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CASE REPORT / ПРИКАЗ БОЛЕСНИКА

Severe renovascular hypertension in an asymptomatic child – 11 years of follow up

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SUMMARY

Introduction Renovascular hypertension is a rare cause of arterial hypertension in the pediatric population. The aim of this report was to present the treatment outcome in a girl with severe stenosis of the renal artery on a solitary kidney.

Case outline A 6.5-year-old girl, otherwise healthy, was found to be highly hypertensive (up to 200/140 mmHg) during a systematic examination for school enrollment. The imaging evaluation revealed that she had a single kidney with critical renal artery stenosis. Medication with three antihypertensive drugs was unsuccessful. The angioplasty attempt was complicated by artery wall dissection and the pseudoaneurysm development. This complication was treated surgically with an autologous saphenous vein graft by-pass. Postoperatively, acute kidney injury developed, which required continuous renal replacement therapy for two days, followed by hemorrhagic shock and the need for reintervention with retroperitoneal hematoma evacuation. After three years, aneurismal dilated vein graft was replaced by a synthetic one (PTFE) in London. Angioplasty of the synthetic graft was performed twice due to the development of proximal stenosis and restenosis. After 11 years of follow-up, the girl has well controlled blood pressure under two antihypertensives, with normal renal function without proteinuria.

Conclusion This case illustrates that angioplasty for single artery stenosis in children is a high-risk procedure, which may result in an aneurism formation or bleeding and a need for several kidney revascularization procedures. In order to preserve kidney function, it requires a serious multidisciplinary approach by nephrologists, interventional radiologists/cardiologists, and vascular surgeons.

Keywords: renal artery stenosis; single kidney; hypertension; renal angioplasty; aorto-renal graft; children

INTRODUCTION

Renovascular hypertension (RVH) is a term that refers to an increased blood pressure (BP) due to renal artery stenosis (RAS) and consequent renal hypoperfusion that leads to the activation of the renin-angiotensin-aldosterone system [1]. In children and adolescents, RAS accounts for about 10% of all causes of secondary hypertension. In Europe and North America, the most common cause of RAS is fibromuscular dysplasia, while it is "Takayasu" arteritis in Asia and South Africa [2]. RAS can be classified into the following categories: genetic syndromes, acquired/inflammatory such as polyarteritis nodosa, idiopathic RAS, mid aortic syndrome ("Mid aortic sy"), external compression of the renal artery and other causes. The most common genetic syndromes that lead to RVH are: neurofibromatosis type 1 "Alagille sy," "Williams sy," tuberous sclerosis, Marfan syndrome [3]. A number of radiological tests are used to diagnose RVH ranging from the screening method – Doppler echosonography of renal blood vessels to contrast angiography, which is the gold standard for diagnosing RAS. Various pharmacological agents can be used in RVH therapy, but very often this hypertension is pharmacoresistant with the requirement to perform different kidney revascularization techniques [4]. The primary option is revascularization by percutaneous transluminal angioplasty (PTA), and in case of its failure, the options are surgical procedures aimed at establishing the best perfusion of the kidney and preserving its function. The association of congenital anomalies of the urinary tract such as a solitary kidney and severe renovascular disease is rarely described in the literature [5]. Here we report our experience in diagnostics, treatment, complications, and long-term outcome in a girl with severe single-kidney RAS.

CASE REPORT

A 6.5-year-old previously healthy girl was noted to be hypertensive with BP 200/140 mmHg during investigations done for school application. On admission to our clinic, the girl was without symptoms, well grown with normal physical findings. BP on the leg was also elevated 200/120 mmHg with palpable femoral pulses. There was no personal and family history of significance. Laboratory investigations revealed normal glomerular filtration rate (GFR – 112 ml/min / 1.73 m^2) and electrolytes. Left ventricular hypertrophy was seen

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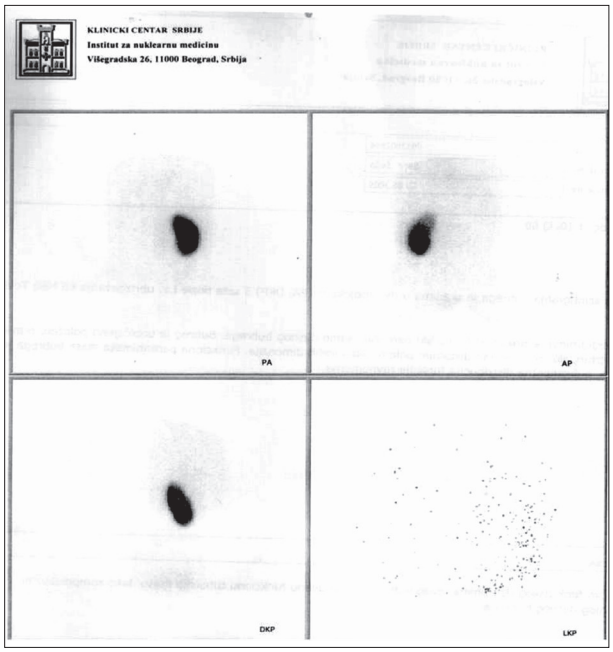

Figure 1. Dimercaptosuccinic acid scan confirmed left kidney agenesis

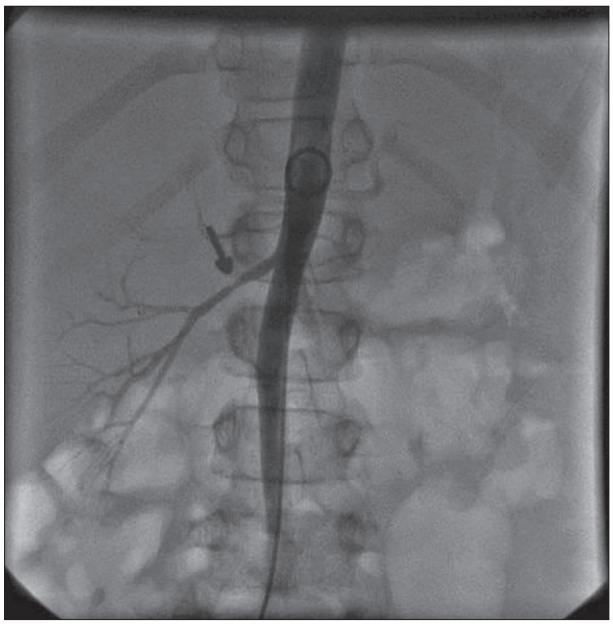

Figure 2. Angiography demonstrated critical stenosis in the middle part of main renal artery with minimal lumen ~ 1 mm (arrow shows the narrowest segment)

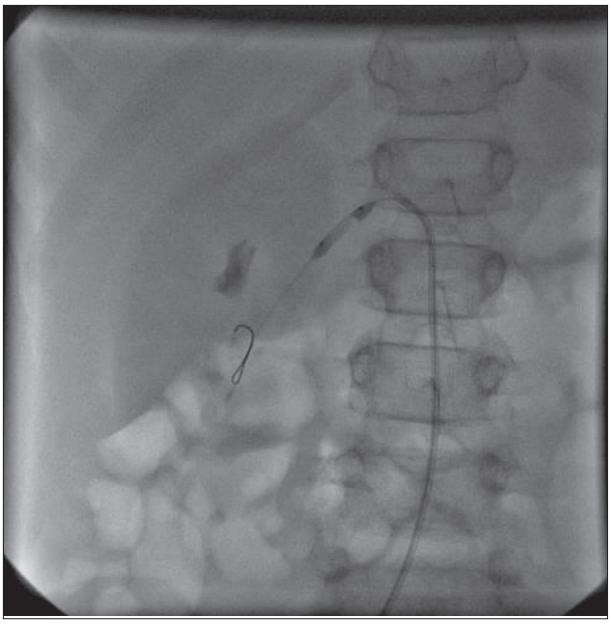

Figure 3. Balloon angioplasty attempt

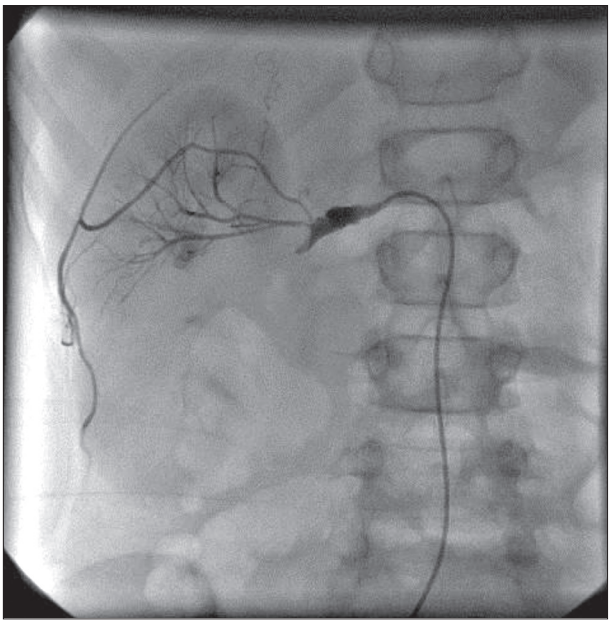

Figure 4. Distal right renal artery lesion with compromised circulation in the lower part of the single kidney

on echocardiography. Abdominal ultrasound showed the right solitary kidney with normal echo structure, 9.4 cm in length (50th centile for age and height and single functioning kidney). Renal artery duplex ultrasound showed an increase in the peak systolic velocity > 300 cm/s at the origin of the right renal artery with post stenotic turbulence indicating a right renal stenosis. Dimercaptosuccinic acid scan confirmed the absence of the left kidney (Figure 1). Three medications failed to control BP: nifedipine, carvedilol, and minoxidil. Due to suspected RVH, the patient underwent angiography, which demonstrated critical stenosis in the middle part of main renal artery (Figure 2). This stenosis was crossed with guidewire and the first attempt of 3.5 mm balloon dilatation failed (Figure 3). A larger balloon of 4 mm was ruptured and induced a lesion of the distal part of the renal artery (Figure 4). The patient was hemodynamically stabile, but kidney function worsening with creatinine increase after 48 hours (55–127 umol/L) and transitory polyuria developed. After two weeks, control angiography revealed pseudoaneurysm formation on the upper-pole segmental branch (Figure 5), with invasive BP in the aorta of 192/96 mmHg. Ten days later, the patient underwent surgery with aneurysm resection and creation of saphenous vein patch. Due to postoperative anuria, continuous veno-venous hemodiafiltration (CVVHDF) was done during 48 hours. Activated clotting time during CVVHDF was at the recommended levels ~165 s. Despite

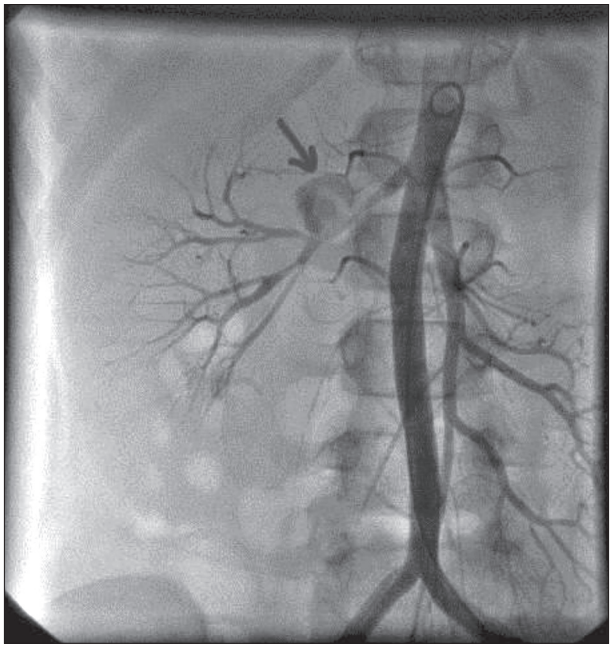

Figure 5. Control angiography revealed a pseudoaneurysm 18 × 15 mm in size on the upper pole segmental branch (arrow shows circular pseudoaneurysm)

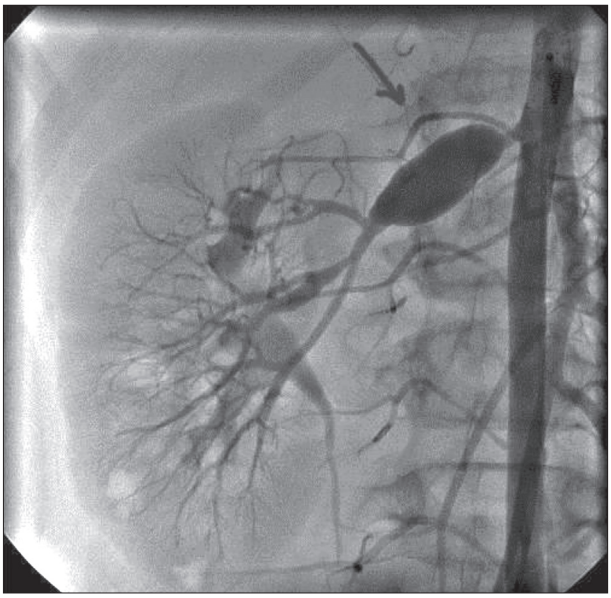

Figure 6. Saphenous patch dilatation on angiography (arrows shows enormous vein patch dilatation)

this, the patient developed massive abdominal bleeding which resulted in hemorrhagic shock (BP: 89/43 mmHg; Hgb 52 g/L). Relaparotomy resulted in evacuation of large number of intraabdominal hematomas with suture of small perivertebral vessels. Immediately after reoperation, diuresis appeared and CVVHDF was stopped. In the following three years, there was satisfactory control of BP (office measurement of 125/80 mmHg) with two antihypertensives (carvedilol and nifedipine), normal renal function (GFR 98 ml/min / 1.73 m^2) and with regression of the left ventricular mass. However, three years after the surgery, the girl became hypertensive, and an aneurysmal dilatation of the vein patch was verified (Figure 6). The next operation with resection of the vein graft and implantation of synthetic polytetrafluoroethylene (PTFE) was performed in London, Great Ormond Street Hospital. Systolic BP target was kept at 120 mmHg with carvedilol. Nifedipine was stopped. After two years, hypertension worsened and Doppler showed a high degree of stenosis at the proximal site of the implanted graft, resulting in angioplasty of PTFE in London. On that occasion, significant intrarenal narrowing was seen on angiography. Four years after the PTFE angioplasty and 11 years after the first operation, a duplex ultrasound revealed a significant narrowing > 70% of the graft lumen. PTFE redilatation was performed in London. At the most recent follow-up, 11 years after the first operation, and three months after the last intervention, the patient's BP is satisfactory, 130/85 mmHg under double medications (carvedilol and doxazosin). Kidney function remained normal (GFR 99 ml/min / 1.73 m^2), without proteinuria.

This case report was approved by the Clinical Ethics Committee and written consent was obtained for the publication of this case report from the patient and her parent.

DISCUSSION

Idiopathic stenosis of the renal artery, or fibromuscular dysplasia, is a heterogeneous group of systemic, non-inflammatory and non-atherosclerotic diseases of the blood vessel wall that led to the development of RVH [1]. It is interesting that RVH is discovered accidentally in as many as 26–70% of asymptomatic children, to which group our patient belongs [1, 6]. The younger population of children may exhibit neurological symptoms (convulsions) or cardiac symptoms such as congestive heart failure. An example of cardiac dysfunction and hypertension due to renovascular stenosis in a single functioning kidney in an infant was presented by Hall et al. [7]. The association of congenital anomalies of the urinary tract such as a solitary kidney and severe renovascular disease as we present here is rarely described in the literature [5, 7]. The diagnosis of RVH in children is often made with a long delay, which significantly affects the course of the disease and the prognosis. The reason for this is that the symptoms are often non-specific or absent, and children older than three years often do not have their BP measured, despite clear recommendations [2]. In children with suspected RVH, duplex ultrasound is a widely accepted method as a screening test [8]. RVH is suggested, like the findings in our patient, by peak systolic velocity > 2 m/s and the finding of the "parvus-tardus" type blood flow waves distal to the stenosis [9]. Contrast angiography, in addition to being the gold standard in diagnostics, also provides the best view of intrarenal blood vessels, and can also be a therapeutic procedure. [3]. As a rule, this type of hypertension is resistant to medication, as in the case of our patient, but one should always try, so there are data that in as much as 65.8% of cases of RAS in the pediatric population conservative treatment was successful after long-term follow-up [10]. Renal revascularization by PTA or surgical procedures are important therapeutic options

aimed at establishing the best perfusion of the kidney and preserving its function. In a large retrospective study by Agrawal et al. [12], 27 years of experience using PTA in the treatment of children with RVH are presented. PTA is a safe, less invasive procedure that can be performed with balloon dilatation, the so-called balloon angioplasty or with stent placement (considered in older children who have finished growing). This method is effective in over 50% of patients (normalization of BP without drugs or reduction of the number of drugs), with restenosis occurring in about 25–30% of treated children [11, 12]. In the case of resistant stenoses, cutting balloons can significantly improve the results even in a single functioning kidney [7, 13]. Possible complications of this method are: contrast nephropathy [14], artery spasm, dissection or even perforation which ultimately can lead to hemorrhagic shock [1]. In our patient, the non-invasive method (PTA) failed due to the dissection of the artery wall and a pseudoaneurysm formation. Pseudoaneurysm as a complication of PTA was described in one of 13 pediatric patients with RAS [14]. Kari et al. [15] showed complications after PTA in 11.4% of procedures (13 out of 114), one of which was fatal and led to death. Namely, in an eight-year-old patient, repeated angioplasty of a single kidney synthetic graft led to dissection of the blood vessel wall, resulting in fatal bleeding. Surgical revascularization has a higher success rate than PTA (70–80%), however, it is generally an option if PTA fails. There are several surgical procedures: resection of the narrowed segment and primary reanastomosis, aorto-renal bypass, autotransplantation or nephrectomy (if there is significant atrophy of the renal parenchyma). In order to prevent potential complications of PTA, Doshi et al. [16] reported a surgical correction as the first revascularization option in a young girl with one functioning kidney. In this case, the cutting of the narrowed segment, which made significant kinking during expirations, after six months of follow-up showed a normal finding on ultrasound Doppler without the use of antihypertensive drugs. In a meta-analysis by Trinquart et al. [17], which included two pediatric studies with a total of 60 patients treated for RAS, aortorenal bypass was most often from the saphenous vein, in 62% of cases, and nephrectomy was performed in 22% of patients. In the first included study, 59.2% of children had BP < 150/90 mmHg after six months without therapy, and in the second study, 87.9% of patients had BP lower than 140/90 mmHg during at least 12 months of follow-up [17]. The saphenous patch in our patient achieved satisfactory BP control (office measurement of 125/80 mmHg) under two antihypertensives for three years, but then it became insufficient due to the development of graft dilatation. Aneurysmal dilatation of the autologous graft from the saphenous vein was described in a study by Sandmann et al. [18] in 9% of cases (42 pediatric and two adult patients) with RAS who required reconstructive surgery. Due to saphenous patch dilatation and worsening of hypertension in our patient, reintervention and Dacron graft replacement had to be performed. An artificial graft was placed in London, but with subsequent *de novo* stenoses that required repeated redilatation. In the aforementioned paper, restenoses in patients with PTFE grafts were treated with stenting in one case or reconstruction with a suitable patch in the other [18]. Despite the development of intrarenal stenoses in our patient and the described numerous complications, renal function was preserved without residual proteinuria with satisfactory BP control. Clinically, RVH should be suspected when high BP refractory to multiple antihypertensive drugs is present, especially in a younger child.

This case illustrates that angioplasty for single-artery stenosis in children is a procedure of high risk, which may results in aneurism formation or bleeding and the need for several kidney revascularization procedures.

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Conflict of interest: None declared.

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Тешка реноваскуларна хипертензија код детета без симптома – једанаест година праћења

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САЖЕТАК

Увод Реноваскуларна хипертензија је редак узрок артеријске хипертензије у педијатријској популацији. Циљ овог рада је био да прикажемо исход лечења код девојчице са тешком стенозом реналне артерије на солитарном бубрегу.

Приказ болесника На систематском прегледу за упис у школу шестоипогодишњој девојчици без здравствених тегоба измерен је крвни притисак од максималних 200/140 *mmHg*. Учињеним испитивањима је откривено да има један функционални бубрег са критичном стенозом на реналној артерији. Медикаментозна терапија са три антихипертензивна лека је била безуспешна, а покушај ангиопластике је био компликован дисекцијом зида артерије и развојем псеудоанеуризме. Компликација је збринута хируршком интервенцијом и креирањем бајпаса аутологним графтом вене сафене. Постоперативно се развило акутно оштећење бубрега, које је током два дана захтевало хемодијафилтрацију и хеморагијски шок праћен реинтервенцијом и евакуацијом ретроперитонеалног хематома. После три године венски графт је због развоја анеуризматског проширења замењен синтетичким (ПТФЕ) у центру у Лондону. Потом је у два наврата рађена ангиопластика синтетичког графта због развоја проксималне стенозе и рестенозе. После 11 година праћења, девојка има добру контролу крвног притиска са два антихипертензива, нормалну бубрежну функцију без протеинурије.

Закључак Овај случај показује да је ангиопластика код стенозе реналне артерије једног функционалног бубрега процедура високог ризика, која може довести до формирања псеудоанеуризме или искрварења и потребе за спровођењем више процедура реваскуларизације. У циљу очувања функције бубрега, захтева постојање озбиљног мултидисциплинарног тима који обухвата нефролога, интервентног радиолога/кардиолога и васкуларног хирурга.

Кључне речи: стеноза реналне артерије; један бубрег; хипертензија; ренална ангиопластика; аорто-ренални графт; деца