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Case report

Hyponatremic hypertensive syndrome (HHS) in an 18-month old-child presenting as malignant hypertension: a case report

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Abstract

Background: The combination of hyponatremia and renovascular hypertension is called hyponatremic hypertensive syndrome (HHS). Malignant hypertension as a presentation has been reported in adults with HHS but is rare in children.

Case presentation: An eighteen month-old male presented with drowsiness, sudden onset status epilepticus and blood pressure of 210/160. The electrolytes on admission revealed sodium of 120 mEq/L and potassium of 2.1 mEq/L. The peripheral renin activity (PRA) was 172 ng/ml/min (normal 3–11 ng/ml/min) and serum aldosterone level was 91 ng/dl (normal 4 to 16 ng/dl). Patient underwent angioplasty with no success, followed by surgical correction. Two years since the diagnosis, the blood pressure is controlled with labetolol and amlodipine (at less than sixth of the pre-operative dosages). The PRA is 2.4 ng/ml/min and aldosterone 15.5 ng/dl. The child not only had three renal arteries on left but all of them were stenosed which to best of our knowledge has not been described.

Conclusion: As uncommon as HHS with malignant hypertension may be in adults it is under-reported in children and purpose of the case report is to raise its awareness.

Background

The combination of hyponatremia and renovascular hypertension is called the hyponatremic hypertensive syndrome (HHS) [1-4]. The majority of patients reported have been elderly, asthenic females, and in most the underlying renal artery pathology was atherosclerosis [5]. Patients with HHS present with central nervous system like headache, confusion, and may also have polydipsia and polyuria [1,5,6]. Malignant hypertension (HTN) as a presentation has been reported in adults with HHS but is rare in children beyond infancy with few reports [6-8].

With renal artery stenosis (RAS), renin secretion is increased resulting in high circulating angiotensin II (A-II) levels, leading to HTN and hyperaldosteronism resulting in pressure natriuresis [5]. We report an 18-month old male presenting with seizures due to malignant HTN and subsequently found to have HHS. As uncommon HHS may be as in adults it maybe under-reported in children as well.

Case presentation

An eighteen month-old male presented with drowsiness, sudden onset status epilepticus and blood pressure (BP) of 210/160 mm of Hg. Initially attempts were made to

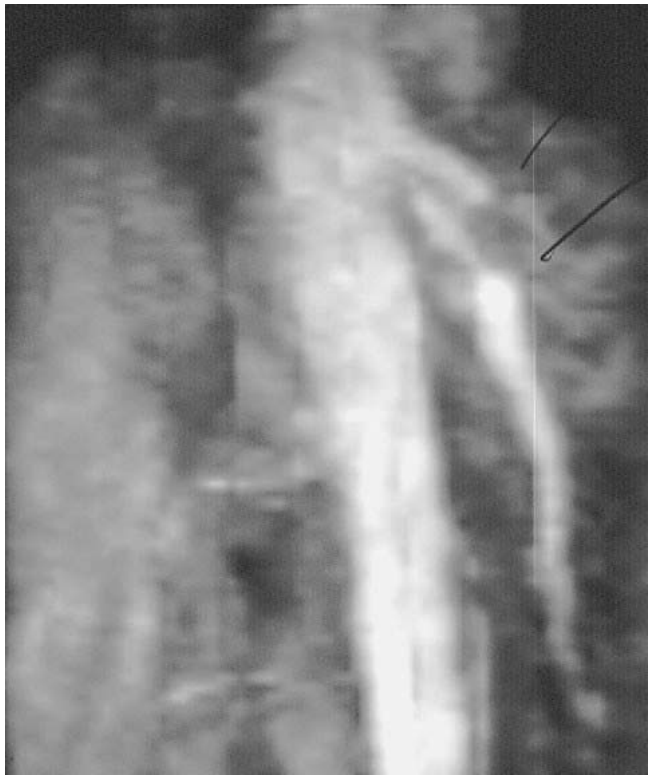

Figure 1
MRA of the left kidney showing at least two renal arteries with stenosis (black line).

control seizures with anti-seizure medication with no success. After starting nitroprusside drip and gradual decrease of BP, the seizures stopped. The patient by then had pinpoint pupils and little spontaneous movement. The renal sonogram was normal. The magnetic resonance imaging (MRI) showed extensive intra-cerebral hemorrhage and possible infarcts. A magnetic resonance angiogram (MRA) of the kidneys revealed diminished blood flow to the left kidney with at least two stenotic arteries (Figure 1). The electrolytes on admission revealed a sodium of 120 mEq/L and potassium of 2.1 mEq/L. The peripheral renin activity (PRA) was 172 ng/ml/min (normal 3–11 ng/ml/min) and serum aldosterone was 91 ng/dl (normal 4 to 16 ng/dl). His serum creatinine was 0.6 mg/dl. His weight was 8.6 kg (< 5th percentile) and height was 80 cm (10th percentile) and head circumference was 48.5 cm (25–50th percentile).

The patient remained on ventilator for a week. Initially rehabilitation potential was discussed but as BP was very gradually lowered by 10 mm of Hg per day, the toddler showed continued improvement in cortical function. After a week the patient was able to breathe spontaneously, nitroprusside was tapered off, and BP was controlled with intravenous (IV) labetolol and oral amlodipine was added later. The 2-D echo cardiogram showed severe concentric left ventricular hypertrophy (LVH). A nuclear renal scan done with 0.1 mg of IV enalaprilat resulted in decrease in BP from 150/110 to 90/60 mm of Hg and was accompanied by ST changes on EKG suggestive of cardiac ischemia. The result for RAS study was inconclusive as following drop in BP the radiotracer clearance from both kidneys completely ceased. Prior to IV enalaprilat the left kidney contributed 30% of overall function.

The patient underwent a renal angiogram (Figure 2) along with percutaneous renal angioplasty. The angiogram revealed three small renal arteries of 1 mm caliber each with stenosis on left and a normal single right renal artery. Angioplasty was attempted but the vessel would not dilate. After prolonged discussions with the patient's family a surgical correction was planned. Prior to surgical correction the patient was on oral labetolol 125 mg orally twice a day (~25 mg/kg/day) and amlodipine 5 mg/day (0.5 mg/kg/day).

The surgical correction of triple RAS on the left kidney was performed ex-vivo while the kidney was in an ice-bath (Figure 3). Aorto-renal bypass was performed to the three renal arteries using a branched internal hypogastric artery graft. Postoperatively, the BP was controlled with labetolol and amlodipine that were gradually tapered.

Eighteen months since the surgery and 2 years since the initial presentation he is on labetolol 25 mg twice a day (current weight 14 kg; 3.5 mg/kg/day) and amlodipine 1.25 mg/day (0.08 mg/kg/day). The dosages are approximately one-sixth of pre-operative dosages. His BP is currently in the range of 100–110/ 50–60. The PRA is 2.4 ng/ml/min, aldosterone is 15.5 ng/dl and the serum creatinine is 0.2 mg/dl. His LVH has regressed, MRI of brain has normalized, and his milestones have caught up to age appropriate levels. A nuclear renal scan done 18 months post-operatively shows that the left kidney now contributes 40% of the total function.

The combination of HTN and hyponatremia can be observedin a number of disorders including renal failure, renin-secreting tumors, and RAS [5,7]. Renal ischemia due to RAS results in increased renin secretion, resulting in high circulating A-II, which raises BP and stimulates aldosterone resulting in pressure natriuresis [1,9,10]. This combination of hypereninemic hypertension with hyponatremia is called HHS [1-4]. In adults HHS presenting with malignant HTN has been reported more often [5] but in children beyond the neonatal age it has rarely been reported [6-8]. The purpose of our case report is to increase awareness of HHS presenting with malignant

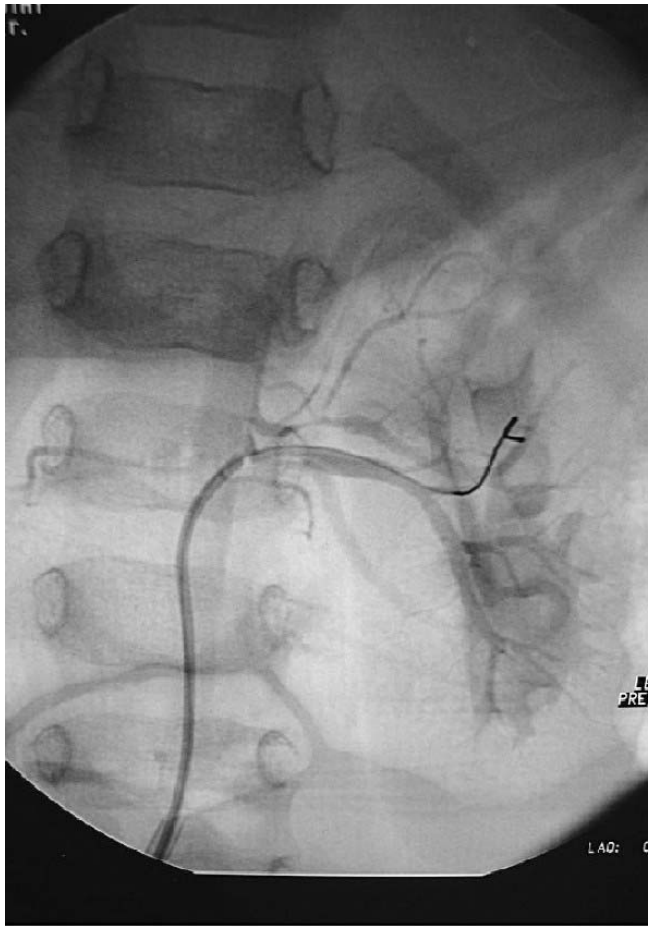

Figure 2
Renal angiogram of the left kidney with triple renal artery stenosis.

HTN in children (Table 1). Elevated renin levels are pathognomonic finding in HHS [5,6,11]. The combination of renin-induced HTN and hyponatremia results in HHS irrespective of the etiology (Table 1).

The renal ischemia leads to a sudden rise in arterial pressure that can induce a pressure natriuresis through the normal kidney, leading to volume depletion and further renin release from the ischemic kidney [5,6,11]. Potassium deficiency from hyperaldosteronism may further stimulate renin secretion and intensify the vicious circle. The hyponatremia itselfis presumed to result primarily from stimulation of thirst and antidiuretic hormone release [3,9,10]. Direct renal actions of A-II to retain water in excess of sodium may also contribute.

In some cases with RAS, an option is to remove the affected kidney as cure for HTN [12,13]. We did consider the option but with 30% function in the affected left kidney every attempt was made to salvage it. The incidence of triple renal artery in one kidney is about 1% of population [14,15]. The patient in our case report not only had three renal arteries on left but also all of them were stenosed which to best of our knowledge has not been described in an eighteen month old. The failure of angioplasty because of ~1 mm caliber of each of the vessels is not surprising.

The step-wise approach for investigation for RAS still remains initial renin estimation followed by a captopril scan for estimating the dependency of glomerular filtration rate (GFR) on A-II and, if needed, an angiogram combined with angioplasty [12,16,17]. In our patient A-II blockade during the first renal scan led to such profound decrease in BP that the child had cardiac ischemia due to hypotension. The BP of 90/60 at that time would be a normal BP for most children of his age but was relatively low for him. Continuation of A-II blockade for treatment of HTN would have led to loss of GFR mostly on the affected side. As our aim was to preserve the left kidney function A-II blockade was not a treatment option.

Our patient also suffered from failure to thrive, delayed milestones, and speech delay prior to the control of HTN. Two years later all of these symptoms have resolved. This underlies the importance of measurement of BP and early detection on HTN at any age.

Conclusions

In summary, in children the combination of hypereninemic malignant HTN with hyponatremia (HHS) does occur and ruling out renal ischemia due to RAS is strongly recommended.

Abbreviations

hyponatremic hypertensive syndrome (HHS)

hypertension (HTN)

renal artery stenosis (RAS)

angiotensin II (A-II)

blood pressure (BP)

magnetic resonance imaging (MRI)

magnetic resonance angiogram (MRA)

peripheral renin activity (PRA)

intravenous (IV)

left ventricular hypertrophy (LVH)

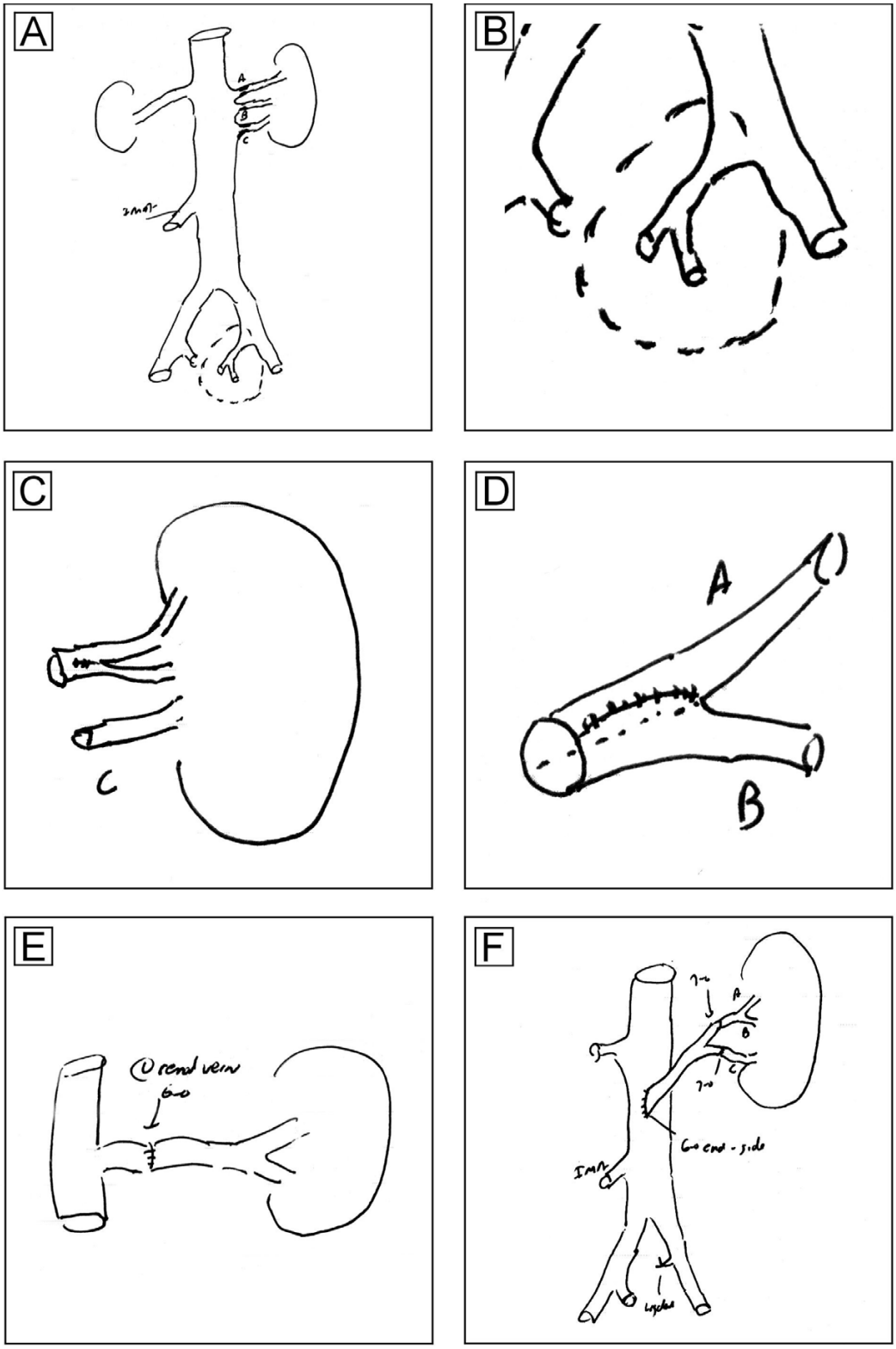

Figure 3
Aorto-renal bypass: A. Triple (A, B, C) left renal artery stenoses B. Bifurcated left hypogastric artery autograft harvest C. A and B renal arteries spatulated and anastomosed D. Creation of a common renal artery E. End-end repair of left renal vein F. End-side anastomosis of the new renal artery and aorta.

Table 1: Pediatric Cases of HHS beyond Infancy

Authors	Year	Number of cases	Etiology	Outcome
Dixit et al.	current	One	Left renal arterial (3) stenoses	Successful renal auto-graft
Dahlem et al.	2000	One	Fibro-muscular dysplasia of left renal artery	Nephrectomy
Kaneko et al.	1994	One	Left renal artery stenosis	Percutaneous transluminal angioplasty
Misiani et al.	1994	One	Renin-producing leiomyosarcoma	Removal of the leiomyosarcoma; relapse

glomerular filtration rate (GFR)

Competing interests
None declared.

Authors' contributions
All authors were involved in management of the child and manuscript preparation.

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