

Brief Communication

Renal artery stenosis in association with congenital anomalies of the kidney and urinary tract

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ABSTRACT

Objectives: To describe 8 cases of renal artery stenosis (RAS) in children with congenital anomalies of the renal tract.

Methods: We conducted a retrospective chart review of 78 children with RAS who were followed up at Great Ormond Street Hospital, London, United Kingdom between 2003 and 2012. We used an interventional radiology database to identify all patients who had RAS confirmed by digital subtraction angiography and examined all cases of congenital anomaly of the renal tract that had been diagnosed during childhood.

Results: We documented the following renal anomalies: multicystic dysplastic kidney (n=2), renal hypoplasia (n=1), congenital solitary kidney with hydronephrosis (n=1), and unilateral vesicoureteric reflux with poorly functioning kidneys (n=2). The anomaly was unknown in 2 cases. Seven children had unilateral nephrectomy at a median age of 2.5 years (range, 0.4-10 years) for various urological abnormalities. All children were confirmed to have RAS after presentation with hypertension at a median age of 10 (3.5-16.2) years. Angioplasty was performed in 7 children, of which 6 achieved control of their blood pressure on reduced medications.

Conclusion: We highlight the association between RAS and other renal anomalies, which indicates that they could share a common genetic background.

Renovascular disease (RVD) is an important cause of severe hypertension in children.¹ It is caused by impairment of blood flow to a part or all one or both kidneys as a result of narrowing of renal arteries.² It has several different etiologies, but the most common is fibromuscular dysplasia (FMD), in Western countries, and Takayasu arteritis (TA) in the developing world.¹ The underlying diagnosis of children with RVD is not always well defined as some children experience renal artery stenosis (RAS) as part of a genetic syndrome, such as neurofibromatosis types 1 or Williams syndrome.¹ It could also occur secondary to other conditions such as tumor surgery, radiation therapy, or rarely following

neonatal umbilical artery catheterization.¹ There is no known relationship between congenital abnormalities in the renal tract (CAKUT) and RVD. However, RVD has previously been reported in a few subjects in association with renal anomalies such as solitary kidneys, multicystic dysplastic kidney, and polycystic disease.³⁻¹³ In this study, we report a series of 8 patients with RAS after being diagnosed earlier in life with CAKUT.

Methods. We performed a retrospective chart review on children with RAS who were followed up at Great Ormond Street Hospital, London, United Kingdom between 2003 and 2012. We used an interventional radiology database to identify all patients who had RAS confirmed by digital subtraction angiography, as it was considered as the gold standard to diagnose RAS.¹⁴ All children also had renal ultrasound with Doppler study. We included all cases of congenital anomaly of the renal tract that had been diagnosed during childhood. Demographic data, underlying syndromes, mode of presentation, blood pressure (BP), and antihypertensive drugs were recorded from the patients' medical records. We also recorded the outcome of their treatment. No statistical analysis was performed as it is case series, and results are expressed as median (range).

Results. Eight children (5 boys) out of 78 children who had been treated with angioplasty over the last 29 years were studied. They were referred to us at a median age of 5.95 (range 1.5-16.2) years. The indication for further investigations was uncontrolled hypertension. Five children were referred from Europe, 2 from the Middle East, and one from the United Kingdom. Two children had neurofibromatosis type 1 (NF1) and one child had a meningocele.

All children had a history of additional renal anomalies (Table 1). Six patients had undergone unilateral nephrectomy before referral to our institution, at median age of 2.5 (range 0.4-10) years. One child had a congenital solitary kidney with hydronephrosis and one child was found to have left-sided vesicoureteric reflux (VUR) with a poorly functioning kidney and had nephrectomy at 2.5 years of age. The median systolic BP at referral was 140 mm Hg (range 90-200). This was 28 mm Hg (range 0-88) above the 95th centile for age, gender, and height. The children were

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Table 1 - Details of the associated renal anomalies, results of angiography and outcome of angioplasty or surgical intervention among children with RAS.

Patients	Age at referral (years)	Other illness	Renal anomaly	Age at nephrectomy (years)	Angiography	Outcome of angioplasty/surgery
1	5.5		Right ectopic multicystic dysplastic kidney	5	Left main RAS	BP controlled on reduced medications
2	6.4		Right multicystic dysplastic kidney	1.9	Stenotic left upper pole renal artery	BP controlled on reduced medications
3	2.7		Right renal hypoplasia	0.4	Severe midaortic stenosis	BP controlled on reduced medications
4	7.5	MMC imperforate anus	Solitary kidney with hydronephrosis		Main RAS	BP controlled on reduced medications
5	4.7		Right VUR and poorly functioning kidney (10% on DMSA)	3	Stenosis of interpolar branch artery	Cured
6	16.2	NF1	Recurrent UTIs in infancy with unknown renal anomaly	10	Main RAS	BP controlled on reduced medications
7	15.5	NF1	Unknown anomaly of right kidney	1	Upper pole RAS and intrarenal disease	Cured after gortex bypass graft from aorta to RA
8	1.5		Left VUR and poorly functioning kidney		Right RAS predominantly at the ostium	Did not receive PTA or surgery. BP controlled on 2 drugs

BP - blood pressure, MMC - meningomyelocele, RA - renal artery, RAS - renal artery stenosis, UTIs - urinary tract infections, VUR - vesicoureteric reflux, PTA - percutaneous transluminal angioplasty, NFI - neurofibromatosis type 1

prescribed with 1-5 antihypertensive drugs (median 3). The BP improved after nephrectomy in 3 subjects, but later had worsened which could be explained by the RAS discovered later on the contralateral kidneys. All patients were confirmed to have RAS by digital subtraction renal angiography and all except one were treated with angioplasty. After angioplasty, 6 children achieved control of BP on reduced medications; one was cured, while one child later needed vascular surgery. Based on angiographic appearance they were diagnosed as RAS caused by FMD.

Discussion. We report on a group of children with the combination of RAS and other renal anomalies: cystic dysplasia, hypoplasia, and obstructive uropathy. All except one were referred with a single kidney as they had unilateral nephrectomy performed to treat their hypertension at the referring center. They were discovered years later to have RAS in the kidneys, single remaining kidneys or contralateral kidney, which looked normal initially when they were diagnosed with their renal anomalies. RAS was treated with angioplasty with good results. There are a few previous children in the literature with this combination. Halpern et al⁹ reported a child of 9 years with FMD in the renal artery supplying a functioning pelvic kidney, while the other kidney proved to be a non-functioning multicystic remnant.⁹ Similarly, Stocker et al¹⁰ reported a 5-year-old

boy with a multicystic dysplastic kidney that developed fatal hypertensive encephalopathy. Doppler ultrasound showed an elevation of flow velocity in the contralateral renal artery, consistent with RAS. Vade et al¹¹ reported a case with diffuse renal artery stenosis and ipsilateral multicystic dysplastic kidney. In this patient, hypertension resolved spontaneously as the dysplastic kidney shrunk in size.¹¹ One of our children had RAS in a congenitally solitary hydronephrotic kidney. Seven similar cases have been reported.³⁻⁸ Our study showed similar results with other studies,³⁻⁸ which had a good response to interventions. None of our cases had polycystic kidney disease, which has been previously reported.^{12,13} The number of children with the combination of RAS and CAKUT in our study with RAS is clearly higher than can be explained by chance (10.3%). We can only speculate on the background for the relationship that we describe. One possibility could be that some cases of CAKUT share a common genetic background with some cases of RAS as more than 70% of renal diseases in children have a genetic cause.¹⁵ Fibromuscular dysplasia was investigated with several genes such as ACTA2 with no conclusive results.¹ It is also possible that some cases of CAKUT are caused by prenatal ischemia due to RAS. The possibility of RAS should be kept in mind in children with renal malformations and high blood pressure.

The major limitation of our study is that we do not have complete data on the renal anomalies of some of the studied patients as they were referred to us from other countries.

In conclusion, RAS was in a significant number of children and young people associated with other renal anomalies, which could indicate a common genetic background to both conditions in some patients.

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