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# Hydronephrosis in pediatric kidney transplant: Clinical relevance to graft outcome

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**Abstract** *Objective:* To evaluate our pediatric renal transplant patient population at the Children's Hospital of Pittsburgh to better understand the clinical significance of hydronephrosis.
*Materials and methods:* We retrospectively reviewed records of patients who had received a renal transplant in 1998—2008. Exclusion criteria included multi-organ transplants and allograft failure within 3-months. We determined the incidence of hydronephrosis and compared serum creatinine, incidence of pyelonephritis, rejection and vesicoureteral reflux between the hydronephrotic and non-hydronephrotic cohorts. Data were analyzed using descriptive statistics, Student's *t*-test and Pearson Chi—Square test.
*Results:* 51 patients (35 male, 68.6%) were identified. The mean age at time of transplant was 8.7 ± 5.9 years and the mean follow-up period was 45.2 ± 45.4 months. Common causes of renal failure included posterior urethral valves, renal dysplasia, reflux and prune belly syndrome. Twenty-five (49%) patients developed hydronephrosis. This was associated with worsening renal function ($p = 0.008$). Hydronephrosis was also associated with pyelonephritis ($p = 0.03$) and male gender ($p = 0.004$). Age at transplant may be a predictor of pyelonephritis: median age of 10 patients with pyelonephritis was 4.6 years (range 0.6—19.9 years). Hydronephrotic cohort had increased rate of reflux and rejection; as not all patients underwent voiding cystourethrogram and/or allograft biopsy, this result was not significant.
*Conclusions:* Pediatric renal graft hydronephrosis was correlated with worsening renal function and increased incidence of pyelonephritis. More aggressive preoperative and postoperative urological testing and management should help preserve renal function.


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## Introduction

Pediatric renal transplant recipient and graft survival are excellent with 5-year survival rates of 100% and 80%, respectively (1). Children's Hospital of Pittsburgh is one of the most active pediatric renal transplant centers in the world, and hydronephrosis after renal transplant appears to be a common clinical finding during long-term follow-up. To date, the incidence of hydronephrosis in pediatric transplanted kidneys is not documented in the literature, and thus its clinical significance is unknown. For this reason, we examined the correlation between graft hydronephrosis, renal function, incidence of pyelonephritis, vesicoureteral reflux and rejection in our institution's pediatric kidney transplant population over a 10-year period. This study focuses on the association between allograft hydronephrosis and allograft function.

## Materials and methods

We retrospectively reviewed the medical records of patients who had received kidney transplants at the Children's Hospital of Pittsburgh between May 1998 and May 2008. The following data were recorded: patient demographics, nadir serum glomerular filtration rate (GFR), follow-up GFR (plateau GFR during the follow-up period), rate and severity of hydronephrosis, incidence and severity of reflux evaluated with voiding cystourethrogram (VCUG), rate of rejection determined by allograft biopsy, and incidence of pyelonephritis defined as more than 100,000 bacterial colonies/milliliter, fever and/or elevated white blood cell count. Patient GFR was calculated using the Modification of Diet in Renal Disease formula based on weight, age, serum creatinine (Cr) and ethnicity. Renal ultrasound is routinely done by the transplant service and whenever Cr is elevated. Hydronephrosis is defined as persistent hydronephrosis. This study was approved by our Institutional Review Board. Exclusion criteria included patients with multi-visceral transplants and patients who had lost their grafts within 3 months of transplantation, since graft failure was likely secondary to vascular complications.

All patients received an ABO compatible kidney graft with a negative standard T-cell cross-match. Grafts were harvested in a similar manner, and stored in University of Wisconsin solution. Kidneys were placed extraperitoneally in most patients, and the external iliac artery and vein were typically used for vascular anastomosis. Tunneled ureteral reimplantation was performed if the urology service was involved; otherwise a non-tunneled anastomosis was performed. All renal transplants are done by the transplant service; therefore, urology involvement and follow-up is at the discretion of the transplant service. Most often urology is involved if non-refluxing anastomosis is requested, usually when patients have a diagnosis of posterior urethral valves (PUV) from a referring hospital. Double J ureteral stents were left in situ for 4–6 weeks postoperatively.

Data were analyzed using descriptive statistics. The Student *t*-test was used to evaluate correlation between hydronephrosis, median nadir GFR and follow-up GFR. The Pearson Chi–Square test was used to evaluate association between hydronephrosis, pyelonephritis, rejection, reflux and gender. A $p$-value $<0.05$ was considered statistically significant.

## Results

Table 1 summarizes the characteristics of the hydronephrotic and non-hydronephrotic cohorts. Fifty-one patients were identified (35 male/16 female), of whom 25 (49%) developed hydronephrosis. In accordance with the Society of Fetal Urology (SFU) criteria, grade I hydronephrosis was found in 4 patients (16%), grade II in 9 (36%), and grade III in 7 (28%), and grade IV in 1 patient (4%); films were unobtainable for 4 patients. Mean age at time of transplant was $7.6 \pm 1.3$ years and $9.3 \pm 1.1$ years in the hydronephrotic and non-hydronephrotic cohorts, respectively ($p = 0.24$). The mean follow-up period was $55.0 \pm 55.5$ months and $36.2 \pm 29.1$ months in the hydronephrotic and non-hydronephrotic cohorts, respectively ($p = 0.76$). There were no mortalities. Allograft hydronephrosis developed at a median of 14 months (3–140 months) after transplant. In most cases, hydronephrosis extended to the level of bladder. There was no difference in patient age at time of transplant ($p = 0.24$), type of donor (living versus cadaveric, $p = 0.77$) or type of anastomosis (tunneled vs non-tunneled, $p = 1.0$) between the two cohorts.

Common causes of primary renal diseases include PUV (13), renal dysplasia (6), neurogenic bladder (6), reflux nephropathy ($n = 5$), prune belly syndrome ($n = 4$) and polycystic kidney disease ($n = 3$). Significantly more patients in the hydronephrotic cohort had PUV compared to the non-hydronephrotic cohort (10 vs 3, $p = 0.02$). All patients with PUV were treated with transurethral resection before transplantation. Thirty-five patients (69%) received living-related transplants, whereas the remainder received cadaveric transplants. Transplant donors were similar between the two cohorts ($p = 0.77$). Non-tunneled ureteroneocystostomy was performed in 37 patients (72.5%), while 14 patients had tunneled ureteroneocystostomy (27.5%); the type of anastomosis was similar between the two cohorts ($p = 1.0$). Immunosuppressive medications were also similar, consisting mainly of Prograf and/or Cellcept. Four patients were taking Prograf and prednisone.

Hydronephrosis was associated with worsening allograft function in follow-up: the median follow-up plateau GFR in the hydronephrotic and non-hydronephrotic cohorts was 90 mL/min/1.73 $m^2$ (50–200 mL/min/1.73 $m^2$) and 67.5 mL/min/1.73 $m^2$ (4–120 mL/min/1.73 $m^2$), respectively ($p = 0.008$). The median nadir GFR was not a predictor of future renal function: 104.5 mL/min/1.73 $m^2$ (82–182 mL/min/1.73 $m^2$) and 86 mL/min/1.73 $m^2$ (51–152 mL/min/1.73 $m^2$) in the hydronephrotic and non-hydronephrotic cohorts, respectively ($p = 0.1$). Therefore, nadir GFR did not predict deterioration of allograft function.

Hydronephrosis was correlated with an increased incidence of pyelonephritis: 2 (7.7%) patients in the non-hydronephrotic cohort were diagnosed with pyelonephritis