Lower Urinary Tract Symptoms in Children and Adolescents With Chronic Renal Failure

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Abbreviations and Acronyms

BD = bladder dysfunction
BSA = body surface area
CRF = chronic renal failure
ED = emptying dysfunction
GFR = glomerular filtration rate
LUTS = lower urinary tract symptoms
UTI = urinary tract infection
VUR = vesicoureteral reflux

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Purpose: Lower urinary tract symptoms are common in children after renal transplantation. However, it is unclear whether lower urinary tract symptoms are present before transplantation or appear postoperatively. We sought to evaluate bladder function in children before renal transplantation.
Materials and Methods: A total of 40 children 5 to 18 years old with a glomerular filtration rate of less than 50 ml per minute per 1.73 m^2 were consecutively enrolled in the study from 2006 to 2008. Bladder function was assessed by a comprehensive history, bladder diary, uroflowmetry and bladder ultrasound.
Results: Of the patients 20% suffered from incontinence, 47.5% had bladder capacity larger than expected for age, 20% had discontinuous flow and 15% had residual urine 20 ml or greater. Signs consistent with bladder dysfunction (incontinence, abnormal bladder capacity, discontinuous urinary flow and/or residual urine) were observed in 13 of 13 children (100%) with urological disorders and 16 of 27 (59%) with nonurological disorders. Polyuria was present in 39% of the patients. Prior febrile urinary tract infection was significantly more common in children with vs without signs of bladder dysfunction.
Conclusions: Lower urinary tract symptoms are common in children with chronic renal failure. Screening for bladder dysfunction is important not only in children with urological disorders, but also in those with nonurological disorders, so that dysfunction can be corrected before transplantation.

Key Words: child; kidney failure, chronic; kidney transplantation; urination disorders; urologic diseases

We previously reported that lower urinary tract symptoms are common in children after renal transplantation,[1] and our results have been supported by others.[2] Although more common in children with underlying urological disorders, lower urinary tract symptoms are, somewhat surprisingly, also common in children with nonurological disorders. Since there is a correlation between lower urinary tract symptoms and urinary tract infections,[3,4] and since recurrent urinary tract infections after renal transplantation are known to accelerate deterioration of graft function,[5,6] we sought to determine whether lower urinary tract symptoms were present before transplantation or if they appeared postoperatively.

LUTS may indicate bladder dysfunction, a condition that encompasses a variety of disorders with the common finding that the bladder does not behave as expected during filling and emptying. Bladder dysfunction has been associated with urinary retention, high intravesical pressure, VUR, UTI and renal scar-

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ring.[7] In children with CRF bladder dysfunction caused by urinary tract malformations or neurogenic disorders may accelerate the progression of CRF to end-stage renal failure. Thus, these conditions are the most important underlying cause of bladder dysfunction. However, bladder function can be affected by other factors such as urine output, and developmental and functional disorders.[8,9]

During the first decades of the transplant era patients with chronic renal failure due to urological diseases often were not accepted for transplantation because of the known risk that bladder dysfunction could compromise graft function. Since then, much has improved and several studies have shown that if treated appropriately before transplantation, children with bladder dysfunction achieve patient and graft survival similar to children without bladder dysfunction.[10–14] These studies have focused mainly on children with bladder dysfunction caused by anatomical disorders (posterior urethral valves, prune belly syndrome, VUR) and neurogenic disorders affecting the urinary tract, often referred to as urological disorders. Less is known about bladder function in children with chronic renal failure caused by nonurological disorders, a group of patients who generally do not undergo evaluation of the lower urinary tract before transplantation.

The aim of this study was to evaluate LUTS in children with chronic renal failure before renal transplantation, and to compare children with urological and nonurological disorders. Additionally we present data on urinary tract infections and urinary output.

MATERIALS AND METHODS

This study was approved by the local ethics committee. Children's Hospital is a referral center for children with CRF. The center treats children from the middle and northern parts of Sweden (approximately two-thirds of the population). All children presenting to our clinic between March 2006 and March 2008 with a GFR of 50 ml per minute per 1.73 m^2 or less were consecutively enrolled in the study and evaluated for lower urinary tract dysfunction before entering the local transplant program. Patients younger than 5 years without bladder control, those with urological diversion and those who did not understand instructions were excluded from the study. A total of 27 boys and 13 girls met inclusion criteria. Mean age at study enrollment was 11.6 years (boys 11.2, girls 12.4).

Causes of renal failure were posterior urethral valves (5 patients), VUR/hydronephrosis with or without multicystic dysplasia (7), neurogenic bladder (1), noncystic dysplasia/hypoplasia (5), nephronophthisis/glomerulocystic disease (4), polycystic kidney disease (4), atypical hemolytic uremic syndrome (2), glomerulonephritis (3), metabolic disease (2), interstitial nephritis (2), oligomeganephronia (1), nephrotic syndrome (1), neonatal ischemia (1) and terminal renal failure of unknown cause (2). These conditions were further classified as urological disorders (posterior ureteral valves, VUR/hydronephrosis without or without multicystic dysplasia and neurogenic bladder in 13 patients) or nonurological disorders (other in 27).

Bladder function was assessed by a comprehensive history (for voiding habits), a bladder diary (frequency-volume chart), uroflowmetry (for voided volume and voiding pattern) and bladder ultrasound (to detect residual urine).[1] Uroflowmetry (Urodyn® 1000) was repeated twice and the most normal looking curve was used for evaluation. Ultrasound (SSD-500, Aloka, Wallingford, Connecticut) was performed within 5 minutes of uroflowmetry and the smallest residual volume was recorded. Maximal voided volume was estimated from the bladder diary or uroflowmetry measurement. Maximal voided volume was approximated for bladder capacity.

Abnormal bladder capacity was defined as less than 65% or greater than 150% of that expected for age using the formula, 30 + (age in years × 30) ml. Discontinuous urinary flow was defined as a staccato, interrupted or plateau flow pattern. Residual urine was defined as 20 ml or more within 5 minutes after voiding on repeated occasions. Definitions of incontinence, hesitancy and straining were in accordance with the definitions suggested by the International Children's Continence Society.[15] Presence of incontinence, abnormal bladder capacity, discontinuous urinary flow and/or residual urine 20 ml or greater constituted signs of bladder dysfunction. Although not regarded as an abnormal finding, the number of patients with a tower flow pattern was recorded because of the possible association between a tower pattern and bladder overactivity.

GFR was measured by renal clearance of inulin using the standard clearance technique during water diuresis and continuous infusion, or plasma clearance of iohexol using the slope curve.[16] Number, type and timing of previous UTIs were obtained by retrospective analysis of medical records. Urinary tract infection was defined as significant bacteriuria (10^5 cfu/ml or greater) requiring antibacterial therapy for suspected UTI. UTIs associated with fever of 38.5C or greater were referred to as febrile and all others as nonfebrile. Polyuria was defined as urine output of 2,000 ml/m^2 BSA or more per 24 hours and oliguria as less than 300 ml/m^2 BSA per 24 hours.[15]

Patients were categorized and compared in 3 different ways. Those with urological disorders were compared to those with nonurological disorders. Patients with signs of bladder dysfunction (incontinence, discontinuous urinary flow, abnormal bladder capacity for age and/or residual urine on repeated occasions, referred to as BD positive) were compared to those without any of these signs (BD negative). Finally patients with signs of bladder emptying dysfunction (discontinuous urinary flow and/or residual urine on repeated occasions, referred to as ED positive) were compared to those without these signs (ED negative).