Primitive neuroectodermal tumour of the kidney: radiologic-pathological correlations

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A primitive neuroectodermal tumour of the kidney is a rare malignancy. We report the computed tomographic features and the histopathological correlation of such a tumour occurring in a middle-aged man. Although the radiological appearance has significant overlap with other renal tumours, this tumour should be included in the differential diagnosis of a large renal mass in younger patients.

Introduction

Primitive neuroectodermal tumours (PNETs) of the kidney are highly aggressive, malignant, small round cell tumours, and a rare cause of renal masses in adults. We report a case of renal PNET and describe the computed tomographic (CT) findings, with an emphasis on the radiologic-pathological correlations.

Case report

A 48-year-old Chinese man presented with a 6-month history of left-sided abdominal pain, weight loss, and 1-day history of fever in October 2005. He had no urinary symptoms. The physical examination revealed left iliac fossa tenderness and a ballotable left kidney. Urinalysis revealed microscopic haematuria but there was no pyuria or malignant cells. The patient had a mild leukocytosis of $16.4 \times 10^3/\mu L$ but the haemoglobin and serum creatinine levels were normal.

The patient underwent a multiphasic CT scan performed by a four-slice helical scanner (Aquilion; Toshiba, Tokyo, Japan). An unenhanced CT scan of the kidneys was performed first. Corticomedullary and nephrographic phase images were obtained at 30 seconds and 100 seconds respectively, following intravenous administration of 100 mL of non-ionic contrast (Omnipaque 350 mgI/mL; Amersham Health Limited, Shanghai, China), which was injected at a rate of 1.5 mL/s.

This revealed a diffusely enlarged left kidney, which was almost completely replaced by a large, infiltrative 11.5 x 10.8 cm renal mass. On the pre-contrast images, there was no calcification, calculus, fat density or areas of high attenuation suggesting haemorrhage. The mass enhanced heterogeneously after administration of intravenous contrast and contained several low-density, non-enhancing areas, suggestive of necrosis. Only a sliver of normally enhancing renal parenchyma was seen at the lower pole (Fig 1a). There was perinephric fat stranding, thickening of the Gerota's fascia and left hemidiaphragm adjacent to the superior aspect of this mass. Several enlarged left para-aortic lymph nodes were present. No hydronephrosis, renal vein, or inferior vena caval thrombosis was detected. The right kidney, liver, and adrenal glands were normal. There was no destructive osseous lesion or ascites.

The patient underwent a left radical nephrectomy. Intra-operatively, the tumour was adherent to the left hemidiaphragm and there were adhesions at the renal hilum. Macroscopically, the left kidney was almost completely replaced by a multinodular, grey, glistening tumour measuring 20 x 11 x 10 cm. There were also foci of necrosis, which correlated well with the low-density areas seen on CT (Fig 1b).

Histologically, the tumour was composed of lobules and sheets of small round cells (Fig 2). These neoplastic cells were characterised by indistinct cell borders, small round-to-oval nuclei and inconspicuous nucleoli. Mitotic figures were identified at a density of 20 mitoses per 10 high-power fields. Focal Homer-Wright type rosettes and perivascular pseudo-rosettes were present. The lobules were separated by fibrous septa containing atrophied tubules and sclerosed glomeruli. Lymphovascular invasion was present. There was tumour infiltration of the perinephric fat corresponding to the perinephric fat stranding observed on CT. Nonetheless, no histological evidence of involvement of the adrenal gland or diaphragm was detected. Although enlarged retroperitoneal lymph

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nodes were detected on CT, there was no histological evidence of metastasis in the three resected hilar lymph nodes. On immunohistochemical analysis, strongly positive membranous CD99 positivity and cytoplasmic vimentin positivity favoured the diagnosis of PNET (Fig 2). Focal cytoplasmic positivity to S-100 and synaptophysin further supported this diagnosis. CD99 positivity excluded a blastema-rich Wilms' tumour. Negativity to leukocyte common antigen, cytokeratin AE1/3, chromogranin, epithelial membrane antigen and CD117 excluded lymphoma, poorly differentiated carcinoma and extramedullary myeloid tumour.

A postoperative CT scan of the thorax performed 2 weeks later showed several small (<1 cm) pulmonary nodules. The patient underwent chemotherapy and was given three cycles of doxorubicin, vincristine, cyclophosphamide, which was later revised to six cycles of etoposide and ifosfamide. Computed tomography performed 8 months following surgery showed resolution of these pulmonary nodules. The patient was clinically well at that time.

Discussion

A PNET was first described by AP Stout in 1918. This tumour can arise in the central nervous system or in the peripheral tissues. Peripheral tumours typically occur in the chest wall and paraspinal region and, rarely, manifest as an organ-based lesion. Genitourinary PNETs are rare.

Patients with renal PNET present at an average age of 24 years.[1] Renal PNET is an aggressive tumour, with a tendency towards local recurrence and early metastases to regional lymph nodes, lungs, liver, and bone. The overall 5-year disease-free survival rate is reported to be between 45 and 55% but in patients with metastatic disease at initial presentation, the median relapse-free survival is only 2 years.[2]

On light microscopy, a PNET consists of small round cells with indistinct cell borders. The latter gives a 'syncytial' appearance. Some tumour cells may arrange themselves as perivascular pseudo-rosettes or Homer-Wright rosettes. Immunohistochemical assessment of the cells from our patient revealed positivity for CD99 and vimentin in the membrane and cytoplasm respectively. Both are consistently expressed in PNET, although CD99 is not pathognomic for PNET as it has been documented in other tumours, including sarcomas.[3] Other immunohistochemical markers, for example S-100 protein, synaptophysin, keratin, neuron specific enolase, gene product 9.5 and secretogranin II, provide further evidence for the neuroepithelial line of differentiation.[3] Molecular studies to demonstrate reciprocal translocation of chromosomes 11;22 (q24;q12), which is present in approximately 85% of PNET and results in fusion of

腎臟原始神經外胚層腫瘤：
放射及病理學的相關性

腎臟的原始神經外胚層腫瘤是一種罕見的惡性病。本文報告一名中年男性患有此病，並分析病人腫瘤的電腦斷層照相特徵及組織病理學的相關性。縱使其放射學的情況與其他腎腫瘤相近，當年輕病人患有腎腫瘤時，應把這種惡性病納入鑒別診斷範圍內。
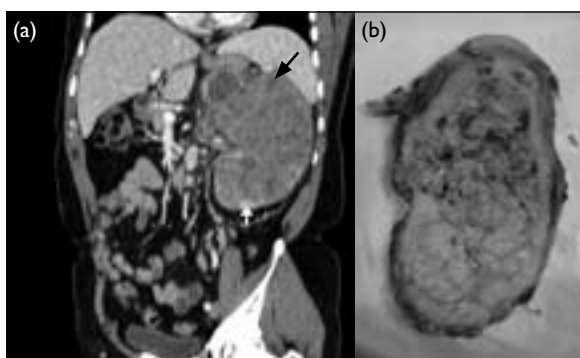

FIG 1. Primitive neuroectodermal tumour of the kidney
(a) Coronal reconstruction of a contrast-enhanced computed tomographic image demonstrates a heterogeneous, infiltrating mass involving the entire left kidney (black arrow). There is a sliver of normally enhancing kidney in the lower pole (white arrow). (b) Photograph of the resected left kidney shows a necrotic, fleshy, nodular tumour almost completely replacing the renal parenchyma
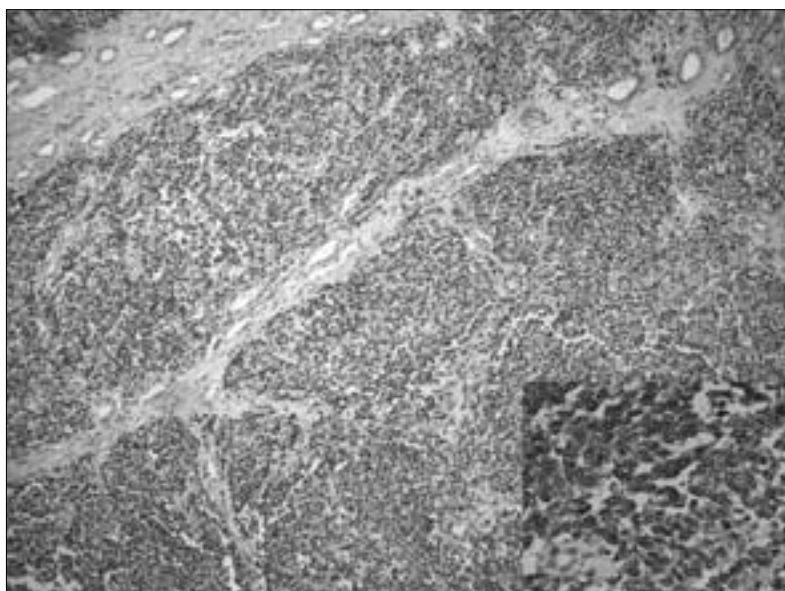

FIG 2. Histology reveals sheets of small round cells, separated by fibrous septae (H&E, x50). The inset shows cells demonstrating diffuse CD99 positivity (Immunostain, x200)

the Ewing's sarcoma gene with the *FLI-1* gene, can further increase diagnostic confidence.[3,4] This was not performed in our case as the specimen was fixed

in formalin and the appropriate techniques, such as fluorescent in-situ hybridisation, are not available in our local institutions.

Histologically, the main differential diagnosis for renal PNET is blastema-predominant Wilms' tumour. A PNET can be distinguished from this tumour by its positivity for CD99, a carboxy terminus of the *FLI-1* gene, and negativity for the *WT1* gene.[3]

Radiologically, PNET typically presents as a large and heterogeneous mass with central low density areas due to necrosis.[5-9] Areas of high attenuation within the tumour, presumably due to haemorrhage, have been observed.[5,7-9] There have been a few reports of intratumour calcification which may be multiple, peripheral, or linear.[5,10,11] A few reports have described tumour extension into the renal vein, inferior vena cava, right atrium and ventricle.[6,12] There are at least two reports of psoas muscle invasion.[6,8] Hepatic metastases, when present, manifest as low attenuation lesions.[9,11]

In view of our patient's age and radiological findings, the main differential diagnosis was renal cell carcinoma (RCC). Renal cell carcinoma is the most common renal malignancy in adults and should be the first consideration in an adult presenting with the classical triad of pain, haematuria, and flank mass. On cross-sectional imaging, RCC is typically a vascular tumour and can contain haemorrhage and necrosis. Calcification is reported in 10% of RCC.[13] Fat is uncommonly seen within RCC. Vascular invasion is a well-known feature, with 23% and 7% of cases showing renal vein and inferior vena cava extension respectively.[13] The lungs are the most common site for metastases; other sites include the liver, bone, brain, and skin.

Primary renal sarcomas are rare mesenchymal tumours and leiomyosarcomas account for over 50% of renal sarcomas. Sarcomas typically present as large, expansile, infiltrative renal masses on imaging. The appearances are non-specific and depend on the cellular components.[14]

Renal lymphoma has a spectrum of radiological appearances, ranging from solitary or multiple bilateral renal masses to diffuse enlargement of the renal parenchyma and sinuses, with a preserved reniform outline.[14] This diagnosis should be suspected when concomitant bulky perinephric disease, widespread lymphadenopathy or contralateral renal involvement is seen in the presence of an infiltrative renal mass. These findings were not present in our case.

Other tumours that may present as large infiltrative masses include transitional cell carcinomas and renal metastases. Although the epicentres of these tumours are expected to be in the renal pelvis or upper ureter, this may be difficult to ascertain if the tumour is large. Renal metastases present more commonly as smaller, multifocal and bilateral nodules or masses in a patient with a known primary malignancy such as lung cancer.

In children, other tumours to consider include Wilms' tumour, mesoblastic tumour, and rhabdomyosarcoma.

Inflammatory conditions such as a renal abscess, focal pyelonephritis, and xanthogranulomatous pyelonephritis can mimic tumours but these patients typically have concomitant clinical signs of infection. A renal abscess usually manifests as a mass with a low-density centre, enhancing walls or septations and perinephric stranding. Xanthogranulomatous pyelonephritis manifests as hypoattenuating masses with enhancing rims that represent dilated and debris-filled calyces and xanthoma collections. The kidney is usually non-functioning and renal calculi are often present.

A renal PNET has non-specific features on CT imaging. Thus, the main purpose of cross-sectional imaging is the assessment of resectability and the detection of metastases.

Conclusion

Primitive neuroectodermal tumours of the kidney is seldom considered in adults presenting with a large renal mass because it is so rare. In this case report, we describe the CT imaging features and the radiologic-pathological correlations of a renal PNET and discuss the main differential diagnoses. Although there is considerable overlap between the imaging features of a renal PNET and other renal tumours, in particular RCC, it should always be considered as a possible diagnosis in a young patient.

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