

Surgical Treatment of Complete Renal Artery Occlusion in Pediatric Patients

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Two children, 8 and 11 years old, presented with severe hypertension secondary to unilateral and bilateral total occlusion of the renal arteries, respectively. The 11-year-old developed sudden anuria requiring hemodialysis. Successful surgical reconstruction allowed recovery of renal function and normal blood pressure in both patients. Routine blood pressure control in the pediatric patient population, high clinical awareness, and judicious use of arteriography, provide the best chance for early diagnosis of renovascular disease. Surgical revascularization or transluminal angioplasty are the treatment modalities of choice in appropriately selected cases of renal artery stenosis. When total occlusion occurs, retrieval or preservation of renal function can be successfully achieved by direct surgical intervention. (*Ann Vasc Surg* 1990;4:490-493).

KEY WORDS: Pediatric hypertension; renal artery occlusion; renal failure; renal revascularization.

Total renal artery occlusion may cause malignant hypertension. It may lead to renal failure if it is bilateral or occurs in a solitary kidney. It has been reported secondary to embolism of a solitary kidney, recent thrombosis or trauma [1,2]. However, these are rare events in the pediatric population. Our experience with two children who presented total renal artery occlusion is reported.

CASE REPORTS

Patient No. 1

An 11-year-old boy was admitted to a Community Children's Hospital due to acute abdominal pain associated with a 10 day history of vomiting and diarrhea. He

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denied any remarkable previous symptoms. On admission his blood pressure was 240/180 mmHg. Pulses were normal in the four extremities and he had no bruits. He did not have "café au lait" spots. His abdomen was tender, especially in the right upper quadrant, and the findings of an abdominal ultrasonogram were consistent with an acute cholecystitis. He underwent a laparotomy which confirmed an acalculous necrotic gall bladder. Cholecystectomy was performed. Preoperative lab work showed mild anemia, 10,400 leukocytes, serum creatinine of 5.2 mg/dl and a left ventricular hypertrophy disclosed by EKG. During the postoperative period he remained severely hypertensive, initially requiring diazoxide, and thereafter propranolol 40 mg q.i.d., nifedipine 20 mg b.i.d., and enalapril 7.5 mg b.i.d. Eye funduscopy was compatible with a grade III hypertensive retinopathy. Histopathologic study of the gall bladder revealed arteriolar thickening due to intimal hyperplasia, medial hypertrophy with fibrinoid necrosis and thrombosis.

After the fifth postoperative day he became progressively oliguric, ultimately requiring dialysis. An intraarterial digital subtraction arteriography (DSA) was obtained. It showed total occlusion of both renal arteries with late filling of secondary branches on the right kidney (Fig. 1). He was considered for renal revascularization and transferred to our hospital after being on dialysis for



Fig. 1. Patient No. 1. Intraarterial digital subtraction arteriography disclosing complete occlusion of both renal arteries at origin with late filling of hilar vessels of right kidney (arrow).



Fig. 2. Patient No. 1. Postoperative arteriogram after right iliac-to-renal saphenous vein graft bypass.

two weeks. At that time his hemoglobin was 9.6 gm/dl, his ESR was 50 mm/hr and his serum creatinine 8.25 mg/dl. At surgery some periaortic fibrosis was found and therefore the aorta was avoided as an inflow site. The main right renal artery was thrombosed, but its trifurcation was spared. The right kidney was revascularized with right iliac-to-renal saphenous vein graft bypass. A severely atrophic left kidney (19 gr.) was removed without an attempt to explore the left renal artery. Microscopic study of the left kidney disclosed intimal hyperplasia of the segmentary branches and hyperplastic arteriosclerosis with microhemorrhages. A specimen of the main renal arteries was not obtained.

Following surgery no further dialysis was required, and the boy's serum creatinine decreased to 1.0 mg/dl by the seventh postoperative day. His blood pressure remained below 130/70 mmHg without medication. After obtaining a control arteriogram (Fig. 2), the boy was discharged on the ninth postoperative day. One-and-a-half years after revascularization he is asymptomatic, his blood pressure is 120/70 mmHg without medication and serum creatinine is 0.65 mg/dl. He has no clinical evidence of occlusive vascular disease elsewhere.

Patient No. 2

An eight-year-old boy was referred with a two year history of headache in the early morning. He had failed to thrive (weight: 24.4 kg, height: 120 cm). His blood pressure was 155/105 mmHg in the upper extremities and 160/130 mmHg in both lower extremities. His eye fundi were normal. A 2/6 systolic mesocardiac murmur was heard. Peripheral pulses were normal and a low pitch bruit was heard in the subphoid area. Blood pressure control was obtained with hydralazine 25 mg t.i.d., propranolol 80 mg t.i.d., and hydrochlorothiazide 50 mg q.i.d. EKG and chest x-ray were consistent with left ventricular hypertrophy. Serum creatinine was 0.65 mg/dl. The right

renal vein renin activity was 40.1 ng/ml/hr and the left was over 100 ng/ml/hr (normal range for peripheral plasma renin activity in children, same age = 4.10 ± 2.19 ng/ml/hr) [3]. Arteriography showed total occlusion of the left renal artery at the origin, with late filling of the kidney through collaterals from the adrenal and ureteral vessels (Fig. 3). The child underwent an aorto-to-left renal saphenous vein bypass. Biopsy of the renal artery was not obtained. A control arteriogram was performed six months after surgery (Fig. 4). Twenty-five months after revascularization his blood pressure remains normal without medication, the serum creatinine is 0.85 mg/dl and has regained normal weight.

DISCUSSION

Renovascular hypertension in children is rare. It comprised 3% of the surgical cases reported in the Cooperative Study published in 1972 [4]. Renovascular occlusive disease may follow a progressive asymptomatic clinical course towards total arterial occlusion. Among the clinical clues leading to diagnosis of arterial hypertension in children are: early morning headache, epistaxis, vomiting, failure to thrive, and irritability, as in our second case [5]. However, since most of the patients are initially asymptomatic, routine check of arterial blood pressure in the pediatric population remains the best tool for early diagnosis and treatment. The intravenous pyelogram, isotopic renogram and Captopril test may be helpful in the diagnosis of renovascular hypertension [6,7]. However, arteriography must be obtained in order to confirm renovascular disease, particularly if there is a decreased renal function suggesting bilateral involvement. Arteriography shows the precise location and extension of



Fig. 3. Patient No. 2. Left renal arteriogram through collaterals from small polar branch. There is complete occlusion of main renal artery at origin (arrow).



Fig. 4. Patient No. 2. Control aortogram six months after left aortorenal saphenous vein graft bypass (arrow).

renovascular lesions and can add information about the possible pathological type.

Intravenous DSA has been useful in the study of renal arteries in pediatric patients [8], however, it may fail to show lesions in secondary or intrarenal branches. Intraarterial DSA provides a better image with less contrast material, an obvious concern if there is renal impairment. In the occluded kidney, the arteriographic finding of late collateral filling of hilar vessels with parenchymal impregnation is a good predictive factor for recovery of renal function. The size of the occluded kidney is less relevant in children compared to the adult population in which there is an accepted limit of 8 cm [9].

Because of the unusual findings of hypertensive retinopathy and hyperplastic arteriolosclerosis in both the gallbladder and left kidney in a hypertensive child, we believe patient No. 1 most likely had undiagnosed long-standing severe hypertension due to tight stenosis of the right renal artery and previous occlusion and atrophy of the left kidney. During the postoperative course of his acute cholecystitis he underwent arterial thrombosis of his only functional kidney and became anuric. The role of the

converting enzyme inhibitors in the derangement of renal function of patients with bilateral renal stenosis or in a solitary kidney has been clearly demonstrated [10] and this case provides a good example. The kidney can tolerate subfiltration perfusion pressure with good functional recovery after revascularization [11]. Restoration of renal function has been obtained after anuria lasting up to 42 days [12].

The second patient illustrates the natural course of Goldblatt's hypertension due to unilateral renovascular disease with severe hyperreninemia. Although the main left renal artery became occluded, the kidney remained viable through collaterals, and the patient had no deterioration of the renal function. Unless these lesions are corrected in time, persistent hypertension may damage the contralateral kidney leading to progressive renal failure.

The lesions most frequently responsible for renovascular disease in children are the fibrous dysplasias, neurofibromatosis, congenital hypoplasia, ab-

dominal aortic coarctation and Takayasu's arteritis [5]. Although arteritis was suspected in patient No. 1, the etiology of renovascular disease remains uncertain in both cases, since no specimen of the main renal arteries could safely be obtained for histopathologic study.

The role of surgery in the management of advanced atherosclerotic ischemic renal disease has been established in adults [13,14]. Both cases presented here are unusual clinical events of pediatric ischemic renal disease. Surgical revascularization of the occluded renal arteries allowed cure of severe hypertension in both cases and retrieval of renal function in patient No. 1. Unless there is an atrophic and scarred kidney, revascularization should be always attempted, leaving nephrectomy for unretrievable organs.

Surgical revascularization or percutaneous transluminal angioplasty (PTA) are the treatment alternatives of choice in renovascular disease, when feasible. PTA has been successful in the management of renal artery stenosis in adults [15], however, the experience in children is still limited and less satisfactory [16,17]. Its application to total arterial occlusion seems less feasible.

Our procedure of choice for renal revascularization is the aortorenal bypass with autologous material [18]. In pediatric patients, although aneurysmal dilatation of venous grafts occurs quite frequently, this does not appear to have a deleterious effect or lead to late complications [19]. To avoid such problems the use of hypogastric arterial grafts has been advised. Long-term patency and effectiveness of revascularization with saphenous vein has been well documented [20]. Other procedures like splenorenal anastomosis or bypass have been less satisfactory in children [21].

In conclusion, these two cases illustrate the role of surgery in the management of advanced ischemic renal disease causing severe hypertension and renal failure in children. Revascularization of the occluded kidney not only preserves renal function but also provides good blood pressure control.

REFERENCES

- FLYE MN, ANDERSON RW, FISH JC, et al. Successful surgical treatment of anuria caused by renal artery occlusion. *Ann Surg* 1982;195:346-353.
- BARLOW B, GANDHI R. Renal artery thrombosis following blunt trauma. *J Trauma* 1980;20:614-617.
- SAIEH C, IRRUARIZAGA V, LOPEZ G, et al. Plasma renin activity in normal and malnourished children. *Eur J Ped* 1983;140 (Abstr):184.
- MAXWELL MH, BLEIFER KH, FRANKLIN SS, et al. Cooperative study of renovascular hypertension. Demographic analysis of the study. *JAMA* 1972;220:1195-1204.
- STANLEY JC. Renal vascular disease and renovascular hypertension in children. *Urol Clin N Am* 1984;11:451-463.
- DAMAN WILLEMS CE, SHAH V, UCHIYAMA M, et al. The Captopril test: an aid to the investigation of hypertension. *Arch Dis Child* 1989;64:229-234.
- SAIEH C, AMARAL H, MORALES B. Effect of Captopril in Takayasu's arteritis. *Ped Nephrol* 1988;2:375-377.
- ZABBO A, MOODIE DS, RISIUS B, et al. Intravenous digital subtraction angiography for evaluation of the renal arteries in pediatric patients. *Clev Clin Q* 1986;53:145-150.
- DEAN RH, ENGLUND R, DUPONT WD, et al. Retrieval of renal function by revascularization. Study of preoperative outcome predictors. *Ann Surg* 1985;202:367-375.
- HRICIK DE, BROWNING PJ, KOPELMAN R, et al. Captopril-induced functional renal insufficiency in patients with bilateral renal artery stenosis or renal artery stenosis in a solitary kidney. *N Engl J Med* 1983;308:373-376.
- MORRIS GC, KEIDER CF, MAYER JG. The protective effect of subfiltration arterial pressure on the kidney. *Surg Forum* 1956;6:623-624.
- BAGI P, HELGSTRAND U, BUCHARDT HJ. Surgical treatment of anuria caused by renal artery occlusion. *Scand J Urol Nephrol* 1987;21:323-324.
- SCHEFFT P, NOVICK AC, STEWART BH, et al. Renal revascularization in patients with total occlusion of the renal artery. *J Urol* 1980;124:184-186.
- NOVICK AC, POHL MA, SCHREIBER M, et al. Revascularization for preservation of renal function in patients with atherosclerotic renovascular disease. *J Urol* 1983;129:907-912.
- FAVA M, LOBO S, CRUZ F. Angioplastia percutanea en el tratamiento de la hipertension renovascular. *Rev Med Chile* 1986;114:1015-1020.
- WATSON AR, BALFE JW, HARDI BE. Renovascular hypertension in childhood: a changing perspective in management. *J Pediatr* 1985;106:366-372.
- STANLEY P, HIESHIMA G, MEHRINGER M. Percutaneous transluminal angioplasty for pediatric hypertension. *Radiology* 1984;153:101-104.
- VALDES F. Cirugia de la arteria renal. Indicaciones tecnicas y resultados. *Rev Chile Cirugia* 1985;37:425-432.
- DEAN RH. Late results of aortorenal bypass. *Urol Clin N Am* 1984;11:425-434.
- ERNST CB, FRY WJ, STANLEY JC. Surgical treatment of renovascular hypertension: revascularization with autogenous vein. In: STANLEY JC, ERNST CB, FRY WJ (eds). *Renovascular Hypertension*. Philadelphia: W.B. Saunders 1984, pp 276-288.
- NOVICK AC, STRAFFON RA, STEWART BH, et al. Surgical treatment of renovascular hypertension in the pediatric patient. *J Urol* 1978;119:794-799.

