

Does hypertension develop in children patients who underwent pyeloplasty due to unilateral ureteropelvic junction stenosis?

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ABSTRACT

Aims: Hypertension may develop in children with renal and cardiovascular pathologies. In our study, we aimed to investigate the prevalence of hypertension in children who underwent pyeloplasty.

Methods: We retrospectively evaluated the blood pressure values measured in the postoperative period in children who were diagnosed with ureteropelvic junction stenosis and underwent pyeloplasty in the pediatric urology clinic of Ankara City Hospital between 2007 and 2020.

Results: In our study, 167 patients (48 women, 123 men; mean age 3.6; 58 right, 109 left) who underwent pyeloplasty due to UPJO were evaluated. In the postoperative follow-up, hypertension was detected in 5 patients (2.9%). Bilateral patients were excluded from the study. Of the 5 patients who developed hypertension, one had a pelvic ectopic kidney and one had a contralateral multicystic dysplastic kidney. All of the patients who developed hypertension had intrinsic UPJO; 3 of them were catheterized with a percutaneous nephrostomy catheter preoperatively. The mean MAG3 function was 43.3%. While the mean follow-up period of the patients was 5.6 years, it was observed that hypertension developed in an average of 3.5 years. In the postoperative period, there was an average increase of 1.2% in the functions of these five patients in the control scintigraphy. No patient who developed hypertension underwent a second surgical intervention.

Conclusion: In cases where pyeloplasty was performed due to UPJO, blood pressure should be monitored in the postoperative period. Blood pressure should be checked, especially in advanced hydronephrotic patients with a history of percutaneous nephrostomy in the preoperative period.

Keywords: Ureteropelvic junction obstruction, hypertension, pyeloplasty, percutaneous nephrostomy

INTRODUCTION

The prevalence of hypertension in children is considered to be 0.5-1.2%, increasing to 3-5% during adolescence. The causes of hypertension in children are categorized as essential (primary) (2-20%) and secondary (79-98%). Causes of secondary hypertension include kidney diseases, vascular disorders, endocrine factors, neurological disorders, and medication use. Renal parenchymal diseases account for 75-80% of pediatric hypertension cases.¹

While most glomerulonephritis cases and congenital anomalies are easily detected during initial screening, recurrent urinary infections are often overlooked, which frequently leads to missed diagnoses of reflux nephropathy. Although severe hypertension may develop in some of these patients, clinical findings can remain unclear. Even in congenital obstructions of the urinary system, such as ureteropelvic junction obstructions (UPJO), hypertension may develop. Additionally, hereditary cystic kidney diseases, renal trauma, ischemia, infarction, and

compression may lead to renal parenchymal damage, thereby causing hypertension.²

In our study, we aimed to investigate the prevalence of hypertension in children who underwent pyeloplasty due to UPJO.

METHODS

The study was conducted with the permission of the Clinical Researches Ethics Committee of Ankara City Hospital No. 1 (Date: 14.05.2020, Decision No: E1-20-592). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Between January 2007 and March 2020, a retrospective review was conducted on 167 patients who underwent pyeloplasty due to ureteropelvic junction obstruction at the Pediatric Urology Clinic of Ankara City Hospital. In the operations,



dismembered pyeloplasty was performed using the Anderson-Hynes technique with a retroperitoneal approach and a mini flank incision. All patients received a perioperative ureteral stent (either external or internal). Postoperatively, an external stent (Pippi Salle catheter) was applied for 10 days, or an internal stent (double-J catheter) was used for one month. Antibiotic prophylaxis was administered only during the first postoperative month while the catheter was in place; it was not continued thereafter. Patients were retrospectively analyzed for gender, age at the time of operation, side of operation, initial presenting symptoms, intrinsic or extrinsic (vascular compression) causes of UPJO, history of antenatal hydronephrosis, urinary ultrasound findings, percentage of renal function, preoperative and postoperative kidney function percentages in MAG-3 scintigraphy, follow-up duration, and blood pressure values. In this study, conducted on patients followed for an average of 6.7 years (± 4.2 years), long-term clinical outcomes were evaluated.

Our study included 167 cases (121 boys, 46 girls) (58 right-sided, 109 left-sided). The mean age of the patients was determined to be 44.5 ± 53 months. Demographic characteristics are presented in **Table 1**. Approximately 50% of the patients with preoperative hydronephrosis had a history of antenatal hydronephrosis. None of the patients had a history of hypertension prior to pyeloplasty. Percutaneous nephrostomy was performed preoperatively in 11 patients (6%) with severe hydronephrosis, and postoperative hypertension developed in two of these patients. No cases of hypertension were observed in patients with severely reduced renal function (below 20%) as shown on renal scintigraphy. During an average follow-up period of 3.5 (± 1.5) years, hypertension developed in only 2.8% of all patients (5 cases).

RESULTS

In 9 patients (5.2%) who underwent pyeloplasty due to UPJO, vesicoureteral reflux (VUR) was detected on the same side. During follow-up, spontaneous resolution was observed in 7 (4%) cases, while 2 cases with grade 4-5 VUR underwent subureteral injection. None of the patients with both UPJO and

VUR on the same side developed hypertension. However, after several years, transient hypertension developed in two patients with stage 2 VUR detected on the contralateral side, with an average follow-up period of 4 years. In these two patients, subureteral injections were performed in case of urinary tract infections (UTI) while they were on antibiotic prophylaxis. These temporary hypertensive patients discontinued their antihypertensive medication once their blood pressure returned to normal, as they did not use the medication regularly.

Renal stones were detected in 21 patients (12.2%). Among these, 10 patients with preoperative stones did not undergo surgery, while 5 patients had perioperative (same session) treatment, 2 patients had treatment before surgery, and 2 patients had laser lithotripsy after surgery. Follow-up showed 3-4 mm stones in 2 cases. No statistically significant correlation was found between nephrolithiasis and VUR ($p=0.084$). None of the patients with nephrolithiasis developed hypertension.

Postoperatively, drainage with a double-J catheter was performed in 7 patients due to temporary obstruction. The average age of these 6 patients was 13 months, and one patient was 13 years old. Additionally, 5 patients underwent reoperation due to persistent obstruction in postoperative follow-up (4 patients had an average age of 5 months, and one patient was 17 years old). In the 12 patients who underwent reoperation due to temporary or persistent obstruction after pyeloplasty, none developed hypertension during their follow-up.

The characteristics of the patients who developed hypertension after pyeloplasty are shown in **Table 2**. All 5 patients who developed hypertension had intrinsic obstruction as the etiology and underwent pyeloplasty. None of these patients required reoperation after their initial surgeries for UPJO. During follow-up, kidney function values (creatinine, urea) remained normal, and no proteinuria was detected in urine samples. After 24-hour blood pressure holter monitoring, 2 patients with high blood pressure values required antihypertensive medication. Only one of these patients was obese and had a high renal Doppler resistance index. However, hypertension improved with weight control in the obese patient.

Table 1. Summary of patient demographic characteristics

Characteristic	All patients	HT patients
Gender	Female: 4, male: 121	Female: 3, male: 2
Average age (months)	44.5 (± 43.3)	46.4
Age groups	<1 year: 74, ≥ 1 year: 101	<1 year: 2, ≥ 1 year: 3
Side	Right: 58, left: 109, bilateral: 4	Right: 4, left: 1
Reason for application	AHN: 90, Pain: 64, UTI history: 21	AHN: 4
Preoperative nephrostomy	11	2
Cause	Intrinsic: 154, vascular compression: 21	Intrinsic: 5
Renal function percentage (%)	<20: 13, 21-40: 88, 41-55: 68, >55: 6	<20: 0, 21-40: 2, 41-55: 3
VUR	11 (9 same side, 2 opposite side)	2 (opposite side)
Stone association (pre/postoperative)	19/2	-
Other renal atrophy	2	1
Postoperative renal function increase	2.31%	1.2%
Additional diseases	Cardiac: 4, thyroid: 4, neurological: 6, hematological: 3	Cardiac: 1, neurological: 1
Continuation of postoperative UPJO		
Temporary stenosis	7	-
Permanent stenosis- reoperated	5	-
None	163	5
Follow-up duration (years)	6.7	5.6

Abbreviations: AHN: Antenatal hydronephrosis, VUR: Vesicoureteral reflux, UTI: Urinary tract infection, HT: Hypertension, UPJO: Ureteropelvic junction obstructions

**Table 2.** Summary of characteristics of hypertensive patients

Parameter	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
Gender	Male	Male	Male	Female	Female
Age (months)	20 days	13 months	10 years	10 months	28 months
Antenatal hydronephrosis	Yes	Yes	No	Yes	Yes
Reason for preoperative referral	AHN	AHN	UTI	AHN	AHN
Co-morbidity	Left MCDR PUV	-	-	Right ectopic renal Right UVJO	Castello syndrome Cardiomyopathy Cerebral dysfunction
Preoperative nephrostomy	Yes	No	Yes	No	No
VUR	No	Left Grade 2 (STING)	No	Left Grade 2 (STING)	No
Postoperative HT development time (years)	1 month	Temporary, 3 years	Temporary, 4 years	Temporary, 5 years	2 years
Blood pressure	High	Normal	Normal	Normal	High
MAG-3 DRF (preop- postop)	50-50%	50-53%	36-37%	34-35%	47-48%
Renin (N: 0.5-5.8) value	1.4 (N)	3.5 (N)	15.73 (High)	1.42 (N)	6.8 (High)
Aldesteron value	25 (N)	21 (N)	31.6 (N)	34 (N)	23 (N)
Blood lipid values	N	N	N	T-Col 158, TG 42, HDL-Col 52	N
Obesity	-	-	-	obesity (+)	-
Renal Doppler RI value	Normal	Normal	Normal	Left 0.84 (high)	Normal
Antihypertensive drug used and duration	Capril (1 year)	-	-	-	Amlodipine, dideral (5 years)
Follow-up duration (years)	6	4	5	6	7

Abbreviations: MCDR: Multicystic dysplastic renal, PCN: Percutaneous nephrostomy, VUR: Vesicoureteral reflux, STING: Subureteric injection, UVJO: Ureterovesical junction obstruction, PUV: Posterior urethral valv, MPS: Muco-polysaccharidosis, AHN: Antenatal hydronephrosis, DRF: Differential renal function on scintigraphy, HT: Hypertension, UTI: Urinary tract infection, Preop: Preoperative, Postop: Postoperative

DISCUSSION

Hypertension is a major risk factor for heart, brain, and vascular diseases in older ages, with roots extending back to childhood. However, the prevalence of hypertension in childhood is lower than in adults (1-2%).¹ The causes of hypertension vary with age. Congenital kidney diseases or cardiovascular factors are leading causes of hypertension in infants and young children. In older children, renal parenchymal diseases, such as reflux nephropathy and chronic glomerulonephritis, are more common.² In adolescents, the most frequent cause is primary hypertension. Reflux nephropathy, commonly seen in children, is an important factor in the development of hypertension, with hypertension observed in about 5% of cases.³ In our study, 5 patients (2.9%) who underwent pyeloplasty due to UPJO developed hypertension after an average of 3.5 years. This rate is higher than the general prevalence of hypertension in children, but lower than the rate seen in reflux nephropathy induced hypertension.

The exact cause of hypertension after pyeloplasty due to UPJO is not yet fully understood. In human and animal models, mechanisms such as the renin-angiotensin system (RAAS), oxidative stress, nitric oxide synthesis disorders, and renal sympathetic activity have been shown.⁴ Animal studies have demonstrated that hypertension resolves with the removal of obstruction, and this is salt-dependent.⁵ In human studies, it has been shown that hypertension resolves when obstruction is treated or when the damaged kidney is removed.⁶ Since there may be several factors contributing to the development of hypertension in UPJO, close monitoring for hypertension after pyeloplasty is important.

There is no established guideline for the ideal follow-up duration for pediatric pyeloplasty. The follow-up period varies due to the absence of standard guidelines and is dependent on physician preference.⁷ In our study, 167 patients were followed

for an average of 6.7 years. Psooy et al.⁷ reported that the likelihood of secondary narrowing was low in children with a non-obstructive renogram after 1-year postoperative follow-up. In our study, 5 patients (2.9%) had reoperation prevented in the first postoperative year, and 7 patients had their obstruction prevented for 3 months with ureteral catheter placement. No hypertension developed in these patients during follow-up.

UPJO can block the flow of urine from the kidney, leading to hydronephrosis and potentially hypertension.⁸ Secondary hypertension, including sodium renal hypertension, is associated with increased activity of renin-angiotensin-aldosterone system (RAAS), which leads to increased vascular resistance, abnormal renal autoregulation and water retention.⁹ Case reports have shown increased renin levels in the plasma of hypertensive hydronephrotic patients. The degree of RAAS activation appears to be influenced by the duration of obstruction, the presence of a contralateral normal kidney, and other intrarenal factors. Plasma renin activity is high in renal parenchymal and vascular diseases, but it can be low in some disease groups (low-renin hypertension). In cases of hypertension associated with UPJO, plasma renin activity may not always be elevated.¹⁰ The value of this test is limited by factors such as salt intake, antihypertensive medications, and the laboratory's technical capacity. In our study, only two patients had elevated renin levels. One of these patients was a 10-year-old who underwent preoperative percutaneous nephrostomy for intrinsic UPJO, and the other had an additional cardiac disorder. Patients with heart anomalies should be closely monitored for hypertension. Two of the 11 patients who underwent preoperative percutaneous nephrostomy due to advanced hydronephrosis and later pyeloplasty developed hypertension. Preoperative percutaneous nephrostomy may contribute to changes in renal pelvis diameter, oxidative stress, and alterations in the renin-angiotensin system. Similarly, in patients with multicystic dysplastic kidney (MCDK), renin-



mediated hypertension is believed to develop due to RAAS activation caused by the dysplastic kidney.⁶

In patients undergoing pyeloplasty due to UPJO, the high renal Doppler resistance index (RI) in the preoperative period normalized after the obstruction was corrected.¹¹ In our study, a high renal Doppler RI index was observed in an obese patient. However, no antihypertensive treatment was needed, and hypertension improved with weight control.

Proteinuria can be an important indicator of the severity and prognosis of underlying kidney disease.⁹ In our study, no proteinuria was observed in patients who underwent pyeloplasty for UPJO, even with temporary or persistent hypertension after the obstruction was removed. The absence of proteinuria suggests that early pyeloplasty may help prevent glomerular damage.

The severity of UPJO may lead to renal dysfunction, urinary tract infections, nephrolithiasis, and rarely hypertension. To prevent these long-term complications and preserve kidney function, surgical correction of UPJO is necessary.¹² In cases with unilateral UPJO, the development of hypertension may be associated with chronic renal disease. In children, UPJO complications can be prevented with early surgical intervention.¹³

CONCLUSION

In patients where preoperative renal decompression was achieved with percutaneous nephrostomy, the hypertension rate was higher than in other UPJO patients (2/11). In conclusion, blood pressure should be carefully monitored during the postoperative period in patients who undergo pyeloplasty due to UPJO. Hypertension may develop years later, and it should be taken into consideration. Pyeloplasty should be performed early, before obstruction progresses and glomerular damage occurs. In patients with a history of preoperative percutaneous nephrostomy and advanced hydronephrosis, blood pressure should be closely monitored after surgery.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was conducted with the permission of the Clinical Researches Ethics Committee of Ankara City Hospital No. 1 (Date: 14.05.2020, Decision No: E1-20-592).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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