Renal lymphoma: Patterns of disease with ultrasound (US), colour Doppler ultrasound (CDUS), contrast-enhanced ultrasound (CEUS) and Computed tomography (CT)

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Learning objectives

To describe several US, CDUS, CEUS and CT findings and potential mimics in the renal lymphoma.

Background

The kidney is a frequent site of involvement in lymphoproliferative disorders.

The incidence of renal involvement in patients with lymphoma has a rate from 34% to 62% in several autopsy series [1].

The kidneys are one the most common extranodal sites of lymphoma. Primary renal lymphoma is rare, accounting for less than 1% of cases of extranodal lymphoma[1,2]. Thus, more commonly, renal lymphoma results from hematogenous dissemination in systemic disease or direct extension from retroperitoneal disease sites.

Renal involvement occurs much more commonly in non-Hodgkin lymphoma, typically B-cell type. Usually, renal involvement is clinically silent, but occasionally, the patients present non specific signs as flank pain, hematuria and palpable mass. Acute renal failure from infiltration has also been described, but is extremely rare.

Immunocompromised and HIV infection patients are at a significantly higher risk for developing lymphoma [3].

Generally, despite the relatively high prevalence of renal involvement, imaging studies underestimate the incidence of renal disease, however, it is detected in only 3-8 % of all patient undergoing routine evaluation for staging or during the course of therapy.

There are several factors: the disease is often clinically silent and the patients rarely undergoing nephrectomy or renal biopsy to confirm the diagnosis in the context of systemic disease.
In addition, most published studies were performed with older-generation computed tomography (CT) scanners, which have low sensitivity for detection of small lesion, compared to multidetector row computed tomography [1,3].

Moreover, contrast enhanced sonography (CEUS), is relatively recent technique introduced in the evaluation of the kidney disease. It is useful to follow-up of lymphomatous disease and to monitor the response to chemotherapy. Indeed, CEUS shows tissue perfusion analogous to that demonstrated on contrast-enhanced CT, moreover it offers the possibility to detect small vessels of microcirculation with a low flow rate. Furthermore, US contrast media are not nephrotoxic and can employed safely, even in patients with impaired renal function [4].

**Imaging findings OR Procedure details**

**Imaging findings**

Renal lymphoma has a wide variety of radiologic appearances that have been well described, including multiple lesions, direct extension from retroperitoneal adenopathy, perirenal and infiltrative disease and a solitary lesion [1,3,5].

Generally, the lymphomatous masses, at Ultrasound (US), are usually hypoechoic and homogeneous. Color and power Doppler US show intense vascularity within lesion, with displacement without infiltration, of renal vessels [4,6,7]. At unenhanced CT, these lesions appear as soft tissue mass, following intravenous administration of contrast material, there is a minimal enhancement compared with the normal renal parenchyma. Lymphomatous deposits appear relatively homogeneous hypodense masses if they are small size, while the large lesions tend to be more heterogeneous with cystic appearance [1,3].

CEUS, in addition Doppler techniques, obtains real time information about microcirculation of lesions, and renal masses show transient enhancement on early-phase scan (corticomedullary phase), while on late-phase scan (nephrographic phase), the masses became slightly inhomogeneous hypoechoic with within fine echo pollution (microcirculation) [6]. Moreover in patients undergoing chemotherapy, the renal lesions exhibit a decreased attenuation/perfusion on CEUS, and an increased internal inhomogeneity on baseline ultrasound, although the masses have not always a size reduction.
The most common imaging appearance is **multiple parenchymal masses**, typically bilateral but may also be unilateral, with variable size masses range between 1 and 4 cm in diameter. This pattern is seen in 50-60 % of cases [1,3]. Calcification is extremely rare. This pattern shows multiple hypoechoic/hypodense soft tissue lesions with a minimal enhancement after contrast injection (Fig.1 on page 5).

The **contiguous extension to the kidney from large retroperitoneal masses** is the second most common pattern (25-30%). The patients, typically, present a large bulky retroperitoneal mass that envelops the renal vasculature without infiltration, and invades the renal hilum, determining commonly hydronephrosis for obstruction of ureters [9].

At imaging, contrast enhanced helical CT show a multiple, large, poorly defined inhomogeneous masses in retroperitoneum with extension, compression and dislocation of adjacent kidney (Fig.2 on page 6).

**Perirenal involvement** is usually the result of direct extension from retroperitoneal disease, isolated perirenal disease is unusual (<10% of cases). The imaging of this pattern is most important to differentiate perirenal lymphoma disease from other benign condition such as hematoma, retroperitoneal fibrosis, amyloidosis and extramedullary hematopoeisis or malignant condition such as sarcoma and melanoma, lung and breast metastases [8,9,11]. At US, appears a nearly fluid-like perirenal hypoechoic tissue of variable thickness. This soft tissue may mimic a hematoma or fluid collection in perirenal space, but the use of CEUS may prove a intralesional enhancement and thus exclude the hematoma or fluid collection. At, the perirenal lymphoma has been described with thickening of the fascia of Gerota, soft-tissue nodules or plaques, perirenal mass without parenchyma compression or infiltration and preservation of renal countour (Fig.3 on page 7, Fig.4 on page 8).

Sometimes, the US is useful to confirm the nature of perirenal soft tissue as guidance of fine needle aspiration biopsy (Fig.5 on page 9).

**Diffuse infiltration** is almost bilaterally and seen in approximately 20% of patients. The kidneys show global enlargement without distortion of normal shape, with loss of the normal differential enhancement between the cortex and the medulla in corticomedullary phase. Occasionally, lymphoma infiltrates and destroy the renal parenchyma extensively and manifests as a large, non functioning kidney. At enhanced CT, the kidneys show with heterogeneous enhancement of the parenchyma, loss of the normal differential enhancement between cortex and medulla in cortico-medullary phase (Fig.6 on page 10, Fig.7 on page 11).
Diffuse infiltration of the kidney can also caused by transitional cell carcinoma, and collecting duct or medullary carcinoma of the kidneys, xanthogranulomatous pyelonephritis [1,3,11].

Renal lymphoma manifests as a solitary mass in fewer than 10% of patient, is important differentiating renal lymphoma from conventional renal cell carcinoma. The renal lymphoma at contrast enhanced-CT demonstrates a lower enhancement than renal cell carcinoma in arterial phase. CEUS shows intense and homogeneous enhancement of limphomatous lesion while renal cell carcinoma is more inhomogeneous and with more intense enhancement. (Fig.8 on page 12).

In addition, at US renal cell carcinoma tends to appear more echogenic than lymphoma, and the presence of associated thrombus in the renal vein or inferior cava is unusual in lymphoma, but with imaging differential diagnosis is very difficult.

These are a typical pattern of renal disease, but rarely the imaging findings are unusual and the diagnosis is most difficult. Atypical findings includes spontaneous hemorrhage, necrosis, heterogeneous attenuation, cystic transformation and calcification. Some of these findings are often the result of chemotherapy and thus the follow-up with CEUS evaluates these changes [10,11].

**Images for this section:**
**Fig. 1:** (A) B-mode ultrasound and (B) color-Doppler image show an enlargement of kidney with multiple slightly hypoechoic masses with displacement of renal vessels at color-Doppler. (C) Transverse and (D) coronal enhanced CT show multiple hypodense masses poorly defined involving the kidneys.
Fig. 2: Fig. 2 A,B,C: Before chemotherapy: (A) US shows a heterogeneous hyperechoic mass involving the left kidney and the spleen. (B) Transverse and (C) coronal contrast enhanced CT show a large bulky hypodense mass in spleno-renal space with invasion of left kidney. D,E,F: After chemotherapy: (D) US shows a small size residual mass. (E) Transverse and (F) coronal contrast enhanced CT show a remarkable reduction of large bulky soft tissue, with a residual mass in spleno-renal space (arrow).
Fig. 3: PERIRENAL DISEASE. Imaging with US and CEUS of perirenal lymphoma. (A),(D) Longitudinal and transverse baseline sonograms show a subtle inhomogeneous hypoechoic soft tissue (arrows). (B) and (E) CEUS oblique and transverse images, 25 seconds after contrast injection, shows an intense transient perirenal enhancement. The image (E) shows invasion of the renal hilum with encasement of renal vasculature without infiltration. (C) And (F) CEUS longitudinal images, 110 seconds after contrast injection, show slightly hypoechoic mass with fine echoes pollution.
Fig. 4: US, CEUS and CT of perirenal lymphoma. (A) Longitudinal ultrasound shows an inhomogeneous hypoechoic perirenal soft tissue. CEUS image (B) 41 seconds and (C) 116 seconds after contrast injection show intense, transient perirenal soft tissue enhancement on early-phase scan and echo pollution (microcirculation) on late phase scan. (D) Contrast enhanced CT scan confirms perirenal and central retroperitoneal solid masses; non-Hodgkin lymphoma was proved at biopsy.
**Fig. 5:** Fig.5: (A) Longitudinal oblique ultrasound shows hypoechoic mass, ill-defined margin that bulges by the renal profile. Transverse (B) and coronal (C) enhanced CT images show a perirenal hypodense soft tissue mass around the kidney. Note the regular shape of kidney. The lesion probably could be a lymphomatous perirenal localization. Biopsy was performed to confirm it. (D) Ultrasound image shows a fine needle aspiration biopsy.
Fig. 6: (A) Baseline ultrasound images show a inhomogeneous hypoechoic nodules that invade the renal sinus. (B) Color- Doppler ultrasound shows a significative vascularity within the nodules. (C) Transverse and (B) coronal enhanced CT show multiple hypodense masses poorly defined involving the kidneys with involvement of renal sinus.
Fig. 7: Fig.7: (A) and (B) Transverse enhanced CT shows a minimal right renal enlargement with homogeneous soft tissue mass in the right kidney, and partial involvement of renal sinus, with loss of the normal cortico-medullary differentiation. There is, therefore, a sufficient renal excretion function and regular shape of the kidneys.
**Fig. 8:** Fig. 8. A,B,C: Before chemo-therapy: (A) B-mode ultrasound shows a slightly inhomogenous hyperechoic nodule that bulges in renal sinus. The renal profile is regular. Note there is also a bulky retroperitoneal lymphomatous masses. (B) CEUS: intense intranodular contrast enhancement on early phase (white arrows). (C) Transverse enhanced CT shows a homogeneous hypodense nodule in right kidney (arrow). D,E,F: control after chemo-therapy: (D) B-mode ultrasound post chemotherapy shows an inhomogeneous nodule, with an internal eccentric hypoechoic area (arrow). The size of this lesion appear greater than previous US control. (E) CEUS image post chemotherapy, obtained 26 sec shows a subtotal absence of vascularity inside the lesion due to necrosis suggestive of good response to chemotherapy. (F) Enhanced CT confirms a necrotic cystic-like hypodensity of the lesion, although with increased size.
Conclusion

CT is the imaging modality of choice for the evaluation of patient with suspected renal lymphoma. It is useful in addition to staging and follow-up; CEUS is a promising technique in the study of kidney, both evaluation and response to chemotherapy, because it is more accessible and performable in all a patient without regard for their renal functional state.

Personal Information

References

References