. Marginal zone lymphoma of mucosa-associated lymphoid tissue (MALT lymphoma) and diffuse large B-cell lymphoma are the most frequently identified types. Bladder lymphoma presents as a solitary mass in the submucosa of the bladder (70%), with 20% occurring multifocally and 10% presenting as diffuse thickening of the bladder wall.

There are no distinct imaging features known to distinguish bladder lymphoma from other types of bladder cancer. Thus, bladder lymphoma usually appears as a lobular mass along the bladder wall with vascularity on color Doppler (Figure 13).<sup>7</sup>



**Figure 13.** (a) 85-year-old man with diffuse large B-cell lymphoma of the bladder. Transverse ultrasound of the bladder shows a large heterogeneous mass along the right posterolateral wall of the bladder. (b) Axial CT scan in the same patient shows similar asymmetric thickening of the right bladder wall. No additional lymphoma sites were identified in subsequent staging studies. It is important to note that the patient had a history of prostate cancer and pelvic radiotherapy.<sup>7</sup>

## CONCLUSION

Ultrasound findings of benign and malignant bladder tumors include isoechogenic or hypoechogenic nodules and/or masses, with heterogeneous echotexture, solid, with flow on Doppler. The contours of the lesions infer benignity when regular, and when irregular, infer malignancy.

From the exposure and description of the ultrasound images, we reiterate the importance of the applicability of ultrasound for the detection and distinction of bladder cancer, and its use should be encouraged when the patient has a compatible clinical condition, since this diagnosis can be confused with other frequent pathologies of the genitourinary tract, causing consequent late discovery of the disease, in an advanced stage and with a worse prognosis.

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