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ARTICLE

Short-term outcomes of pyeloplasty vs. nephrectomy in adult patients with ureteropelvic junction obstruction and differential renal function ≤15%

Pedro F. S. Freitas[a], João A. B. A. Barbosa[a], David H. Cho[a], Ana B. M. Boffa[a], Hiury S. Andrade[a], Marco A. Arap[a,b], Ricardo J. Duarte[a], William C. Nahas[a], Miguel Srougi[a] and Victor Srougi[a,c]

[a]Division of Urology, University of São Paulo Medical School, São Paulo, Brazil; [b]Hospital Sírio Libanês, São Paulo, Brazil; [c]Hospital Moriah, São Paulo, Brazil

ABSTRACT

Objectives: To compare symptom resolution and short-term renal function after pyeloplasty or nephrectomy in adults with ureteropelvic junction obstruction (UPJO) in poorly functioning renal units (PFRU).

Methods: Retrospective analysis of adult patients with UPJO and differential renal function (DRF) ≤ 15% who underwent laparoscopic pyeloplasty or nephrectomy. Primary endpoints included symptom resolution and estimated glomerular filtration rate (eGFR) at 12 months. Surgical complications were compared between groups. A secondary analysis was performed comparing baseline and postoperative DRF to evaluate the PFRU recovery potential after pyeloplasty.

Results: Sixty-three patients were included; 19 underwent pyeloplasty and 44 underwent nephrectomy. The mean age of the cohort was 39.5 ± 13.8 years. Nephrectomy was associated with significantly higher intra-operative blood loss ($p = 0.02$). Operative time and length of hospital stay were not significantly different between groups. There were three complications in the nephrectomy group, and none in the pyeloplasty group ($p = 0.34$). Symptom resolution rates were equivalent between groups (73% vs. 76%; $p = 0.78$). The eGFR variation was not statistically different after pyeloplasty or nephrectomy (+6.2 vs. +0.1 mL/min/1.73m^2, respectively; $p = 0.18$). Patients undergoing pyeloplasty had no significant change in the mean DRF (baseline 9.5 vs. 10%; $p = 0.99$).

Conclusion: Pyeloplasty can be considered for selected patients with UPJO in PFRU as an organ-sparing alternative to nephrectomy. Although there was no significant gain in mean DRF, pyeloplasty prevented further functional loss and relieved symptoms in most cases in the short-term with at least the same complication rates of nephrectomy.

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Pyeloplasty; ureteropelvic junction obstruction; nephrectomy; split renal function; differential renal function

Introduction

Ureteropelvic junction obstruction (UPJO) is the most common cause of hydronephrosis in newborns and children [1,2]. A few individuals, however, may be diagnosed in adulthood due to gradual symptom onset. For these patients, surgery is indicated because of symptoms or functional impairment, which is generally considered when the differential renal function (DRF) is under 40%. Anderson-Hynes dismembered pyeloplasty remains the gold standard procedure for such cases, providing long-term success rates up to 90% [3,4].

The management of UPJO in poorly functioning renal units (PFRU) remains a topic of debate. Nephrectomy is indicated for most patients based on the assumption that functional recovery is unlikely [1,5]. Nevertheless, series in the pediatric population have reported that pyeloplasty may not only relieve the symptoms but also improve the differential renal function (DRF) [6–10]. In this scenario, pyeloplasty would be preferred over nephrectomy.

This rationale is controversial in adults since the kidney has achieved full development, leaving less potential for recovery [11,12]. There is a paucity of high-level evidence about the role of pyeloplasty in adults with PFRU. The few studies performed to date report conflicting results regarding DRF recovery [11–15]. Still, pyeloplasty provided substantial symptom relief, improved hydronephrosis and renogram curves in most of these series [11–15]. In this context, patients could benefit from a kidney-sparing procedure that controls symptoms and may improve the DRF in some cases. We sought to investigate the best surgical alternative for patients with UPJO in PFRU, comparing symptom resolution and the short-term renal function after pyeloplasty or nephrectomy.

Patients and methods

We searched our prospectively collected electronic database for patients with UPJO who underwent either laparoscopic pyeloplasty or nephrectomy between August 2010 and April 2018. Inclusion criteria comprised age ≥ 18 years, DRF ≤ 15% in Tc-99m DMSA renal scintigraphy, pyeloplasty

CONTACT Pedro F. S. Freitas pedro.freitas05@gmail.com Department of Urology, Hospital das Clínicas de São Paulo, Av. Enéas de Carvalho Aguiar,255, São Paulo, SP, 05403-000, Brazil

performed with the Anderson-Hynes technique, and at least 12 months of follow-up. UPJO was diagnosed in the presence of lumbar pain or ipsilateral hydronephrosis evidenced in computed tomography (CT), and a $T_{1/2} > 20$ min on Tc-99mDTPA diuretic renogram. We excluded patients with bilateral UPJO, ectopic kidneys, previous renal surgery, chronic kidney disease, vesicoureteral reflux, or anatomic anomaly. This study was approved by our Institutional Review Board.

The procedures were indicated for symptomatic patients or when the hydronephrotic kidney produced mass effect. The final decision between pyeloplasty or nephrectomy was at the surgeon's discretion considering the baseline DRF, the degree of hydronephrosis and parenchymal atrophy, followed by a detailed discussion on the risks and benefits with each patient. All procedures started laparoscopically by senior residents proctored by an experienced urologist. The follow-up visits occurred at 3, 6, and 12 months postoperatively, when creatinine levels were measured. DMSA renal scintigraphy and CT scans were performed between 6 and 12 months postoperatively for patients who underwent pyeloplasty.

Demographic, intra- and post-operative data were compared between groups. Primary endpoints included symptom resolution and estimated glomerular filtration rate (eGFR) improvement at 12 months according to the CKD-EPI formula [16]. The eGFR improvement was measured with a paired comparison between the baseline and postoperative values for each group. The eGFR variation was then compared between the pyeloplasty and nephrectomy groups. The secondary endpoint was the occurrence of surgical complications (graded according to the Clavien-Dindo system [17]). Whenever available, the postoperative DRF as per DMSA scan was compared to the baseline value in the pyeloplasty group. Any change $> 5\%$ was considered substantial. Finally, pre- and postoperative anteroposterior (AP) diameter of the renal pelvis at the level of UPJ on CT scan were measured and compared.

Data were compared using the Chi-square test in the case of categorical variables, while the Fisher's exact test was used if the analysis included a value 0 for a given category. Student's *T*-test was applied for normally distributed continuous variables. The Mann–Whitney *U* test was employed for non-normally distributed numerical variables. Statistical analysis was performed using SPSS 22.0 (IBM, Chicago, IL, USA). A p value <0.05 was considered significant.

Results

Among the 165 patients with UPJO who were operated on at our institution in the study period, 63 had PFRU and met the study criteria. The mean cohort age was 39.5 ± 13.8 years. Pyeloplasty and nephrectomy were performed in 19 and 44 patients, respectively. Baseline demographic and preoperative data of each group are shown in Table 1. All patients were symptomatic, except five in the nephrectomy group who were operated on due to mass effect. Patients undergoing pyeloplasty had significantly higher baseline DRF than those undergoing nephrectomy (mean 9.5% vs. 3.0%; $p < 0.001$). Recurrent urinary tract infections (UTIs) were more frequent in the nephrectomy group (34% vs. 5%; $p = 0.02$). The remaining baseline variables were similar between groups. Median follow-up was 25.3 months (IQR: 15.9–43.6 months).

Table 2 shows the intra- and postoperative outcomes. Patients undergoing nephrectomy had significantly higher blood loss (mean 107 mL vs. 27 mL; $p = 0.02$). Symptom resolution occurred in 73% and 76% of pyeloplasty and nephrectomy cases, respectively ($p = 0.78$). There were no complications in the pyeloplasty group, whereas three events occurred in the nephrectomy group, yet the difference was not statistically significant ($p = 0.34$). One patient had a duodenal injury during a converted nephrectomy due to difficult dissection and bleeding. Primary repair was performed at the same procedure, and the patient's recovery was uneventful (Clavien-Dindo not applicable). Two patients presented postoperative complications. The first had a surgical site hematoma associated with a drop in serum hemoglobin levels. The second presented a fluid collection at the surgical site and fever. Both were managed conservatively with blood transfusion and intravenous antibiotics, respectively (Clavien-Dindo II). No patient in the pyeloplasty group required a nephrectomy or a redo procedure on follow-up. Furthermore, there were no UTIs among these 19 patients after a median follow-up of 35.1 months.

As illustrated in Figure 1, the eGFR did not change significantly after the procedures. Accordingly, Table 2 shows that eGFR variation was not significantly different after pyeloplasty and nephrectomy (eGFR $= +6.2$ vs. $+0.1$ mL/min/1.73m^2; $p = 0.18$).

A follow-up Tc-99m DMSA scan was available for 16 patients after pyeloplasty (Figure 2). The mean baseline and postoperative DRF were $9.5 \pm 3.4\%$ and $10 \pm 7.5\%$ ($p = 0.99$), respectively. Two individuals had a substantial increase in DRF (15% to 26% and 15% to 29%), whereas two had a substantial drop in DRF (15% to 6% and 5% to 0). The remaining 12 patients showed stable DRF. The median AP diameter of the renal pelvis decreased from 4.9 cm (IQR: 3.6–6.8) to 1.9 cm (IQR: 1.6–2.8) after pyeloplasty ($p = 0.01$).

Discussion

We compare the outcomes of laparoscopic pyeloplasty and nephrectomy in adults with UPJO in poorly functioning kidneys. Pyeloplasty achieved equivalent results for the primary endpoints evaluated, namely symptom resolution and eGFR at 12 months. We also observed that although only 2 patients showed a substantial recovery of renal function after pyeloplasty, most had a stable, non-deteriorating DRF on follow-up. The significant reduction in the AP diameter of the renal pelvis following pyeloplasty corroborates adequate obstruction relief of urine flow at the UPJ in this group. Finally, no patient who underwent pyeloplasty had an UTI or required a nephrectomy or a redo procedure during the follow-up period.

Table 1. Demographic and baseline clinical parameters according to the procedure performed.

	Pyeloplasty ($n = 19$)	Nephrectomy ($n = 44$)	p Value
Age, *years*	36 (12)	41 (13)	0.17[a]
Gender – Female, *n (%)*	9 (47)	22 (50)	0.84[b]
Laterality – Right, *n (%)*	12 (63)	20 (45)	0.19[b]
Charlson score	0 (0–1)	0 (0–2)	0.39[c]
Symptoms, *n (%)*	19 (100)	39 (88)	0.31[d]
Pain	19 (100)	37 (84)	0.09[d]
Recurrent UTI	1 (5)	15 (34)	0.02[d]
Differential renal function, %	9.5 (8.0–11.5)	3.0% (0–8.0)	<0.001[c]

[a]Student's *t*-test.
[b]Chi-square test.
[c]Mann–Whitney *U* test.
[d]Fisher's exact test.
UTI: Urinary tract infection.
Values are expressed as frequency (percentage) or medians (quartile 1–quartile 3), except for Age that is given as mean (standard deviation).

Table 2. Intra- and postoperative outcomes for each procedure.

	Pyeloplasty ($n = 19$)	Nephrectomy ($n = 44$)	p Value
Operative time, *min*	159 (46)	165 (46)	0.67[a]
Blood loss, *mL*	27 (20)	106 (130)	0.02[a]
Intraoperative complications, *n (%)*	0	1 (2)	0.99[b]
Postoperative complications, *n (%)*			0.34[d]
Clavien ≤2 (minor)	0	2 (4)	
Clavien ≥3 (major)	0	0	
Conversion to open surgery, *n (%)*	0	4 (9)	0.30[b]
Hospitalization, *days*	3 (3–4)	3 (3–4)	0.50[c]
Symptom Resolution, *n/exposed (%)*	14/19 (73)	30/39 (76)	0.78[d]
eGFR variation, *mL/min/1.73m²*	+6.2 (14.6)	+0.1 (15.3)	0.18[a]

Values are expressed as frequency (percentage) or mean (standard deviation), except for Hospitalization that is given as medians (quartile 1–quartile 3).
[a]Student's *t*-test.
[b]Fisher's exact test.
[c]Mann–Whitney *U* test.
[d]Chi-square test.
eGFR: estimated glomerular filtration rate.

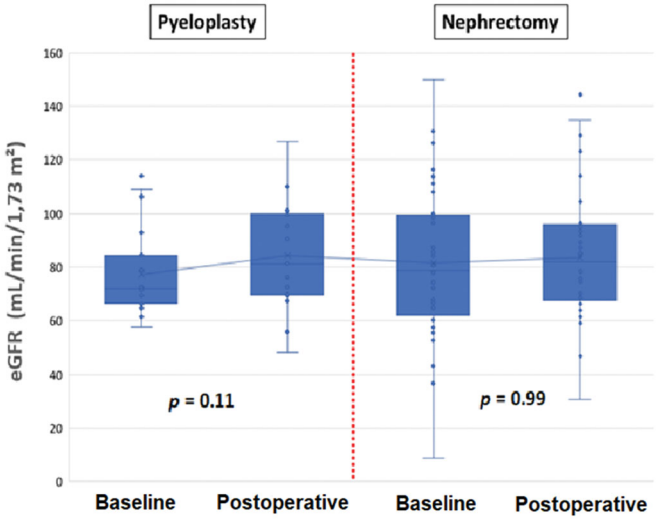

Figure 1. Estimated glomerular filtration rate (eGFR) at baseline and 12 months after pyeloplasty or nephrectomy, according to the CKD-EPI formula. The p values indicated for each group refer to non-significant differences in median eGFR before and after each procedure as per the paired Student's *t*-test.

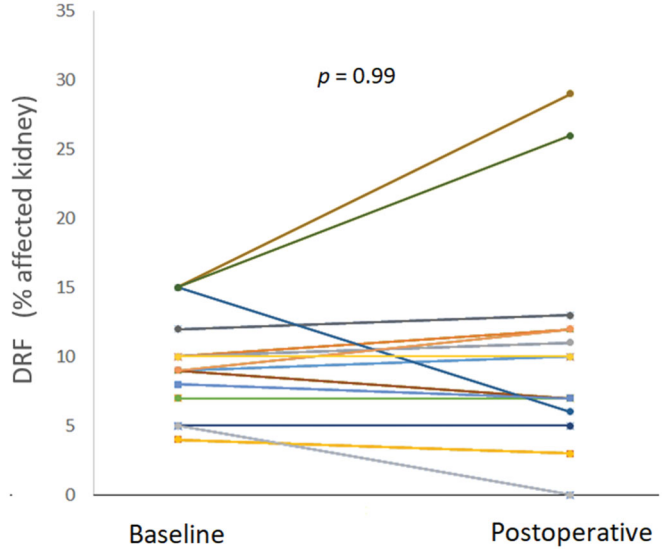

Figure 2. Differential renal function (DRF) at baseline and after pyeloplasty. Each line represents a patient for whom a follow-upTc-99m DMSA scan was available ($n = 16$). The p value indicated refers to a non-significant difference between mean DRF before and after the procedure (9.5% vs. 10.0%) as per the Mann–Whitney *U* test.

The potential for functional recovery following UPJO repair in severely damaged kidneys remains uncertain. The existing series report conflicting results and differ in their methods, hindering the comparison of their outcomes. Patient selection bias is also likely, as poorly functioning renal units have been defined by arbitrary cutoff values for DRF between 10% and 30% [8–11,14,18]. In addition, renal scintigraphy may be misinterpreted in cases of urinary tract obstruction and renal dysfunction [19].

Even so, nephrectomy remains frequently indicated for PFRU despite there is no evidence that it is the best choice

for all cases [1,20]. This approach is based on the theory of renal atrophy and counterbalance, which states that functional loss becomes irreversible after chronic obstruction [21]. Hence, the decompression of a long-standing UPJO would not improve function and may well result in further loss.

Recent studies in pediatric and adult populations have challenged this rationale. Some observed a significant gain in DRF following pyeloplasty (preceded or not by nephrostomy) in low-functioning kidneys [6–8,13,14]. Even series that failed to demonstrate a significant improvement in renal function report that most patients have symptom resolution and non-obstructive renograms on follow-up [11,12,15]. Our results corroborate such findings. Pyeloplasty may stand as an organ-sparing alternative to nephrectomy with possible less morbidity and similar symptom relief and renal function preservation rates.

Gnech et al. [10] also compared the outcomes of pyeloplasty and nephrectomy for UPJO in PFRU, but in a pediatric population. Pyeloplasty was associated with improved and stable DRF in 36% and 45% of children, respectively. Of note, complication rates did not differ between the procedures, and the clinical success for PFRU (97%) was equivalent to kidneys with baseline DRF $>$ 20%. As previously shown, younger age may be associated with better prognosis following obstruction relief [11,13]. Most of our cohort comprised patients older than 30 years, which may have limited their recovery potential. Baseline function may also be a predictor of recovery for PFRUs [12,22]. Accordingly, both patients in our series who presented a significant functional improvement after pyeloplasty had the highest baseline DRF values of the cohort. The parenchymal thickness and contrast enhancement on CT may also be a predictor of DRF recovery [11,23]. All these factors may be useful to define a realistic prognosis in order to manage patient's expectations for surgery.

Zhang et al. [13] proposed to perform a percutaneous nephrostomy and repeat renal scintigraphy to identify the best candidates for either pyeloplasty or nephrectomy. After six weeks with nephrostomy, 56% of the patients had improvement of DRF and underwent pyeloplasty. The same rationale was applied in children, with similar results [8,20]. The authors must be commended for their effort. However, this approach requires at least two procedures and has the caveats of harboring external drainage, which carries the risk of infection and is poorly tolerated by patients.

Our study has the inherited drawbacks of its retrospective design. Pyeloplasty might have been indicated for patients prone to functional recovery, namely those in the upper limit of DRF. The low number of patients should be mentioned, which could have underpowered our results. Nevertheless, UPJO is an uncommon diagnosis in adults, hampering the performance of a broad and prospective trial. The uneven distribution of patients in each group also hinders the comparison. Despite of that, to our knowledge this is the first study to compare pyeloplasty and nephrectomy for PFURs in an exclusively adult population, providing data to support clinical decision making in this scenario. Timely, a multi-institutional effort could overcome the hurdle of the low prevalence of UPJO in adults to evaluate the long-term impact of each surgical strategy on renal function.

Conclusion

Pyeloplasty may be considered for selected patients with UPJO in PFRU as an organ-sparing alternative to nephrectomy, providing similar symptom resolution and eGFR in the short-term. Although there was no significant gain in mean DRF, pyeloplasty prevented further loss in most cases with less bleeding and lower (yet nonsignificant) complication rates than nephrectomy. Future studies should focus on the long-term outcomes and elucidate if there are clusters that will benefit more from preserving a kidney with marginal function.

Ethics approval

This study was approved by our Institutional Review Board.

Informed consent

As this is a retrospective study limited to the analysis of electronic patient records, formal consent was waived.

Disclosure statement

The authors declare no conflict of interest. There were no specific funding grant or agencies for this study.

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