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OUTCOMES OF PRIMARY VALVE ABLATION VERSUS URINARY TRACT DIVERSION IN PATIENTS WITH POSTERIOR URETHRAL VALVES

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ABSTRACT

Objectives. Although valve ablation is the treatment of choice for patients with posterior urethral valves, debate continues as to the role of urinary diversion. We sought to retrospectively compare the clinical and radiologic outcomes between valve ablation and urinary diversion for patients with posterior urethral valves.

Methods. We retrospectively reviewed the records of 50 consecutive patients with posterior urethral valves since January 1995. On the basis of the initial renal function and radiologic findings, patients were divided into three groups: group 1, normal renal function and radiologically normal upper tracts; group 2, normal renal function with hydronephrosis and/or reflux; and group 3, azotemia with hydronephrosis or reflux.

Results. All 22 patients in group 1 were treated with valve ablation. After a mean follow-up of 32 months, these children had normal renal function and no evidence of upper tract deterioration. All 13 patients in group 2 were also treated with valve ablation. The radiologic abnormalities (hydronephrosis, reflux) resolved in 50% of cases, with an average follow-up of 28 months. Of the 15 patients in group 3, 7 underwent valve ablation and 8 underwent urinary diversion. Urinary diversion was performed in patients with renal deterioration and severe hydronephrosis and/or high-grade reflux. Renal function returned to normal in all patients who underwent valve ablation except one; renal function returned to normal in only 3 of 8 patients who underwent urinary diversion. Radiologically, the severity of the hydronephrosis and reflux was downgraded in patients who underwent valve ablation but not in the diverted group.

Conclusions. Valve ablation is the mainstay of treatment for patients with posterior urethral valves. Prenatal and postnatal factors, such as renal dysplasia and urinary tract infection, respectively, rather than the posterior valve treatment dictate the long-term renal and radiologic outcomes. UROLOGY **56:** 653–657, 2000. © 2000, Elsevier Science Inc.

The most common cause of obstructive uropathy leading to childhood renal failure is posterior urethral valves (PUV). According to the North American Pediatric Renal Transplant Cooperative Group, end-stage renal disease secondary to PUV accounts for 16.8% of children with end-stage renal disease.[1] The incidence of PUV is 1 in 5000 to 8000 infant boys.[2] Primary valve ablation with observation is considered the preferred management option in patients with improved serum creatinine levels after the initial catheter drainage of the bladder. Controversy still exists as to the role of urinary diversion (ie, vesicostomy, pyelostomy) in patients with continued elevated serum creatinine levels.

We conducted a study of 50 consecutive patients with PUV, in whom the planned treatment was primary valve ablation, to compare the outcome of primary valve ablation versus urinary diversion. However, we recognized a number of circumstances in which factors, in addition to the primary bladder outlet obstruction, led us to perform either primary or secondary diversion. We have enumerated and defined these extraneous factors.

MATERIAL AND METHODS

The records of 50 consecutive children with the diagnosis of PUV between January 1995 and April 1998 were reviewed. Inclusion criteria included children diagnosed with PUV on

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Submitted: April 10, 2000, accepted (with revisions): June 15, 2000

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0090-4295/00/$20.00
PII S0090-4295(00)00784-6

the basis of voiding cystourethrographic and cystoscopic findings. These patients were treated prospectively, with an attempt to confine the surgical therapy to valve ablation alone. Despite our desire to pursue valve ablation alone, we saw two groups of infants in whom we believed vesicostomy was indicated: (a) infants in whom a scope could not be introduced, and (b) children born with a vesicoamniotic shunt, in whom a vesicostomy was created to provide unequivocal bladder drainage and absolve the very anxious parents of any uncertainty.

Infants presenting at birth and those with urosepsis were treated with initial bladder drainage followed by valve ablation. The data collected included patient age, clinical presentation, prenatal diagnosis, radiologic studies, and serum creatinine levels. Children who required dialysis were considered to have end-stage renal disease. Children with elevated serum creatinine were considered to have chronic renal insufficiency. The grading of the hydronephrosis was based on the Society of Fetal Urology grading system[3]: grade I, mild splitting of the pelvis; grade II, evident splitting and dilation of the renal pelvis; grade III, dilated pelvis and calices; and grade IV, dilated pelvis and calices and parenchymal thinning. The grading of reflux was based on the International Reflux Grading System.[4] Valve ablation was performed using one of two methods: electrocautery or cold knife under direct vision. Vesicostomy was performed using the Blocksom technique.[5] Pyelostomies were performed through a dorsal lumbotomy incision, and simultaneous renal biopsy was performed.

Patients were divided into three groups according to their initial renal function and radiologic findings. Group 1 included 22 patients (44% of total) who presented with normal serum creatinine levels and normal radiographic findings other than the presence of a valve and/or bladder trabeculations (ultrasound, voiding cystourethrogram). Group 2 included 13 patients (26% of total) who presented with normal serum creatinine levels and abnormal ultrasound findings (hydronephrosis, echogenic kidneys) and reflux on the voiding cystourethrogram. Group 3 consisted of 15 patients (30% of total) who presented with elevated serum creatinine levels (mean 1.9 mg/dL) and an abnormal ultrasound and/or reflux on the voiding cystourethrogram. The renal outcome and degree of improvement in the radiologic abnormalities were evaluated in all three groups.

RESULTS

The median age at presentation was 7 months (range 1 day to 13 years). Sixteen patients (32%) were younger than 1 month old. Of these, 12 were diagnosed antenatally and the remaining 4 patients presented with urinary tract infections. Twelve patients (24%) presented between the age of 1 month and 1 year. Of these, 11 presented with urinary tract infections and 1 with failure to thrive. Six patients (12%) presented between 1 and 5 years of age, three with nonspecific complaints such as vomiting and abdominal pain, two with urinary tract infections, and one with voiding dysfunction. Sixteen patients (32%) were older than 5 years at presentation. Of these, 11 patients presented with voiding dysfunction and 5 with urinary tract infections.

Of the 50 patients, 44 underwent valve ablation, 4 primary temporary urinary diversion with vesicostomy (1 because of a vesicoamniotic shunt inserted in utero, 1 because of a low birth weight, 1 because of anuria and intractable sepsis, and 1 because of elevated creatinine levels with high-grade hydronephrosis and reflux), and 2 patients underwent pyelostomy and renal biopsy (1 because of a vesicoamniotic shunt and 1 because of end-stage renal disease and anuria). Of the 44 patients who underwent primary valve ablation, 2 required secondary temporary urinary diversion through a vesicostomy at 6 and 8 months of age, because of unrelenting sepsis, despite successful valve ablation.

TABLE I. ***Change in the hydronephrosis grade in group 2 before and after valve ablation***

At Presentation		After Valve Ablation	
Hydronephrosis Grade	Renal Units (n)	Hydronephrosis Grade	Renal Units (n)
I	9	0	7
		I	2
II	4	0	3
		I	1
III	4	0	1
		II	2
		III	1
IV	4	II	2
		III	1
		IV	1

The 22 patients in group 1 (normal serum creatinine levels and normal radiologic findings at presentation) were treated with valve ablation. The median age was 6.7 years. All patients had normal creatinine levels and normal radiologic findings at last follow-up (mean follow-up 32 months).

The 13 patients in group 2 (normal creatinine levels and abnormal radiologic findings) were treated by valve ablation alone. The median age was 2.8 years and the mean follow-up 28 months. Hydronephrosis was present in 21 renal units and resolved in 50% of the renal units. The grades of hydronephrosis initially and at last follow-up are shown in Table I. Reflux was present in 17 renal units and resolved in 50% of the renal units. The grades of reflux initially and at last follow-up are shown in Table II.

The 15 patients in group 3 (elevated serum creatinine levels and abnormal radiologic findings) were treated as follows: 7 patients underwent valve ablation, 6 primary temporary urinary diversion (vesicostomy, n = 4; pyelostomy, n = 2), and 2 patients underwent secondary urinary diversion through the vesicostomy after valve ablation. The median age was 4 months, and the mean creatinine

TABLE II. *Change in the reflux grade in group 2 before and after valve ablation*

At Presentation		After Valve Ablation	
Reflux Grade	Renal Units (n)	Reflux Grade	Renal Units (n)
I	3	0	3
II	5	0	5
III	3	0	1
		II	2
IV	5	I	1
		II	2
		III	1
		IV	1
V	1	IV	1

TABLE III. *Change in the hydronephrosis grade in patients in group 3 treated with valve ablation only before and after valve ablation*

At Presentation		After Valve Ablation	
Hydronephrosis Grade	Renal Units (n)	Hydronephrosis Grade	Renal Units (n)
II	2	0	1
		I	1
III	7	0	1
		II	1
		III	3
		IV	2
IV	3	III	2
		IV	1

TABLE IV. *Change in the reflux grade in patients in group 3 treated with valve ablation only before and after valve ablation*

At Presentation		After Valve Ablation	
Reflux Grade	Renal Units (n)	Reflux Grade	Renal Units (n)
III	2	0	1
		II	1
IV	2	III	1
		IV	1
V	4	II	2
		III	1
		V	1

TABLE V. *Change in the hydronephrosis grade in patients in group 3 treated with primary urinary diversion before and after diversion*

At Presentation		After Urinary Diversion	
Hydronephrosis Grade	Renal Units (n)	Hydronephrosis Grade	Renal Units (n)
I	1	0	1
II	4	II	4
III	7	II	3
		III	4
IV	4	IV	4

level at presentation was 1.9 mg/dL. The serum creatinine level returned to normal in 6 of the 7 patients in group 3 treated with valve ablation alone (mean follow-up 22 months). One patient had renal insufficiency with a serum creatinine level of 1.5 mg/dL at last follow-up. Hydronephrosis was present in 12 renal units and resolved in 17% of the renal units. The grades of hydronephrosis initially and at last follow-up are shown in Table III. Reflux was present in eight renal units and resolved in 12% of the renal units. The grades of reflux initially and at last follow-up are shown in Table IV.

The outcomes of the 6 patients in group 3 who underwent primary urinary diversion were as follows. Two patients (1 shunted antenatally and 1 with a low birth weight) had normal renal function with normal serum creatinine levels at last follow-up. Two patients (1 with anuria and 1 with an elevated serum creatinine level) had renal insufficiency. One patient who was shunted antenatally underwent a pyelostomy and renal biopsy, which revealed renal dysplasia. No improvement occurred in renal function, and the boy underwent a living-related transplantation. One patient who underwent pyelostomy (anuria and renal failure) died secondary to the renal failure.

The renal function of the 2 patients with unrelenting sepsis who underwent secondary urinary diversion after initial valve ablation improved after diversion. One patient had normal creatinine levels and the other patient (renal failure) stopped dialysis 11 months after diversion and had renal insufficiency (serum creatinine 1.3 mg/mL) at last follow-up.

The mean follow-up for patients who underwent urinary diversion was 28 months. Hydronephrosis was present in 16 renal units and resolved in 6%. The grades of hydronephrosis initially and at last follow-up are shown in Table V. Reflux was present in nine renal units; no resolution occurred in any of the renal units. The grades of reflux initially and at last follow-up are shown in Table VI.

TABLE VI. ***Change in the reflux grade in patients in group 3 treated with urinary diversion before and after diversion***

At Presentation		After Urinary Diversion	
Reflux Grade	Renal Units (n)	Reflux Grade	Renal Units (n)
III	1	IV	1
IV	2	IV	2
V	6	V	6

COMMENT

PUV are the most common cause of intravesical obstruction in males. Historically, the treatment was bladder decompression with a bladder catheter and then sequential renal function assessment. Patients who did not respond to the initial bladder drainage with a decrease in creatinine of 10% daily to a nadir of less than 0.8 mg/dL by day 5 were treated with high urinary diversion.[6,7] The role of urinary diversion in patients with PUV has been questioned,[8–11] and it was thought that the renal function in these patients was not influenced by the initial therapy. Proponents of high urinary diversion believe that by draining the pelvicaliceal system, the renal function improves temporarily, thus delaying the need for transplantation. Those against upper tract diversion state that these patients are born with renal dysplasia and are prone to progressive renal failure, irrespective of the treatment at presentation. The renal dysplasia is secondary to abnormal caudal budding of the ureter from the mesonephric duct with subsequent abnormal induction of the mesenchyme.[12] This finding was consistent with the findings of our study, in which both of the patients with renal failure and uremia had echogenic kidneys on ultrasound and renal dysplasia on biopsy.

In an attempt to define the role of urinary diversion, Close *et al.*[11] compared the bladder and renal recovery of patients after valve ablation and urinary diversion. They concluded that proximal urinary diversion is not warranted, because it rarely affects the final outcome.[11] In our study, the renal outcome was independent of the treatment; urinary diversion to salvage renal function in 5 patients (two after valve ablation and three after urinary diversion) improved the function in 1 patient with unrelenting sepsis after initial valve ablation. The pyelostomy in this patient was the last option after maximal medical management for sepsis.

Tietjen *et al.*,[9] who performed kidney biopsies on all patients after upper tract diversion, reported that 42% of their patients developed end-stage renal disease or renal insufficiency at a median follow-up of 9 years. They doubted the benefits of upper tract diversion. Our study also found that upper tract diversion is ineffective in improving renal function. On the other hand, we believe that secondary vesicostomy in a select group of patients with unrelenting sepsis may stabilize the renal function and possibly delay the onset of dialysis, being an end treatment for otherwise refractory urinary sepsis and stasis. Dialysis was stopped in one of our patients after performing the vesicostomy, but we believe this patient will develop renal deterioration with further somatic growth.

In a study evaluating the prognostic value of serum creatinine levels at the initial treatment, Denes *et al.*[13] believed that some patients with creatinine levels greater than 0.8 mg/mL after catheterization might benefit from early high diversion. In our study, 15 patients presented with elevated creatinine levels; 9 of these patients had normal creatinine levels at last follow-up. Three of these 9 patients were treated with vesicostomy; the other 6 patients underwent valve ablation only. We recommend waiting for longer than 7 days to allow the creatinine level to return to baseline and considering performing delayed vesicostomy in those patients with unrelenting sepsis.

Patients treated only with valve ablation had a 50% improvement rate in both hydronephrosis and reflux. On the other hand, no improvement occurred in those patients who underwent diversion; this may reflect more severe bladder abnormalities leading to severe upper tract changes, with a higher incidence of renal insufficiency.[11] Smith and colleagues[10] found that patients treated with primary valve ablation did not need bladder augmentation, as opposed to those treated with urinary diversion. This again indicates that patients who underwent diversion had more severe bladder abnormalities and upper tract changes.

CONCLUSIONS

Prenatal and postnatal factors, such as dysplasia and urinary tract infection, respectively, rather than treatment for PUV dictate the long-term renal and radiologic outcomes. Primary valve ablation in these patients may achieve the primary goal of nephron preservation; however, urinary diversion performed in children with severe upper tract deterioration did not improve the final outcome of these patients. Urinary diversion (vesicostomy) may be indicated in patients with unrelenting urosepsis refractory to all treatment and in those with a very small urethral caliber. We have identified another group of patients, those who have undergone antenatal bladder diversion, in whom temporary vesicostomy may be beneficial postnatal treatment.

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EDITORIAL COMMENT

It is difficult to compare the data in this report with that of others because of the wide interpretation of PUV as defined by the authors on radiologic and laboratory studies. I have a much tighter definition of PUV that includes elevated serum creatinine, hydronephrosis, and radiologic evidence of the valve on a voiding cystourethrogram. I do accept that some patients with PUV present in childhood with incontinence or urinary tract infections without hydronephrosis or elevated serum creatinine levels, but that number is small.[1] In a recent review of 46 new patients whom I saw between 1990 and 1999, 33 (71%) had all three criteria compared with the 30% in group 3 of the present paper.

Are we talking about the same population of patients? I think only in part. I believe that the authors may have been too liberal in their diagnosis and may well have included normal boys, boys with urethral sphincter dyssnergia, and some with PUV in the 44% that comprise group 1. By their definition, it is possible to include boys solely on the basis of bladder trabeculation, a definition I cannot accept.

The controversy about "minimal" valves continues, but is not resolved by this report. Neither does it allow us to reach a conclusion about the role of diversion in this complex group of patients.

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PII S0090-4295(00)00785-8

REPLY BY THE AUTHORS

We thank Dr. Walker for these comments, and we would like to clarify a few points. We disagree with the tighter definition of PUV, because the diagnosis of this entity is not always associated with elevated creatinine or hydronephrosis. Also, this tighter definition could account for the discrepancy between our results and that of Bomalski *et al*[1] (30% versus 71%). Although the controversy about "minimal" valves continues, we did not address this issue in our report.

Also, we would like to stress that we used both the radiologic evidence of PUV on the voiding cystourethrograms and cystoscopic evidence to diagnose PUV in our analysis to avoid including boys with urethral dyssynergia or normal boys. Both the radiologic and the endoscopic definitions of PUV may be open to overinterpretation, and for this reason we have used both.

Furthermore, we believe that to reach a conclusion about the role of diversion in group 3, prospective randomized studies are needed to compare the outcomes between diversion and valve ablation.

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PII S0090-4295(00)00786-X