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Outcome analysis of pediatric pyeloplasty in units with less than 20% differential renal function

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Summary

Objective
This study was conducted to assess ureteropelvic junction obstruction (UPJO) units with differential renal function (DRF) ≤20%, 3 months post-pyeloplasty as well as complications and stability of function in long term follow up.

Material and methods
In this prospective study, children below 12 years age with unilateral UPJO and DRF ≤20% undergoing open Anderson-Hynes dismembered pyeloplasty from 2002–2014 excluding associated vesicoureteric reflux were included. Drainage and function were assessed with isotope [ethylene di-cysteine (EC)] scan at 3 months and later during yearly follow-up as well as by intravenous urography (IVU).

Results
Of a total 744 patients with UPJO in the study period, 112 had DRF ≤20%. Thirty four (30%) underwent percutaneous nephrostomy. Ten with no function underwent nephrectomy. 102 (mean age 4.7 years) with DRF 0–9% ($n = 40$) and 10–20% ($n = 62$) formed the study group. Hypertension (3), small kidney (13) and crossing vessels (9) were associated. Follow up ranged from 1–8 years (4.6 ± 1.34 years). Six patients were lost to follow up. There was significant improvement in drainage in the remaining 96 patients. Mean DRF and IVU function showed highly significant improvement ($p < .001$) in those with clinical signs and symptoms ($n = 85$), compared to asymptomatic patients in preoperative 0–9% and 10–20% group. The mean rise in DRF was significantly more in the preoperative 0–9% group, palpable mass presentation and by age at 5–12 years in the 0–9% group and 1–5 years in the 10–20% group. In the symptomatic group, except for intermittent UTIs ($n = 8$) and pain ($n = 3$) which subsided 1–2 years after surgery, all patients had resolution of initial complaints. Hypertension resolved in two patients with crossing vessels. No patient required re-do pyeloplasty or developed hypertension during followup. There was no significant difference ($p = 1.000$) in mean DRF between 3 month and 1–8 years post-operative scans ($n = 53$).

Conclusions
This study which appears to be the largest in the literature of pediatric UPJO with DRF ≤20%, conclusively shows that there is statistically significant improvement in function after pyeloplasty which remains stable during the period of growth with no long term complications. Nephrectomy should be considered only in patients with nil or <5% uptake on isotope imaging with associated (a) no parenchyma on imaging or on exploration, (b) pyonephrosis, (c) hypertension or (d) minimal urine output on percutaneous nephrostomy.

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Introduction

Functional improvement after pyeloplasty in pediatric ureteropelvic junction obstruction (UPJO) is still debated, especially in poorly functioning kidneys [1,2]. Nephrectomy is often recommended when the differential renal function (DRF) is less than 10% [3,4]. Others have noted abnormal renal biopsy in patients with DRF below 35% with no postoperative improvement [5]. Most studies on poorly functioning kidneys, which incidentally have a variable definition, have very small numbers often not attaining statistical significance [6,7]. We analyzed the post-pyeloplasty outcome in renal units with preoperative DRF $\leq$20% over a 12-year period in prospectively collected data. Our study appears to be the largest such study in children in world literature.

Material and methods

Data of consecutive children with UPJO below 12 years age attending a tertiary referral center from 2002 to 2014 were prospectively collected. The study was approved by the Institute Ethics Committee and parents of all subjects gave informed consent. The study group comprised those with unilateral UPJO and poorly functioning renal units, that is DRF $\leq$20% on an isotope renal scan. UPJO in bilateral units, duplex systems, crossed fused kidneys, and associated vesicoureteral reflux (VUR) were excluded. A voiding cystourethrogram (VCUG) was performed in all infants and in children presenting with urinary tract infection (UTI) or suspicion of hydroureteronephrosis on ultrasonography (USG).

Preoperative blood urea, serum creatinine, urine culture and sensitivity, and blood pressure were recorded. UPJO diagnosis was based on USG of the kidney, ureter, bladder (USG KUB), and obstructed drainage on a standardized ethylene dicysteine (EC) scan with dynamic and static images taken at regular intervals after injection of the radionuclide along with lasix (1.0 mg/kg dose). Intravenous urography (IVU) was also performed after contrast injection; films were taken at standard intervals of 7, 15, and 30 min, 1 h, 2–4 h, and 5, 10, and 15 min post lasix. IVU was studied for (a) drainage (normal: complete drainage by 10 min post lasix); and (b) function, which was scored on the basis of a system devised in the unit to facilitate comparison between preoperative and postoperative films, depending on the first visualization of the pelvicalyceal system (PCS) after contrast injection: 0, non visualized kidney; 1, rim sign or only nephrogram; 2, after 2–4 h or 20 min post lasix; 3, at 1–2 h or 5–10 min post lasix; 4, 30 min; 5, 15 min; and 6, 7 min.

In the presence of very poor uptake on these studies, magnetic resonance urography (MRU) or a percutaneous nephrostomy (PCN) followed by a nephrostogram were performed. In case of insignificant urine output or low osmolality and specific gravity, especially with pyonephrosis and stones, nephrectomy was advised. In others, pyeloplasty was performed within 2–4 weeks once any associated infection had been controlled. In most cases, therefore, a post-PCN EC scan was not performed in view of financial constraints and no obvious benefit to the patient, as our policy in general is to preserve the kidney in UPJO. DRF before PCN was considered for analysis.

All patients underwent open Anderson–Hynes dismembered pyeloplasty as practiced in our unit through the anterior extraperitoneal approach with adequate excision of intrinsically narrow ureters. An EC scan was repeated 3 months later after stent removal. An increase in DRF >5% was considered significant. The regions of interest (ROIs) were specifically marked around the functional renal cortex in each case, avoiding the renal pelvis. Therefore, after pyeloplasty, with improvement in renal function and cortical thickness, this would change accordingly. The background ROI was drawn inferolateral to the kidney ROI, taking care to avoid any vascular structure, ureter, or distended bladder. IVU was also repeated once, as, in our experience, appreciation of improvement in function was better with this imaging. Further follow-up was done in the outpatient department with USG. The results of any further scans and development of complications such as hypertension, UTIs, etc. were noted during the entire study period.

Patients were divided into those with clinical signs and symptoms (palpable mass, pain, UTI) and asymptomatic (antenatal or postnatal USG diagnosis) groups for comparison.

Statistical analysis was performed with the statistical package for social sciences (SPSS 11.5). A p value < 0.05 was considered significant. Preoperative and postoperative EC scans were compared using the Wilcoxon signed rank test and the change in IVU scores with a paired t test. The change in DRF (>5%/0 $\pm$ 5/> minus 5%) was compared in the 0–9% and the 10–20% group using the Pearson chi-square test. EC scans performed at 3 months and later years was compared using one-way ANOVA (within and between groups) and the post hoc Bonferroni test.

Results

Patient details are shown in Fig. 1 and Table 1. Giant hydronephrosis ($n = 12$), intermittent abdominal pain for 2 weeks–4 years (median 6 months) that was dull aching in nature, mostly in the flank and occasionally in the epigastrium ($n = 28$), and hypertension ($n = 3$) were noted. Blood urea ranged from 10 to 68 mg/dL (24.7 $\pm$ 9.04) and serum creatinine from 0.2 to 1.2 mg/dL (0.55 $\pm$ 0.18). This was above the normal range in two infants diagnosed before birth, one of them presenting with a mass. Renal parenchymal thickness on USG ranged from 0.1 to 1.2 cm (mean 0.4 cm). Urine cultures were positive in 25.

Crossing vessels ($n = 9$, 2 with hypertension), anteriorly malrotated kidney (2), entire ureter narrow (9), ureter narrow with corkscrew appearance (2), and very friable pelvis (2) were noted at pyeloplasty. Drainage was by nephrostomy or a double J (DJ) stent based on the anatomy of the PCS and the ureter, and purulent urine etc. Proximal stent migration required lumbotomy ($n = 1$) and ureteroscopy ($n = 1$) for removal. In three patients with a baggy kidney, giant hydronephrosis, and nephrostomy, a DJ stent had to be inserted later.

Follow-up ranged from 1 to 8 years (4.6 $\pm$ 1.34 years). Six patients were lost to follow-up, including three who had