Poor split renal function and age in adult patients with ureteropelvic junction obstruction do not impact functional outcomes of pyeloplasty

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Introduction: *To examine if poor preoperative split renal function (SRF) and age influence pyeloplasty outcomes in adults with ureteropelvic junction obstruction (UPJO).*
Materials and methods: *We retrospectively reviewed our pyeloplasty experience in adults with UPJO from 2004 to 2014. Patients with solitary kidneys or missing renal scans were excluded. Renal scans were performed at 6 weeks, 8 months, and 20-24 months postoperatively. Demographics, operative approaches, and pre and postoperative SRF and diuretic half-times (T1/2) were obtained. Patients were stratified by preoperative SRF (≤ or > 25%) and age. Cox regression analyses were performed to explore predictors for stability or improvement of SRF.*
Results: *A total of 139 patients met the study criteria: 15 and 124 with preoperative SRF ≤ 25% and > 25%, respectively. Median follow up was 11 months, 12.9% of patients experienced worsening, 67.6% stability, and 19.4% improvement in SRF at last follow up. Median change in SRF was similar between groups; however, patients with lower preoperative SRF more frequently experienced improvement or worsening of SRF (p = 0.045). Failure rates (need for additional surgery) were comparable (p = 1.000). No significant differences were observed in SRF dynamicity when stratified by age (p = 0.120). On univariate Cox analysis, older age was predictive of stability or improvement in SRF across the entire cohort (HR 1.013, p = 0.016), while preoperative SRF was not (HR 1.007, p = 0.429).*
Conclusions: *Poor SRF (≤ 25%) and age were not associated with worse outcomes after pyeloplasty for UPJO. Our results suggest that older adults with UPJO and patients with poor ipsilateral SRF should not be excluded from pyeloplasty.*

Key Words: ureteropelvic junction obstruction, pyeloplasty, split renal function, renal recovery

Introduction

Ureteropelvic junction obstruction (UPJO) is among the most common forms of obstruction in the upper urinary tract and may result from congenital or acquired etiologies. Surgical management is indicated for relief of symptoms and/or prevention of complications arising from UPJO, including progressive deterioration of renal function.[1]

The treatment of UPJO in poorly functioning kidneys remains controversial, due to questionable recovery of renal function following relief of obstruction.[2,3] The threshold for what is "poor" split renal function (SRF) is not clearly defined. Investigators have recommended proceeding with nephrectomy in patients with an ipsilateral SRF anywhere from less than 10% to 35%,[4-9] while others have favored renal salvage in all patients, based on subsequent improvements seen in SRF.[10-13] Many of these studies, however, are based on the pediatric population where renal parenchyma regeneration is known to occur.[14,15] Literature concerning renal recovery in adult patients remains scant.[3,8,16]

In the present study we sought to evaluate whether preoperative SRF and age affect surgical outcomes in adults with UPJO treated with pyleoplasty. We secondarily evaluated predictors for worsening or improvement of SRF following pyeloplasty in adults.

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Materials and methods

Patients

Following institutional review board approval, we created a retrospective database of all adult patients (18 years of age or older) who underwent pyeloplasty for UPJO from 2004 to 2014 at a single institution. In each case, UPJO was confirmed radiographically by abdominal computerized tomography, excretory urography, and/or diuretic radionuclide renal scans. Indications for surgery in the majority of patients included the presence of symptoms (flank pain), infection, and/or calculi secondary to urinary stasis, though pyeloplasty was also offered to four patients who were completely asymptomatic yet had decreased SRF. Nine patients with either solitary kidneys (3) or missing pre or postoperative diuretic renography (6) were excluded from analysis. Postoperative renal scans were performed at 6 weeks, 8 months and 20-24 months following surgery. Renal scan interpretation was performed at a single center by multiple radiologists. Patients with a nephrostomy tube in place at the time of preoperative renal scan had their tube capped during renography. Data including demographics, prior surgeries, presence of stent or nephrostomy tube preoperatively, indications, operative approach, pre and postoperative SRF, pre and postoperative diuretic half-time (T1/2), complications, and failure rates (defined as need for additional surgery based on the same indications for initial intervention) were obtained.

Surgical technique

All patients underwent dismembered pyeloplasty via conventional laparoscopic (CLP) or laparoendoscopic single-site (LESS: conventional, C-LESS; robotic-assisted, R-LESS) approaches, as we have described previously.[17-19]

Statistical analysis

Patients were stratified based on preoperative SRF (≤ or > 25%), similar to Gupta et al's selected threshold for poor SRF,[20] as this value reflects relatively half of normal differential renal function. Patients were also stratified by age, with cutoffs of younger (≤ 35 years) versus older (> 35 years) adults similar to those used by Zhang et al,[3] along with additional comparisons at higher age thresholds (25, 45, and 60 years of age). We also performed a parallel 2:1 case-matched analysis with 45 patients matched by age (+/- 10 years), surgery date (+/- 12 months), and prior history of UPJO repair, stratified in a similar fashion by preoperative SRF (15 patients with SRF ≤ 25% and 30 with SRF > 25%). Descriptive data were tabulated and compared using independent-samples Mann-Whitney U and Chi-square tests for continuous and categorical variables, respectively. Cox regression analyses were performed to explore predictive factors for worsening (> 5% decrease), stability, or improvement (> 5% increase) of SRF following pyeloplasty, where 5% thresholds for defining worsening or improvement of SRF are similar to those used previously.[8] Multivariable analysis was not performed if less than two variables were found to be significant on univariable analysis. All statistical analyses were conducted using SPSS version 19.0 (IBM, Armonk, NY, USA). All reported p values are two-sided, with statistical significance defined for $p < 0.05$.

Results

Between 2004 and 2014, 139 patients met the study criteria with a median follow up of 11 months. Median age was 42.3, and 36.0% of patients were male. Majority of patients were symptomatic at presentation with flank pain or nausea/vomiting (94%). Complete patient demographics, baseline descriptive characteristics, and surgical technique are provided in Table 1.

There were 15 and 124 patients with preoperative SRF ≤ 25% and > 25%, respectively. Significantly more males had SRF ≤ 25% (73.3% versus 31.5%, $p = 0.003$) and more patients with SRF > 25% had preoperative urinary tract infection (29.8% versus 0%, $p = 0.011$). There were no other significant differences in demographics, duration of follow up, laterality, prior interventions, surgical approach, preoperative symptoms, or intraoperative details between the two groups, Table 1.

Overall postoperative results are presented in Table 2. The median duration to the most recent renal scan after surgery was 9 months. Median change in absolute SRF was not significantly different between groups stratified by preoperative SRF ($p = 0.121$); however, rates of SRF improvement or worsening were both significantly higher in patients with lower preoperative SRF (40% versus 16.9% improvement, 20% versus 12.1% worsening), while stability in renal function was more prevalent in patients with higher preoperative SRF (71.0% versus 40%), $p = 0.045$. T1/2 was similar between the two groups both pre and postoperatively, with equivalent rates of persistent T1/2 > 20 minutes after pyeloplasty ($p = 0.293$). Failure rates and complication rates were also comparable, Table 2. No significant difference was observed in renal function recovery when stratified by age (≤ or > 35 years, $p = 0.120$).

TABLE 1. **Patient characteristics stratified by baseline split renal function (SRF)**

	Total	**SRF ≤ 25%**	**SRF > 25%**	**p value***
Total patients				
Entire cohort	139	15	124	
2:1 case-matched cohort	45	15	30	
Median age (IQR), yrs.				
Entire cohort	42 (27-56)	38 (23-59)	40 (27-56)	0.789
2:1 case-matched cohort	39 (24-58)	38 (23-59)	39 (24-57)	0.971
Median body mass index (IQR)				
Entire cohort	24.3 (21.7-28.8)	23.8 (21.5-28.9)	25 (21.7-28.8)	0.549
2:1 case-matched cohort	24 (21.6-29.5)	23.8 (21.5-28.9)	25.9 (21.8-31.6)	0.406
Gender (% male)				
Entire cohort	36.0	73.3	31.5	0.003*
2:1 case-matched cohort	53.3	73.3	43.3	0.068
Median follow up (IQR), mos.				
Entire cohort	11 (6-22)	9 (7-27)	11 (6-22)	0.865
2:1 case-matched cohort	18 (9-29)	9 (7-27)	19.5 (10-31)	0.141
Prior abdominal surgeries (%)				
Entire cohort	37.4	33.3	37.9	0.786
2:1 case-matched cohort	40.0	33.3	43.3	0.748
Prior UPJO treatment (%)				
Entire cohort	15.8	26.7	14.5	0.258
2:1 case-matched cohort	26.7	26.7	26.7	1.000
Stent at time of surgery (%)				
Entire cohort	24.5	26.7	24.2	0.761
2:1 case-matched cohort	31.1	26.7	33.3	0.743
PCN at time of surgery (%)				
Entire cohort	24.5	33.3	23.4	0.524
2:1 case-matched cohort	33.3	33.3	33.3	1.000
Duration of stent/PCN preoperatively (mean +/- st. dev.), days				
Entire cohort	41.8 +/- 113	57.2 +/- 92.7	40 +/- 115.4	0.517
2:1 case-matched cohort	80.6 +/- 178.8	57.2 +/- 92.7	92.3 +/- 209.5	0.441
Approach (%)				
Entire cohort	CLP: 54.0 C-LESS: 21.6 R-LESS: 24.4	CLP: 53.3 C-LESS: 26.7 R-LESS: 20.0	CLP: 54.0 C-LESS: 21.0 R-LESS: 25.0	0.844
2:1 case-matched cohort	CLP: 62.2 C-LESS: 20.0 R-LESS: 17.8	CLP: 53.3 C-LESS: 26.7 R-LESS: 20.0	CLP: 66.6 C-LESS: 16.7 R-LESS: 16.7	0.746
Preoperative symptoms (%)				
Entire cohort	93.5	93.3	93.5	1.000
2:1 case-matched cohort	91.1	93.3	90.0	1.000
Preoperative urinary tract infection (%)				
Entire cohort	26.6	0	29.8	0.011*
2:1 case-matched cohort	26.7	0	40.0	0.004*
Preoperative stone (%)				
Entire cohort	18.0	13.3	18.5	1.000
2:1 case-matched cohort	20.0	13.3	23.3	0.695

TABLE 1 (cont.). **Patient characteristics stratified by baseline split renal function (SRF)**

	Total	**SRF ≤ 25%**	**SRF > 25%**	**p value***
Preoperative hematuria (%)				
Entire cohort	4.3	0	4.8	1.000
2:1 case-matched cohort	8.9	0	13.3	0.285
ASA score (%)				
Entire cohort	1: 14.4 2: 75.2 3: 10.4	1: 7.7 2: 69.2 3: 23.1	1: 15.2 2: 75.9 3: 8.9	0.251
2:1 case-matched cohort	1: 10.0 2: 72.5 3: 17.5	1: 7.7 2: 69.2 3: 23.1	1: 11.1 2: 74.1 3: 14.8	0.789
Median operative time (IQR), mins.				
Entire cohort	207 (179.5-238)	204.5 (172.5-238.8)	207 (180.5-238)	0.776
2:1 case-matched cohort	209 (186-245)	204.5 (172.5-238.8)	210 (189-255)	0.353
Median estimated blood loss (IQR), mL				
Entire cohort	50 (27.5-50)	30 (25-50)	50 (30-50)	0.217
2:1 case-matched cohort	50 (25-50)	30 (25-50)	50 (50-62.5)	0.133
Median length of stay (IQR), days				
Entire cohort	2 (2-3)	2 (2-3)	2 (2-3)	0.710
2:1 case-matched cohort	2 (2-3)	2 (2-3)	2 (2-3)	0.450

*independent-samples Mann-Whitney U tests were used to compare continuous variables and Chi-square tests for categorical variables. P values all two-sided with statistical significance defined for p < 0.05 (indicated by asterisk). IQR = interquartile range; PCN = percutaneous nephrostomy; ASA = American Society of Anesthesiologists physical status classification; CLP = conventional laparoscopy, LESS: laparoendoscopic single-site (C-LESS: conventional, R-LESS: robotic-assisted)

On univariate Cox analysis, older age was the only factor predictive of stability or improvement in renal function across the entire cohort (HR 1.013, p = 0.016), as displayed in Table 3. When dichotomized, age > 35 years was significantly more predictive for renal stability or improvement than age ≤ 35 (HR 1.60, p = 0.013), while statistical significance was lost at other age thresholds (age > 25 years, p = 0.072; age > 45 years, p = 0.111; age ≥ 60 years, p = 0.257). Preoperative SRF (HR 1.007, p = 0.429) and T1/2 (HR 1.003, p = 0.444) were not found to be significant predictors across the entire cohort.

In our 2:1 case-matched analysis, preoperative UTI rate was similarly higher in patients with SRF > 25% (p = 0.004), otherwise no significant differences in baseline characteristics were observed between the two groups, Table 1. Median change in absolute SRF was not significantly different between case-matched groups stratified by preoperative SRF (p = 0.177), as shown in Table 2. Rates of SRF improvement, stability, or worsening did not differ between groups (p = 0.280). T1/2 was likewise similar between the two groups both pre and postoperatively. Failure rates and complication rates were also comparable. On univariate Cox analysis, age > 35 years was again predictive for stability or improvement in renal function in the case-matched cohort (p = 0.046), while statistical significance was not achieved for other age thresholds, Table 3. No other significant predictors were found in the case-matched analysis.

Discussion

The treatment of UPJO in poorly functioning kidneys is controversial with nephrectomy often recommended. Stock et al provide a histologic argument in support of this based on a series of 17 consecutive pediatric patients with unilateral UPJO who underwent primary pyeloplasty.[9] They found that patients with SRF < 35% were likely to have significant histologic changes on renal biopsy and limited postoperative improvement in renal function. Accordingly, in a large retrospective review of 116 children who underwent robotic-assisted laparoscopic pyeloplasty for UPJO, Grimsby et al concluded that surgical success rates were significantly higher for patients with preoperative SRF > 30% than those with preoperative SRF < 30% (97% versus 58%, p = 0.0005).[21]

However, there are conflicting reports of renal function recovery following relief of obstruction. In a retrospective analysis of 39 pediatric patients who underwent dismembered pyeloplasty, Bansal et al divided their cohort into patients with moderately impaired SRF (10%-30%) versus severely impaired SRF (< 10%).[2] They reported intermediate-term improvements in mean SRF following surgery in both groups (14.2% increase in moderately impaired SRF group, 13.9% increase in severely impaired SRF group), favoring pyeloplasty in children with poorly functioning kidneys. In another study, Wagner et al divided 32 infants with severe hydronephrosis secondary to UPJO treated with dismembered pyeloplasty into three groups based on preoperative SRF (> 40%, 10%-40%, and < 10%) and found that SRF was more likely to improve in children with reduced SRF, with the greatest degree

TABLE 2. **Pyeloplasty outcomes**

	Total	**SRF ≤ 25%**	**SRF > 25%**	**p value***
Median preoperative SRF (IQR), %				
Entire cohort	41 (32-48)	22 (20-25)	44 (35-48.5)	< 0.001*
2:1 case-matched cohort	34 (25-45.5)	22 (20-25)	41 (33.8-47.3)	< 0.001*
Median postoperative SRF (IQR), %				
Entire cohort	45 (33.5-49)	24 (20-33)	46 (38-49)	< 0.001*
2:1 case-matched cohort	39 (26.3-47.6)	24 (20-33)	46 (34.3-49)	0.001*
Median change in SRF (IQR), %				
Entire cohort	+1 (-2 to +5)	+4 (0 to +12)	+1 (-2 to +4)	0.121
2:1 case-matched cohort	+1 (-2 to +6)	+4 (0 to +12)	0 (-2 to +5)	0.177
Renal recovery				
Entire cohort	Worsened: 12.9 Stable: 67.6 Improved: 19.4	Worsened: 20.0 Stable: 40.0 Improved: 40.0	Worsened: 12.1 Stable: 71.0 Improved: 16.9	0.045*
2:1 case-matched cohort	Worsened: 17.8 Stable: 55.6 Improved: 26.7	Worsened: 20.0 Stable: 40.0 Improved: 40.0	Worsened: 16.7 Stable: 63.3 Improved: 20.0	0.280
Median preoperative T1/2 (IQR), mins.				
Entire cohort	40 (21.5-40)	40 (38.3-40)	32 (20.5-40)	0.212
2:1 case-matched cohort	40 (26.6-40)	40 (38.3-40)	40 (23.5-40)	0.933
Median postoperative T1/2 (IQR), mins.				
Entire cohort	10 (6-15.7)	10 (8.3-15)	10 (6-15.9)	0.613
2:1 case-matched cohort	11 (7.0-21.5)	10 (8.3-15)	11.5 (5.9-28.8)	0.990
Preoperative T1/2 > 20 mins. (%)				
Entire cohort	77.0	80.0	76.6	1.000
2:1 case-matched cohort	80.0	80.0	80.0	1.000
Postoperative T1/2 > 20 mins. (%)				
Entire cohort	17.3	26.7	16.1	0.293
2:1 case-matched cohort	26.7	26.7	26.7	1.000
Postoperative symptoms (%)				
Entire cohort	10.8	6.7	11.3	1.000
2:1 case-matched cohort	11.1	6.7	13.3	0.651
Median duration to last postoperative renal scan (IQR), mos.				
Entire cohort	9 (4-18)	9 (6-19)	9 (3.3-18)	0.598
2:1 case-matched cohort	14.2 (7.5-21)	9 (6-19)	15 (8-21)	0.447
Failure rate (%)				
Entire cohort	9.4	6.7	9.7	1.000
2:1 case-matched cohort	11.1	6.7	13.3	0.651

TABLE 2 (cont.). **Pyeloplasty outcomes**

	Total	**SRF ≤ 25%**	**SRF > 25%**	**p value***
Complication rates per Clavien-Dindo grade (%)				
Entire cohort	Total: 23.0	Total: 13.3	Total: 24.2	0.724
	Grade I: 10.1	Grade I: 6.7	Grade I: 10.5	
	Grade II: 1.4	Grade II: 0	Grade II: 1.6	
	Grade IIIa: 7.2	Grade IIIa: 0	Grade IIIa: 8.1	
	Grade IIIb: 4.3	Grade IIIb: 6.7	Grade IIIb: 4.0	
	Grade IV: 0	Grade IV: 0	Grade IV: 0	
	Grade V: 0	Grade V: 0	Grade V: 0	
2:1 case-matched cohort	Total: 28.9	Total: 13.3	Total: 36.7	0.245
	Grade I: 15.6	Grade I: 6.7	Grade I: 20.0	
	Grade II: 0	Grade II: 0	Grade II: 0	
	Grade IIIa: 8.9	Grade IIIa: 0	Grade IIIa: 13.3	
	Grade IIIb: 4.4	Grade IIIb: 6.7	Grade IIB: 3.3	
	Grade IV: 0	Grade IV: 0	Grade IV: 0	
	Grade V: 0	Grade V: 0	Grade V: 0	

*independent-samples Mann-Whitney U tests were used to compare continuous variables and Chi-square tests for categorical variables. P values all two-sided with statistical significance defined for $p < 0.05$ (indicated by asterisk)

of improvement witnessed in the group of patients with SRF < 10%.[10]

While much of the present literature is based on the pediatric population, in whom renal parenchyma regeneration is known to occur,[14,15] few studies assess the impact of age on renal recovery in adults.[3,8,16] In our study, we found that poor SRF (≤ 25%) preoperatively was not associated with worse renal outcomes after pyeloplasty in adults. In addition, we found that renal function recovery was not significantly different between groups stratified by age. Interestingly, older age was the only factor predictive of stability or improvement in renal function (HR 1.013, $p = 0.016$), and specifically for those patients > 35 years of age. These results suggest that older adult patients with UPJO and those with poor ipsilateral SRF should not necessarily be excluded from undergoing pyeloplasty.

Temporary placement of a percutaneous nephrostomy (PCN) tube in poorly functioning kidneys has been described as a reasonable alternative to immediate pyeloplasty or nephrectomy to determine recoverability of renal function in patients with UPJO. Gupta et al placed PCN tubes in children with UPJO and initial SRF < 10% and repeated renography after 4 weeks of PCN drainage prior to performing nephrectomy (if no improvement seen) or pyeloplasty (if improvement seen).[12] In those who underwent pyeloplasty, SRF remained stable. Similarly, in a retrospective cohort of 53 adult patients with SRF < 10% and UPJO managed initially with PCN drainage prior to surgical treatment, Zhang et al reported improvement of SRF to > 10% in 57% of patients after a mean PCN drainage of 6.6 weeks.[3] The results from these studies suggest that observing the recoverability of obstructed kidneys with a PCN trial may be an effective means by which to stratify patients and determine surgical management. In our cohort, 34 patients (24.4%) had a PCN and 34 (24.4%) had a ureteral stent at the time of surgery, indwelling for a mean duration of 41.8 +/- 113 days, Table 1. Although we did not have SRF data available for comparison before and after PCN/stent placement to assess for functional improvement prior to surgery (we report baseline renal scans immediately prior to surgery), on Cox regression analysis we found that neither the presence of a PCN ($p = 0.510$) or stent ($p = 0.265$), nor the indwelling duration of either ($p = 0.894$) made a difference in functional outcomes, Table 3.

Our study is limited by its retrospective nature, which likely introduced selection bias in our analysis. Renal scans were interpreted by an array of radiologists across a long time interval, which may have introduced heterogeneity with respect to interpretation of imaging. As with other studies,[2,10,21] we had a relatively lower proportion of patients in the poor preoperative SRF group (10.8%) than those in the higher preoperative SRF group (89.2%); however, our series is strengthened by its relatively large overall sample size as compared to several other studies cited herein. Furthermore, to circumvent the skew of patients towards higher SRF, we performed a parallel 2:1 case-matched analysis with 45 patients, which revealed results similar to those for the entire cohort.

TABLE 3. **Univariate Cox regression analysis for predictors of stability or improvement in split renal function (SRF)**

	Entire cohort		**2:1 case-matched cohort**	
Variable	**HR (CI)***	**p value****	**HR (CI)***	**p value****
Age (continuous)	1.01 (1.00-1.02)	0.016**	1.02 (1.00-1.03)	0.088
Age > 25 years	1.49 (0.97-2.31)	0.072	1.89 (0.88-4.05)	0.102
Age > 35 years	1.60 (1.11-2.33)	0.013**	2.06 (1.01-4.18)	0.046**
Age > 45 years	1.35 (0.93-1.94)	0.111	1.45 (0.74-2.83)	0.275
Age > 60 years	1.33 (0.81-2.17)	0.257	1.09 (0.45-2.66)	0.846
Male gender	0.76 (0.52-1.12)	0.165	0.64 (0.33-1.27)	0.204
Body mass index	1.00 (0.97-1.04)	0.889	0.99 (0.92-1.06)	0.763
Prior abdominal surgery	1.03 (0.71-1.49)	0.878	1.13 (0.58-2.21)	0.719
Prior UPJO treatment	0.86 (0.53-1.39)	0.528	1.15 (0.55-2.41)	0.704
Stent at the time of surgery	0.79 (0.52-1.19)	0.265	0.80 (0.40-1.60)	0.521
PCN at the time of surgery	0.87 (0.58-1.31)	0.510	1.44 (0.73-2.85)	0.292
Duration of stent/PCN preoperatively	1.00 (1.00-1.00)	0.894	1.00 (1.00-1.00)	0.243
Preoperative symptoms	1.10 (0.51-2.38)	0.803	0.92 (0.32-2.65)	0.872
Preoperative UTI	0.96 (0.64-1.46)	0.864	1.11 (0.52-2.36)	0.781
Preoperative stone	0.80 (0.51-1.26)	0.328	0.93 (0.42-2.09)	0.867
Preoperative hematuria	0.78 (0.34-1.78)	0.548	1.05 (0.37-3.01)	0.922
ASA score	1: Ref. 2: 0.74 (0.44-1.26) 3: 1.81 (0.87-3.77)	1: Ref. 2: 0.268 3: 0.115	1: Ref. 2: 0.48 (0.16-1.45) 3: 1.91 (0.54-6.74)	1: Ref. 2: 0.191 3: 0.316
Intraoperative time	1.00 (1.00-1.01)	0.548	1.00 (0.99-1.01)	0.788
Eestimated blood loss	1.00 (0.99-1.00)	0.301	1.00 (0.98-1.02)	0.934
Preoperative SRF > 25%	1.75 (0.92-3.33)	0.087	1.31 (0.60-2.86)	0.503
Preoperative T1/2 > 20 mins.	1.52 (0.98-2.35)	0.059	1.67 (0.68-4.11)	0.265

*HR = hazard ratio; CI = confidence interval (95%)
**statistical significance defined for p < 0.05 (indicated by asterisk)

The threshold for defining poor SRF is also not clearly elucidated in the literature and varies among studies. We defined our threshold for poor SRF as 25%, similar to Gupta et al's selected threshold.[20] As only four patients had a preoperative SRF ≤ 20% (18% lower bound), we did not have sufficient patients with poor SRF to perform a sub-analysis based on severity of SRF impairment. Many patients with more severe SRF impairment ultimately elected for nephrectomy, and perhaps this issue may be better addressed via a prospective approach. The effect of UPJO duration on renal recovery and placement of a PCN or stent prior to definitive surgery may also be studied in this fashion. Multivariable Cox regression analysis was not performed since univariable analysis yielded only one predictive variable (age) for SRF outcome. Other factors that may affect renal function chronically, such as hypertension and diabetes, were not evaluated. However, these conditions would not be expected to impact renal function recovery within the follow up period of this study. Finally, it is noteworthy that while we evaluated SRF as a surrogate for renal function recovery, this only provides for a relative assessment of kidney function. While we did not correlate SRF with the severity of hydronephrosis or renal pelvis size, it is possible that the reported SRF may be falsely elevated in the setting of larger renal pelvis diameters, as recently reported by Wehbi et al.[22] Dynamic changes in glomerular filtration rate would alternatively provide for a more absolute assessment of global renal function recovery.

Conclusion

We found that neither poor preoperative SRF (≤ 25%) nor older age is associated with worse renal outcomes after pyeloplasty in adults with UPJO. We identified no other factors in predicting worsened or improved renal function following pyeloplasty. Our results suggest that older adult patients with UPJO and those with poor ipsilateral SRF should not necessarily be excluded from undergoing renal salvage. Further prospective studies are warranted in a larger cohort. □

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