CASE REPORT

CT and ultrasound findings of metanephric adenoma: a report of two cases and literature review

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ABSTRACT. Metanephric adenoma (MA) of the kidney is an uncommon benign epithelial tumour that can present at any age. The histology of the lesion is well established, but imaging findings have been described in only a few cases. We report the CT and ultrasound appearance of MA in two females to increase the awareness of this entity among radiologists. Its recognition may facilitate nephron-sparing surgery.

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Metanephric adenoma (MA) is a rare benign epithelial tumour of the kidney that shows characteristic histology [1]. It is not well recognised by either clinicians or pathologists, nor have the clinical and morphological features of this tumour been well documented. Until now it was thought to have a benign course. In the English language literature no more than 100 cases of MAs have been reported, and in only a few have the imaging findings been well illustrated [2–13]. We report two cases of MA in a 17-year-old and a 30-year-old female and describe their appearances on CT and ultrasonography.

Case report

Case 1

A 17-year-old female presented with a 4 month history of fatigue. Her medical and family history was unremarkable. Blood laboratory studies showed a high red blood cell count ($6.88 \times 10^{12} \text{ l}^{-1}$, normal reference value of $3.5\text{--}5.0 \times 10^{12} \text{ l}^{-1}$), high haemoglobin level (195 g l^{-1} , normal reference value of $110\text{--}150 \text{ g l}^{-1}$) and low level of erythropoietin, (6.27 mIU ml^{-1} normal reference value of $12\text{--}35 \text{ mIU ml}^{-1}$). No haematuria was recorded. Physical examination was normal. Bone marrow examination showed a normal ratio of red blood cells, which were overwhelmingly adult. The clinical diagnosis was polycythaemia. Ultrasonography showed a discrete, sharply marginated solid hypoechoic mass in the inferior pole of the right kidney (Figure 1a). The lesion had grown to $5.8 \times 3.8 \text{ cm}$. CT confirmed the presence of a solid mass in the lower pole of the right kidney that measured $6 \times 6 \times 4.4 \text{ cm}$. On unenhanced

scans the lesion was slightly denser than the adjacent normal renal parenchyma (34 HU) (Figure 1b). The tumour was 47 HU before contrast enhancement and somewhat enhanced on dynamic CT, 56 HU on cortex-phase, 64 HU on medullary-phase and 76 HU on delayed-phase images, but the degree of enhancement of the renal mass was less than that of the adjacent normal renal parenchyma (Figure 1c–e). No other remarkable findings were identified in the abdomen, pelvis or thorax. This indicated a benign tumour in the right kidney. The patient underwent a radical nephrectomy. The specimen contained a 6 cm, well-circumscribed, unencapsuled, lobulated, tan-pink fleshy tumour. Microscopically, the tumour was composed of tubules of varying size and shape, either densely packed or forming glomeruloid and cerebriform structures, and organised into lobules by fine fibrovascular septa. There was few tumour mesenchymal or blastema components. The uninvolved renal parenchyma was unremarkable. The histological features of the tumour were characteristic for MA (Figure 1f).

Case 2

A 30-year-old female was admitted to our hospital for treatment of a right renal mass discovered incidentally on ultrasonography 2 months ago. No medical history was recorded except for the odinopoeia owing to the treatment of the renal mass. The patient had no complaints and the physical examination was normal. Conventional greyscale and colour Doppler ultrasonography performed in our hospital showed a heterogeneously hypoechoic solid mass ($49 \times 61 \text{ mm}$) in the inferior pole of the right kidney and linear blood flow signal could be found at the peripheral part of the mass (Figure 2a). Contrast-enhanced ultrasonography displayed the mass with mild enhancement, appearing as the enhancement pattern of slow wash-in and fast wash-out (Figure 2b,c). Non-enhanced and enhanced CT of the kidney was also performed and

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Figure 1. (a) Ultrasonography shows a hypoechoic mass at the lower pole of the right kidney; (b) non-enhanced CT shows an enlarged right kidney and a slight hyperdense mass. (c) Cortex-, (d) medullary- and (e) delayed-phase CT images show a hypovascular mass with a well-defined margin and homogeneous density; (f) pathological section shows densely packed glomeruloid structures (haematoxylin and eosin staining; $\times 100$ original magnification).

showed an isodense mass on unenhanced CT (Figure 2d) and a progressively moderately enhanced well-defined mass of 30×20 mm on the enhanced CT images (Figure 2e–g). Renal cell carcinoma was considered both on ultrasonography and CT. Radical nephrectomy was performed, a well-defined tumour of 30×30 mm was found on cutting of the right kidney. Microscopically, the homogeneous round or ovoid tumour cells arranged with tubiform and adenotubiform. Tumour cells had few eosinophilic cytoplasm and cylinder nuclears. No karyokinesis was observed. Immunohistochemical staining was negative for epithelial membrane antigen (EMA), melanoma antibody (HMB45), clusters of differentiation (CD34), chromogranin A (CgA), desmin (Des), synaptophysin (Syn), smooth muscle actin (SMA), Wilm tumour (WT), cytokeratin 5/6, S100, CK CD99. The final pathological findings were in accordance with MA (Figure 2h).

Discussion

The concept of MA has recently become established and accounts for 0.2% of adult renal epithelial tumours [2, 3]. A clinicopathological study of 50 cases of MA invariably reported the benign tumour with a female predominance (2:1). MA can present at any age, ranging from 15 months [1] to 83 years [3], and the size of the tumour ranges from 0.3 to 15 cm. Davis et al [2] found 50% of tumours were discovered incidentally. For patients with symptoms, the

most common were abdominal or flank pain, haematuria and a palpable mass [4]. Among possible clinical findings, the incidence of polycythaemia with MA is remarkable. In the series by Davis [2], 6/50 cases (12%) showed this clinical sign, making MA the renal lesion with the highest incidence of polycythaemia. In comparison, renal cell carcinoma had an incidence of polycythaemia ranging from 1% to 6% [6]. Patients with MA have a good prognosis after undergoing total nephrectomy or local resection of MA with kidney preservation.

Metanephric tumours (MA, adenofibromas and stromal tumours) have been reported to compose a continuous histological spectrum [2]. Normally they occur unilaterally and unifocally, only a few cases of multifocal MAs were found [14]. The cut surfaces vary from grey to tan to yellow and may be soft or firm. Calcification is present in approximately 20% and a few are densely calcified [4]. Foci of haemorrhage and necrosis are common [4, 7]. The histological features of MA are distinctive and are characterised by epithelial cells with different amounts of cytoplasm. The adenomatous components are composed of uniform small cells arranged in tubular or papillary architectural patterns [4]. In addition, immunohistochemical staining with CD57, WT1 and CK7 may be useful to differentiate MA from papillary renal cell carcinoma when distinction by histological features alone proves difficult.

The imaging features of MA have been reported in some cases [6–9]. However, no typical sonographic or

Figure 2. (a) Greyscale ultrasonography shows a heterogeneously hypoechoic solid mass in the inferior pole of the right kidney, and linear blood flow signal can be found at the peripheral part of the mass; (b,c) contrast-enhanced ultrasonography shows mild enhancement, appearing as the enhancement pattern of slow wash-in and fast wash-out; (d) non-enhanced CT of the kidney shows an isodense mass in the inferior pole of right kidney. (e, f, g) Dynamic contrast-enhanced CT shows a progressively moderately enhanced well-defined mass of 30×20 mm; (h) histological specimen shows the homogeneous round or ovoid tumour cells arranging with tubiform and adenotubiform. Tumour cells have few eosinophilic cytoplasm and cylinder nuclei. No karyokinesis is observed. (Haematoxylin and eosin staining, $\times 200$ original magnification).

radiological features of MA have been identified. The association of hyperechogenicity on ultrasound with hyperdensity on unenhanced CT has been reported as characteristic for benign adenomatous tumours of the kidney [2, 3, 13]. Hyperechogenicity on ultrasound is associated with the presence of psammomatous calcifications and interfaces caused by numerous tubules [5, 7]. However, hypoechoic or hypodense masses were reported on ultrasonography or on unenhanced CT,

indicating cystic changes, necrosis or haemorrhage [5, 11, 12]. Our two MAs appeared as slightly hyperdense masses on unenhanced CT and as well-demarcated, round, hypovascular solid masses in relation to the adjacent renal parenchyma on contrast-enhanced CT with mild enhancement after intravenous (iv) administration with a contrast agent. Contrast-enhanced ultrasonography displayed a hypoechoic mass with mild enhancement compared with the adjacent renal parenchyma, which has

rarely been used to diagnose MA [15]. This case report indicates that contrast-enhanced ultrasonography has no additional value for the differential diagnosis between some type of renal cell carcinoma and MA. Small punctate calcifications have been reported in some cases [3, 6]. The T_1 weighted MRI showed a hypo- or isointense mass that was slightly hyperintense on T_2 weighted MRI [4, 9].

MA must always be considered in the differential diagnosis of renal tumours in children and adults, independent of their size, particularly when the tumours appear as well-defined rounded lesions. Recognising the appearance of MA is important because of its benign nature and course and assist in nephron-sparing surgery. This is especially significant in paediatric patients in whom future renal function is a constant consideration. For adults, the predominant differential diagnosis with MA is renal cell carcinoma, especially papillary renal cell carcinoma. Papillary renal cell carcinoma is also hypovascular on contrast-enhanced CT and angiography [16]. Renal cell carcinoma, the most common renal malignancy affecting adults, accounts for approximately 85% of renal tumours. Because of this high prevalence, most MAs were misdiagnosed as renal cell carcinomas pre-operatively, such as the two cases in this study. There have been case reports of MA diagnosed by needle biopsy. However, this approach to diagnosis and management is controversial because of the risk of changing the stage of a malignant lesion. In children, Wilms tumour is the most frequent abdominal solid malignancy. Its peak incidence is at 3–4 years of age, and 80% of patients present before 5 years of age. The mass has heterogeneous echogenicity, density or intensity at ultrasonography, CT and MRI, which represents haemorrhage, fat, necrosis or calcification. After iv administration of contrast material, the mass appears heterogeneously enhanced, compressing the adjacent normal enhanced parenchyma. Wilms tumour can extend into the renal vein or inferior vena cava and have nodal or hepatic metastases.

Conclusion

MA is a rare renal tumour in adults. Most MAs are located in the posterior part of the kidneys with mild enhancement either in contrast-enhanced ultrasonography or in contrast-enhanced CT images. MA should be kept in mind in the differential diagnosis of well-defined solid renal mass without marked enhancement in young females.

References

1. Brisigotti M, Cozzutto C, Fabbretti G, Sergi C, Callea F. Metanephric adenoma. *Histol Histopathol* 1992;7:689–92.
2. Davis CJ, Jr, Barton JH, Sesterhenn IA, Mostofi FK. Metanephric adenoma. Clinicopathological study of fifty patients. *Am J Surg Pathol* 1995;19:1101–14.
3. Chaudhary H, Raghvenderan M, Dubey D, Srivastava A, Mandhani A, Kapoor R, et al. Correlation of radiological and clinical features of metanephric neoplasms in adults. *Indian J Cancer* 2004;41:37–40.
4. Schmelz HU, Stoschek M, Schwerer M, Danz B, Hauck EW, Weidner W, et al. Metanephric adenoma of the kidney: case report and review of the literature. *Int Urol Nephrol* 2005;37:213–17.
5. Navarro O, Conolly B, Taylor G, Bägli DJ. Metanephric adenoma of the kidney: a case report. *Pediatr Radiol* 1999;29:100–3.
6. Jinzaki M, Tanimoto A, Mukai M, Ikeda E, Kobayashi S, Yuasa Y, et al. Double-phase helical CT of small renal parenchymal neoplasms: correlation with pathologic findings and tumour angiogenesis. *J Comput Assist Tomogr* 2000;24:835–42.
7. Fielding JR, Visweswaran A, Silverman SG, Granter SR, Renshaw AA. CT and ultrasound features of metanephric adenoma in adults with pathologic correlation. *J Comput Assist Tomogr* 1999;23:441–4.
8. Hwang SS, Choi YJ. Metanephric adenoma of the kidney: case report. *Abdom Imaging* 2004;29:309–11.
9. Araki T, Hata H, Asakawa E, Araki T. MRI of metanephric adenoma. *J Comput Assist Tomogr* 1998;22:87–90.
10. McNeil JC, Corbett ST, Kuruvilla S, Jones EA. Metanephric adenoma in a five-year-old boy presenting with chyluria: case report and review of literature. *Urology* 2008;72:545–7.
11. Prasad SR, Surabhi VR, Menias CO, Raut AA, Chintapalli KN. Benign renal neoplasms in adults: cross-sectional imaging findings. *AJR Am J Roentgenol* 2008;190:158–64.
12. Amodio JB, Shapiro E, Pinkney L, Rivera R, Strubel N, Douglas D, et al. Metanephric adenoma in an 8-year-old child: case report and review of the literature. *J Pediatr Surg* 2005;40:e25–8.
13. Comerchi SC, Levin TL, Ruzal-Shapiro C, Berdon WE, Beckwith JB, Hibshoosh H, et al. Benign adenomatous kidney neoplasms in children with polycythemia: imaging findings. *Radiology* 1996;198:265–8.
14. Kohashi K, Oda Y, Nakamori M, Yamamoto H, Tamiya S, Toubou T, et al. Multifocal metanephric adenoma in childhood. *Pathol Int* 2009;59:49–52.
15. Nilsson A. Contrast-enhanced ultrasound of the kidneys. *Eur Radiol* 2004;14:104–9.
16. Herts BR, Coll DM, Novick AC, Obuchowski N, Linnell G, Wirth SL, et al. Enhancement characteristics of papillary renal neoplasms revealed on triphasic helical CT of the kidneys. *AJR Am J Roentgenol* 2002;178:367–72.