Imaging findings in renal lymphoma

C. Medar¹, M.C. Grasu¹-2, C. Baston¹-3, O.M. Baston¹, I. Sinescu¹-3
¹ University of Medicine and Pharmacy “Carol Davila” Bucharest, Romania
² Department of Radiology, Medical Imaging and Interventional Radiology, Fundeni Clinical Institute, Bucharest, Romania
³ Center of Urological Surgery and Renal Transplantation, Fundeni Clinical Institute, Bucharest, Romania

Abstract

Introduction and objectives. The aim of this paper is to systematize and illustrate distinct imaging patterns and lesions distribution seen in renal lymphomas and to discuss the differential diagnosis with other renal tumors.

Materials and methods. We realized a retrospective study over a period of 12 years from the cases investigated by CT or MRI in our hospital and diagnosed with a lymphoproliferative disease. Of the 3290 patients found, a total of 48 showed renal lymphoma. There was pathological confirmation for all patients, either node biopsy or after nephrectomy. All patients had at least two CT / MRI examinations. Indications for CT examination were: disease staging, follow-up at 6 or 12 months, clinical suspicion of recurrence and evaluation of renal or other organs lesions. Follow-up interval varied from four months to four years. MRI examination was performed only in two patients with iodinated contrast material allergy.

Results. The most common imaging appearance of renal lymphomas is that of homogeneous, isodense (non-enhanced CT) and hypoattenuated (contrast-enhanced CT) masses compared with normal parenchyma. We found a wide variety of manifestation: multiple bilateral (52%) or unilateral masses (13%), a solitary nodular lesion (8%) or infiltrative lesions (13%), contiguous retroperitoneal extension (6%) or masses in the perirenal space (8%).

Conclusions. Contrast enhanced CT is useful in: detection and characterization of renal involvements in patients with lymphoma, disease staging, follow-up and response after therapy and differential diagnosis with other renal masses. Histological confirmation of disease and the presence of bilateral renal nodular lesions associated with other extra-nodal involvements can establish the diagnosis of renal lymphoma. Otherwise renal biopsy is necessary.

Keywords: contrast agent-intravenous, CT, hematologic, kidney, lymphoma

Correspondence: Dr. Cosmin Medar
University of Medicine and Pharmacy “Carol Davila” Bucharest, Romania
Tel: +40212750700
E-mail: cosmin78@gmail.com
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Results
Supra- or subdiaphragmatic lymph nodes was present in all patients. Along with renal impairment were described lesions of the liver (15 cases), adrenals (10 cases), soft tissues (9 cases), pancreas (8 cases), spleen (7 cases), mediastinum (7 cases), lungs (6 cases), bones (3 cases) and digestive tube (2 cases). According to NHL Working Formulation classification the most common lymphomas were with intermediate grade of aggressivity and I mention here the diffuse large B-cell lymphoma with 23 cases (Table 1) [1].

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Typical CT pattern of renal lymphoma was [1]:
- isodense on unenhanced CT;
- low contrast enhancement;
- homogeneous attenuation;
- smooth borders.

Atypical CT aspects: heterogeneous attenuation due to necrosis, hemorrhage or calcification, especially after chemotherapy. We found a wide variety of manifestation [1]:
- multiple bilateral masses (52%),
- unilateral masses (13%),
- solitary nodular lesion (8%),
- infiltrative lesions (13%),
- contiguous retroperitoneal extension (6%),
- masses in the perirenal space (8%).

Multiple bilateral lesions:
The most common imaging appearance of renal lymphoma is that of multiple masses of variable size, typically 1–4 cm in diameter. At unenhanced CT, these masses appear as isodense soft-tissue lesions compared with surrounding parenchyma. After intravenous administration of contrast material, there is minimal but homogenous enhancement, the lesions manifesting as areas of decreased enhancement compared with the normal renal parenchyma (Fig. 1).
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Fig. 1: Diffuse large B-cell lymphoma in a 30-year-old woman. Unenhanced CT scan (a,b) shows enlargement of the left kidney and a focal contour distortion of the right kidney (arrowhead). Contrast-enhanced CT scan (c,d) demonstrates multiple bilateral masses (arrows) with characteristic homogeneous attenuation, smooth borders, and low contrast enhancement, a typical finding in renal lymphoma. Retroperitoneal adenopathies are also present (arrowheads).

Like most malignant and inflammatory renal lesions, lymphoma exhibits hypointense signal on T1-weighted MR images and is slightly hypointense or isointense relative to normal renal cortex on T2-weighted images. After the intravenous administration of gadolinium-based contrast material, lymphomatous deposits enhance less than the surrounding normal parenchyma (Fig. 2).

Fig. 2: Diffuse large B-cell lymphoma in a 33-year-old woman. Axial fat-saturated T2-weighted FSE (a) and axial venous phase contrast-enhanced fat-saturated T1-weighted (b) MR images of the abdomen show bilateral renal lesions (arrows), which are slightly hypointense or isointense relative to normal renal cortex on T2-weighted images, with very little enhancement after gadolinium-based contrast material administration.

However, metastases from primary tumors such as lung, breast or pancreatic cancer (Fig. 3), often manifest as bilateral masses that are indistinguishable from multifocal lymphoma [2,3].

Unilateral lesions:

Usually, unilateral renal lesions are small (Fig. 4), therefore it is not always possible to make accurate density measurement for demonstrating the degree of enhancement. For differences in densities ranging between 10 and 20 HU should be taken into consideration and the pseudo-enhancement artifact of isodense renal cysts (cysts with protein or hemorrhagic content). In such cases, MRI imaging with intravenous administration of gadolinium-based contrast material can be used for a correct staging of the disease (renal involvement means stage IV) [4,5].

Fig. 4: Small lymphocytic lymphoma in a 57-year-old woman. Contrast-enhanced CT scan (a,b) shows two small, hypointensating masses in the left kidney (white arrows) associated with focal splenic lesions (black arrows). The third renal lesion (arrowhead) is too small to characterize. Large retroperitoneal adenopathies are present (*).

Solitary lesion:

At contrast-enhanced CT, the solitary mass demonstrates little enhancement following intravenous contrast material administration (Fig. 5). This feature is helpful in differentiating renal lymphoma from clear cell renal cell carcinoma, which usually is a hypervascular and heterogeneous tumor. However, some primary renal tumors, such as the papillary (Fig. 6) and chromophobe carcinoma, are also hypovascular tumors and the differential diagnosis is sometimes almost impossible to do. In such cases, needle biopsy is required to exclude an atypical renal cell carcinoma or a solitary metastasis [6].

Fig. 5: Diffuse small cleaved cell lymphoma in a 20-year-old woman. Contrast-enhanced CT scan in corticomedullary (a) and nephrographic (b) phase demonstrate in the right kidney a subcapsular nodular mass with homogeneous attenuation and low contrast enhancement (arrows) which does not distort the renal contour.

Fig. 6: Non-Hodgkin lymphoma associated with papillary carcinoma in a 37-year-old man. Contrast-enhanced CT scan in corticomedullary (a) and nephrographic (b) phase shows a hypovascular, heterogeneous mass (arrow) with areas of necrosis (arrowhead), in the left kidney.

CT scan in nephrographic phase (a,b) demonstrate multiple renal (arrows) and hepatic (arrowheads) hypovascular lesions arising from primary tumor of pancreas (*).
Infiltrative lesions:
Lymphomatous proliferation usually occurs within the interstitium of the kidney and is almost always bilateral (Fig. 7) [7].

![Fig. 7](image)
**Diffuse mixed lymphoma in a 33-year-old man.** Contrast-enhanced CT scan in excretory phase (a,b) demonstrates infiltrative lesions which are presenting as patchy ill-defined areas with low contrast enhancement (arrows), without distortion of the renal contour. Retroperitoneal adenopathies are present (arrowheads).

Tumor growth often results in nephromegaly with preservation of renal contour, a finding that is characteristic of infiltrative lymphoma [8]. Heterogeneous enhancement of the kidneys, loss of the normal differential enhancement between the cortex and the medulla in the corticomedullary phase, and infiltration of the renal sinus fat are features of the infiltrative lesions. Sometimes, in invasion of pyelocaliceal system and impairment of kidney function can be seen (Fig. 8).

![Fig. 8](image)
**Small lymphocytic lymphoma in a 67-year-old man.** Contrast-enhanced CT scan in corticomedullary (a) and delayed excretory phase (b) shows the kidneys as diffusely enlarged and replace by tumor. It was noted the absence of excretion on the left kidney approximately 3 h after administration of contrast media.

Fig. 8
Small lymphocytic lymphoma in a 67-year-old man. Contrast-enhanced CT scan in corticomedullary (a) and delayed excretory phase (b) shows the kidneys as diffusely enlarged and replaced by tumor. It was noted the absence of excretion on the left kidney approximately 3 h after administration of contrast media.

An infiltrative growth pattern may be seen with inflammatory processes such as acute pyelonephritis (Fig. 9), where we can find multiple wedge-shaped areas of diminished enhancement that extend to the periphery of the kidney, thickening of perirenal and infiltration of perinephric fat. Diffuse infiltration of the kidney can also be caused by transitional cell carcinoma, renal medullary carcinoma or carcinoma of the collecting ducts of Bellini [8].

![Fig. 9](image)
**Acute pyelonephritis in a 62-year-old man.** Contrast-enhanced CT scan in nephrographic phase (a,b) shows multiple wedge shaped low attenuation lesions in both kidneys (arrows).

**Contiguous retroperitoneal extension:**
Direct renal invasion from contiguous retroperitoneal disease is another pattern of involvement in renal lymphoma (Fig. 10). These patients typically present with a large, bulky retroperitoneal mass that envelopes the renal arteries and veins and invades the renal hilum. However, in most patients the renal arteries and veins remain patent, a finding that is characteristic for lymphoma. Following treatment of larger masses, residual fibrosis is often seen and can be mistaken for recurrent or residual disease [3,9].

![Fig. 10](image)
**Lymphoblastic lymphoma in a 13-year-old girl.** Contrast-enhanced CT scan in nephrographic phase (a,b,c) and excretory phase (d) shows a large soft-tissue mass (*) infiltrating the retroperitoneum, encasing the left renal vessels (arrowheads) and invading the renal sinus and parenchyma (arrows). Note that the renal arteries and veins remain patent and, also, the absence of hydronephrosis.

Fig. 10
Lymphoblastic lymphoma in a 13-year-old girl. Contrast-enhanced CT scan in nephrographic phase (a,b,c) and excretory phase (d) shows a large soft-tissue mass (*) infiltrating the retroperitoneum, encasing the left renal vessels (arrowheads) and invading the renal sinus and parenchyma (arrows). Note that the renal arteries and veins remain patent and, also, the absence of hydronephrosis.

Perirenal lesions:
Perirenal involvement is usually the result of direct extension from retroperitoneal disease or transcapsular spread or renal parenchymal disease. Less commonly, perirenal disease is isolated from the renal parenchyma, in which case the disease can completely surround the kidney without parenchymal compression or functional impairment (Fig. 11a) [10]. Other manifestations of perirenal lymphoma are: soft tissue mass enveloping the kidney but interrupting the renal contour in several points (Fig. 11b), bilateral irregular hypovascular tissue masses (Fig. 11c), without demarcation limit to the renal cortex or hypovascular nodules (Fig. 11d). Differential diagnosis includes sarcoma arising from the renal capsule and metastases to the perinephric space, as well as benign conditions such as perinephric hematoma, retroperitoneal fibrosis, amyloidosis, and extra-medullary hematopoiesis [11,12].

![Fig. 11](image)
**Acute pyelonephritis in a 62-year-old man.** Contrast-enhanced CT scan in nephrographic phase (a,b) shows multiple wedge shaped low attenuation lesions in both kidneys (arrows).
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Fig. 11: (a) Mantle cell lymphoma in a 61-year-old man. Contrast-enhanced CT scan in nephrographic phase shows a ring of homogenous soft tissue compressing the normal parenchyma but preserving the integrity of the renal cortex (arrows). (b) Small lymphocytic lymphoma in a 55-year-old man. Contrast-enhanced CT scan in nephrographic phase demonstrates a soft tissue mass (*) enveloping the kidney but interrupting the renal contour in several points (arrowheads). (c) Diffuse mixed lymphoma in a 61-year-old man. Contrast-enhanced CT scan in nephrographic phase shows bilateral irregular hypovascular tissue masses (arrows), without demarcation limit to the renal cortex. Retroperitoneal adenopathies are present (arrowheads). (d) Diffuse large B-cell lymphoma in a 48-year-old woman. Contrast-enhanced CT scan in nephrographic phase demonstrates hypovascular nodules (*) with smooth edges and homogeneous attenuation.

Monitoring results of therapy

Renal lesions either were present at the time of initial diagnosis and have changed in appearance after therapy (33 cases) (Fig. 12) or appeared during disease evolution (15 cases). After treatment, complete regression was diagnosed in only four cases (Fig. 13).

Fig. 12: Diffuse small cleaved cell lymphoma in a 20-year-old woman. Contrast-enhanced CT scan in corticomedullary (a) phase demonstrates in the right kidney a subcapsular nodular mass with homogeneous attenuation and low contrast enhancement (arrow) which does not distort the renal contour. Seven months after the right nephrectomy CT examination (b) revealed multiple lesions with the same characteristic in the left kidney (progression of disease).

Fig. 13: Lymphoblastic lymphoma in a 13-year-old girl. Contrast-enhanced CT scan in nephrographic phase (a) shows a large soft-tissue mass (*) infiltrating the retroperitoneum and invading the renal sinus and parenchyma (arrows). Six months after starting treatment CT examination (b) revealed complete regression of renal and retroperitoneal lesions. Note the presence of a small left renal cyst (arrowhead).

Discussions

In autopsy series renal involvement in patients with lymphoma, range from 30 to 60% [13,14]. Despite this relatively high prevalence, imaging studies demonstrate renal abnormalities in only 3%–8% of patients undergoing routine evaluation for staging or during the course of therapy [7,15]. This apparent discrepancy between the pathologists and radiologist can be explained by several factors: renal lymphoma is often poorly documented, since the disease is often clinically silent and renal biopsy is rarely indicated to confirm the diagnosis in the context of systemic disease. Furthermore, the statistics cited earlier were obtained with older generation scanners and led to underestimation of the prevalence of renal lesions [6].

Clinically, renal lymphomas are often silent, but can occur flank pain, hematuria or palpable mass [16].

The lesions can appear by hematogenous dissemination or by lymphogenic spread from retroperitoneal disease [4,16]. Non-Hodgkin’s lymphoma (NHL) is much more common than Hodgkin’s disease [17,18].

Primary lymphoma is a very rare tumor because the kidney does not contain lymphoid tissue [19].

Computed tomography (CT) is the imaging modality of choice for the evaluation of patients with suspected renal lymphoma. This modality depicts the renal lesions and helps identify extension to the perirenal space and the retroperitoneum, thereby helping to determine the systemic spread of the disease. The administration of intravenous contrast material and image acquisition in the nephrographic (venous) phase of enhancement are essential for the detection of subtle or small lesions, particularly those in the medullary portion of the kidney. Excretory phase imaging also best demonstrates obstruction of the collecting system by retroperitoneal masses [6,20].

The role of magnetic resonance imaging (MRI) is less clearly documented in the literature, small series have shown MR imaging to be as accurate as contrast-enhanced CT in demonstrating renal and perirenal disease [4]. MR imaging is the optimal imaging modality in patients with iodinated contrast material allergy or renal insufficiency. In addition, MR imaging has proved superior to CT in depicting involvement of the bone marrow [5,21].

Ultrasonography (US). Both contrast-enhanced CT and MR imaging are superior to US in detecting the presence of disease as well as the number of renal lesions and the presence of extrarenal tumors [4,14,22]. However, US may be the first test requested in patients...
who present with renal insufficiency or iodinated contrast material allergy. US is the ideal guidance modality for percutaneous biopsy, which, with the refinement of immunohistochemical and flow cytometric studies, allows specific diagnosis in the majority of cases [6,23].

**Prognosis and treatment.** Secondary renal lymphoma usually indicates stage IV disease with dismal prognosis. In primary renal lymphoma, survival is extremely poor since 75% of patients die less than 1 year after operation. Prognosis may be improved by early detection of disease and by performing systemic chemotherapy. Modern radio-chemotherapy has improved survival and renal functional compromise [24,25].

**Conclusions**
Contrast enhanced CT is useful in: detection and characterization of renal involvements in patients with lymphoma, disease staging, follow-up and response after therapy, and differential diagnosis with other renal masses. Low and intermediate grade lymphoma are associated with nodular and perirenal lesions, and the high grade lymphoma with infiltrative lesions and extension from retroperitoneal disease. The presence of bilateral renal nodular lesions associated with other extra-nodal involvements in a context of known systemic lymphoproliferative disease can establish the diagnosis of renal lymphoma. Otherwise, renal biopsy and histological confirmation are necessary.

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