Review

Pyeloplasty in Adults With Ureteropelvic Junction Obstruction in Poorly Functioning Kidneys: A Systematic Review

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OBJECTIVES To systematically summarize the available evidence concerning the impact of pyeloplasty on symptoms and differential renal function (DRF) in adults with unilateral UPJO in poorly functioning kidneys (PFK), and to identify potential predictors of kidney function recovery that could help clinicians select candidates for pyeloplasty.

METHODS A literature search (MEDLINE, Embase, Google Scholar, Scopus, ClinicalTrials.gov, and the WHO Clinical Trials Registry) and systematic review were performed up to September 2020 according to the PRISMA guidelines. PFK were defined as a baseline DRF ≤30% on renal scintigraphy. The primary endpoints were symptom relief and postoperative scintigraphic DRF. Predictors of kidney function recovery were evaluated and compared among studies.

RESULTS Nine studies comprising 731 patients met the inclusion criteria and were included for evidence synthesis. A DRF increase >5% occurred in 13.3%-53.8% of 160 patients with a pre- and postoperative renal scan. Symptoms improved in 73.3%-93.3% of 141 adults after pyeloplasty. Neither patient's age, baseline DFR, comorbidities, degree of hydronephrosis, kidney parenchymal thickness, nor kidney biopsy findings consistently predicted a significant DRF increase among 375 patients undergoing pyeloplasty.

CONCLUSION Based on a low level of evidence, pyeloplasty may relieve symptoms and stabilize kidney function in adults with UPJO in PFK. A significant number of patients showed a DRF increase >5%, yet no consistent predictor of kidney function recovery was identified. Until more evidence becomes available, pyeloplasty could be considered for selected cases after accounting for the risks of a failure requiring a future nephrectomy. UROLOGY 156: e66–e73, 2021. © 2021 Elsevier Inc.

Ureteropelvic junction obstruction (UPJO) is a frequent cause of hydronephrosis and may result in progressive kidney damage. Some individuals are diagnosed in adulthood, either incidentally or because of a gradual onset of symptoms. Surgical repair is typically indicated in the presence of pain, stone, or urinary tract infections (UTI) or when scintigraphic differential renal function (DRF) is <40%.[1,2] Anderson-Hynes dismembered pyeloplasty is the gold-standard procedure, with success rates exceeding 90% and low morbidity regardless of access (open, laparoscopic, or robot assisted).[3]

Symptomatic patients with poorly functioning kidneys (PFK)—variably defined in the literature as DRF <10% to 30%—[4-6]remain a dilemma in clinical practice. Nephrectomy is a definitive alternative that eliminates the source of symptoms and is generally indicated when kidney function recovery is unlikely. One study [7], however, showed that kidney preservation is feasible in up to 70% of children when a percutaneous nephrostomy was placed before definite management. Paediatric series report stable DRF and symptom resolution in most cases after pyeloplasty.[8-11] Some patients show significant recovery, generally defined by a DRF increase >5%.[2,4,5,12] These observations have led some authors to argue against systematic nephrectomy in children with PFK.[8-10]

This scenario is more challenging in adults, who may have a lower recovery potential because of longer-standing disease in fully developed kidneys. Still, some series suggested a role for pyeloplasty as a nephron-sparing procedure for select cases.[12,13] Although some studies have reported significant DRF recovery and symptom

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resolution, heterogeneity in inclusion criteria and result reporting preclude adequate selection of candidates for pyeloplasty. Additionally, UPJO repair should be worth the risk of a failure requiring a later kidney removal. The decision to perform a pyeloplasty in such cases requires an evidence-based analysis of its outcomes in adults, which is lacking in the literature.

Thus, we systematically reviewed the current literature for all the available evidence concerning the impact of pyeloplasty on symptoms and DRF in adults with unilateral UPJO in PFK. We also searched for potential predictors of kidney function recovery that could help clinicians select candidates for pyeloplasty.

METHODS

Search Strategy

A systematic review of the medical literature was performed in September 2020 according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[14] The search also followed the principles outlined in the *Cochrane Handbook for Systematic Reviews of Interventions*.[15] The review protocol was planned a priori and prospectively registered at the PROSPERO database under the code CRD42020192917.

The searched databases were MEDLINE, Embase, Google Scholar, and Scopus. To identify possible ongoing trials, ClinicalTrials.gov and the World Health Organization International Clinical Trials Registry were also searched. Additionally, the abstracts of the American Urological Association and European Association of Urology annual meetings were screened for unpublished studies. No time limitations were applied, and results were restricted to articles published in English.

The standard search included the following keywords: *ureteropelvic junction obstruction*, *UPJO*, *recovery*, *pyeloplasty*, *differential renal function*, and *split renal function*. Filters to avoid pediatric studies were used. Additionally, references from the retrieved articles were checked to complement the search. A detailed description of the search protocol may be found in the supplementary material.

Study Selection

Two reviewers (P.F.S.F. and V.S.) independently conducted the search and screened abstracts for eligibility. The selected studies were compared, and eventual disagreement was resolved by discussion or ultimately by 1 senior author (R.J.D.) in the case of persistent dispute.

Original studies (randomized clinical trials, prospective cohorts, case-control studies, and retrospective series) assessing pyeloplasty outcomes for adult patients (≥18 years of age) with unilateral UPJO in PFK were eligible. To be considered for inclusion, at least 1 of the following characteristics should have been evaluated: postoperative symptoms, scintigraphic DRF, or predictors of kidney function recovery. Review articles, editorial comments, case reports, and congress abstracts were excluded. Case series with 10 or more patients were also included.

To accommodate the multiple DRF cut-offs used to define PFK in the literature, studies assessing pyeloplasty outcomes in patients with a DRF ≤30% (either as a single arm or compared with those above a specified DRF cut-off) were included. As every DRF cut-off implies an arbitrary decision, the chosen value followed a practical approach intended to be clinically useful. Studies assessing predictors of DRF recovery were included regardless of the baseline DRF value. No restrictions were applied with regard to pyeloplasty technique (dismembered or not) or access (open, laparoscopic, or robot assisted).

Studies with patients younger than 18 years of age who had bilateral UPJO or congenital anomalies of the urinary tract or who had undergone endopyelotomy, redo pyeloplasty, or salvage pyeloplasty were excluded. If 1 study assessed urinary obstruction from multiple causes (eg, UPJO, ureteral stone, stricture), it would still be included if specific data for UPJO were available in the article or upon email request. Finally, we excluded series in which pyeloplasty was selectively indicated after a drainage procedure (eg, percutaneous nephrostomy, ureteral stenting) to avoid selection bias towards favorable cases.

Data Acquisition

Data were independently extracted by 2 reviewers (P.F.S.F. and V.S.). A data extraction form was developed a priori to collect the following parameters: study design, period, and demographics; inclusion criteria; DRF cut-off; pyeloplasty access and technique; the proportion of symptomatic patients and improvement after pyeloplasty; postoperative DRF (mean and percentage of patients with significant improvement); duration of follow-up; and predictors of recovery (whether statistically significant or not). In the case of missing information, the first author was contacted by email for elucidation.

Quality Assessment and Risk Of Bias

The Newcastle-Ottawa Scale[16] was used to evaluate study quality for case-control studies and prospective cohorts. Scores ≥7 indicated low risk of bias, scores between 4 and 6 indicated moderate risk of bias, and scores ≤3 indicated high risk of bias.

For case series, the risk of bias was assessed according to a pragmatic approach based on external validity. It included the disclosure of selection criteria used, consecutive selection of study participants, the application of an a priori protocol, disclosure of patients lost to follow-up, how attrition bias was dealt with, and whether the proposed outcomes were properly addressed and measured.

Data Analysis

Descriptive statistics were used to summarize the baseline characteristics and study demographics. Because of the anticipated clinical heterogeneity and the majority of studies being nonrandomized in design, a narrative (qualitative) synthesis was planned. The outcomes of interest were clinically oriented and included (1) postoperative DRF (compared with baseline and as percentage of improved, stable, and worsening patients); (2) symptom improvement; and (3) predictors of DRF improvement after pyeloplasty. In accordance with most studies on the topic,[2,5,12] significant DRF recovery was defined as an increase ≥5% from the baseline value.

A quantitative synthesis (ie, meta-analysis) was not possible because of significant heterogeneity in the study populations, DRF cut-offs, and the low level of evidence of the retrieved studies. Instead, the outcome frequencies were plotted and summarized, followed by a qualitative analysis to propose hypotheses and assemble all the available evidence to support clinical decision-making in this scenario.

RESULTS

Study Selection

The literature search identified a total of 873 results — 569 studies from databases and 304 abstracts from urological meetings. After removing duplicates, 666 studies underwent abstract screening. Of these, 16 were eligible for full-text screening. Nine studies comprising 731 patients met the inclusion criteria and were included for evidence synthesis. Two articles assessed the impact of pyeloplasty on DRF level and symptoms, 3 assessed only predictors of kidney function recovery, and 4 evaluated both. We could not retrieve any randomized clinical trial, case-control, or prospective cohort to be included in the analysis. Figure 1 shows the PRISMA flow diagram representing the study-selection process. Table 1 summarizes the general features, demographics, and duration of follow-up for each study selected.

Quality Assessment

Supplementary Table 1 outlines the pragmatic approach criteria applied to estimate the risk of bias for each selected study. Only surgical series that fulfilled the search criteria were included in the analysis, resulting in a high risk of selection and attrition bias. Conversely, these studies were at a low risk of bias in terms of treatment outcome measurement and reporting.

Impact of Pyeloplasty On Differential Renal Function

Table 2 summarizes DRF outcomes after pyeloplasty. Results are expressed both as the mean increase from baseline and the proportion of patients sustaining a significant improvement or decrease in DRF level postoperatively.

Six studies comprising 160 patients with PFK evaluated the impact of pyeloplasty on scintigraphic DRF; 5 compared patients above and below a DRF cut-off of 15%-30%, while 1 consisted in a single-arm series of adults with DRF <20%.

All studies reported some gain in mean DRF level after pyeloplasty. The mean increase varied between 1.0% and 7.2%, reaching significance from baseline values in 2 series comprising 105 adults with PFK. A DRF increase >5% occurred in 13.3%-53.8% of patients after pyeloplasty. Conversely, none to 20% of

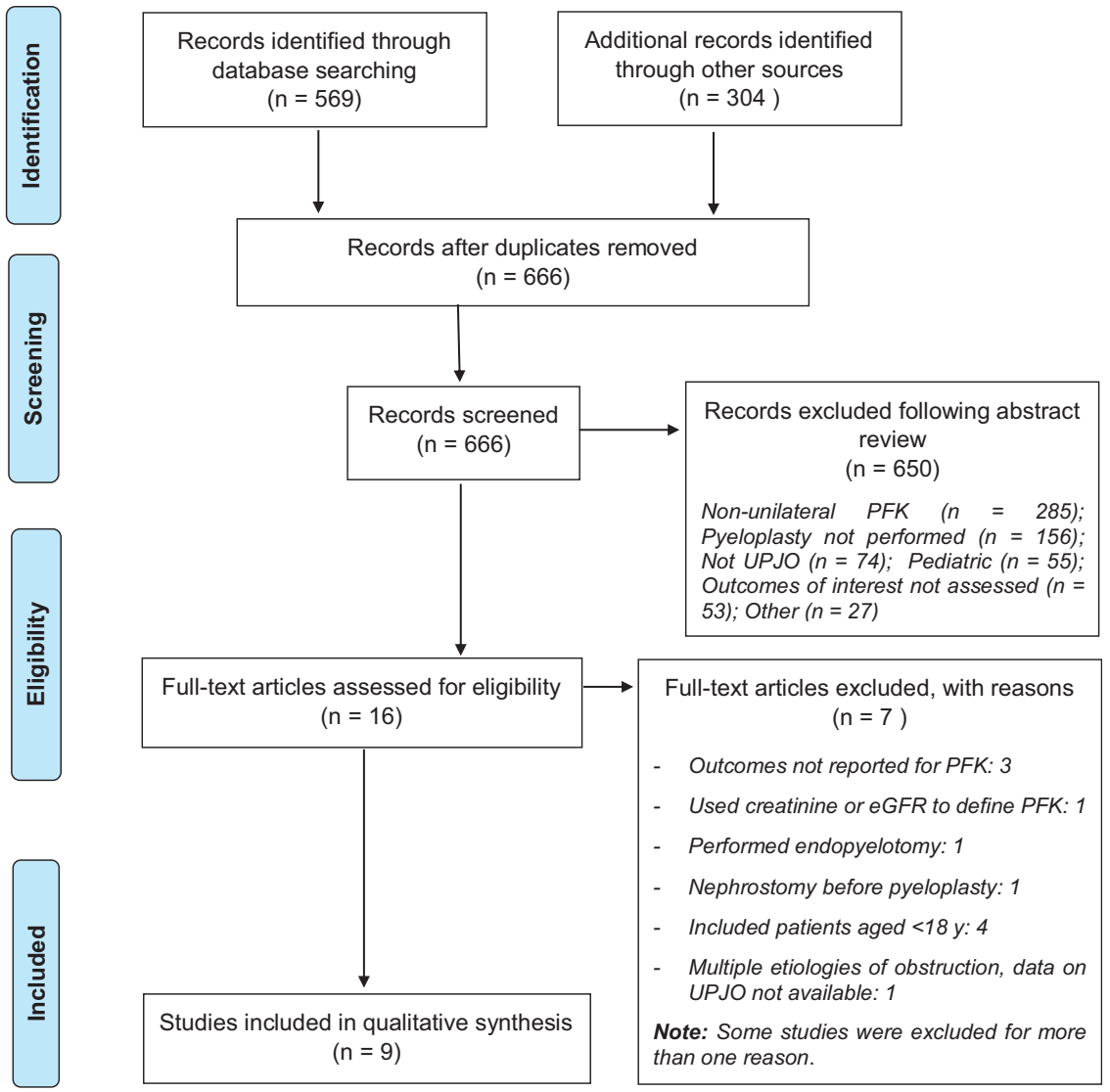

Figure 1. PRISMA flow diagram outlining the search performed. Abbreviations: eGFR, estimated glomerular filtration rate; PFK, poorly functioning kidney; PRISMA, preferred reporting items for systematic reviews and meta-analyses.

Table 1. Demographics and characteristics of the included studies

Ref	Y	Patients, No.	Age, Y*	Men, %	Right Side, %	Kidney Scintigraphy Method	DRF Cut-Off, %	Pyeloplasty			
								Access	Dismembered, %	Crossing Vessel At UPJ, %	Follow-Up†, Mo
Studies assessing pyeloplasty outcomes											
Ortapamuk[4]	2003	32	36.5	53.1	41	DTPA	30	N/A	100	N/A	6.0
Singla[1]	2016	139	38	73.3	N/A	N/A	25	54.0% lap 24.4% robot assisted	100	N/A	9.0
Nayyar[12]	2016	32	26.8	78.1	25	L-ethyl cysteine	20	18.7% open 18.7% lap 62.6% robot assisted	96.8	N/A	26.8
Nishi[18]	2016	13	30.0	53.8	26	MAG-3	20	100% lap	100	30.7	24.0
Elbaset[2]	2019	211	29.5	62.9	45	MAG-3	20	84.6% open 15.4% lap	97.7	15.4	67.1
Nascimento[5]	2020	57	36.6	38.6	51	DMSA	15	100% lap	100	26.3	17.8
Studies assessing only predictors of recovery											
Bhat[21]	2012	24	29.6	66.7	42	DTPA	None	N/A	100	N/A	60.0
Harraz[19]	2014	85	30	51.8	54	MAG-3	None	100% open	100	N/A	11.0
Li[17]	2017	138	33.9	45	48	DTPA	≥10%	76% open 24% lap	100	N/A	12.0

Abbreviations: DMSA, technetium Tc 99m dimercaptosuccinic acid; DRF, differential renal function; DTPA, technetium Tc 99m diethylene triamine penta-acetic acid; Lap, laparoscopic; MAG-3, mercaptoacetyltriglycine-3; N/A, not available; Ref, reference; UPJ, ureteropelvic junction.

* Age was reported as median by Singla, Ortapamuk, Harraz, and Nishi et al and as mean by Elbaset, Nayyar, and Nascimento et al.

† Follow-up was reported as median by Singla, Nascimento, Harraz, and Nishi et al and as mean by Elbaset and Nayyar et al. Ortapamuk et al report that all patients in their series were assessed at 6 months postoperatively.

Table 2. Impact of pyeloplasty on DRF according to baseline values*

Ref	Subgroups by DRF, %	Patients, *n*	DRF, %		DRF Change%†	*P* value	DRF Outcome After Pyeloplasty	
			Baseline	After			Improved >5%, %	Decreased >5%, %
Subgroups according to baseline DRF								
Ortapamuk 2003[4]	<30	10	22.8	25.0	+2.2	.33	20.0	0
	≥30	22	38.0	41.2	+3.2		50.0	0
Singla 2016[1]	≤25	15	22	24	+4‡	.12	40.0	20.0
	>25	124	44	46	+1‡		16.9	16.7
Nayyar 2016[12]	≤20	15	15.8	19.4	+3.6	Not reported	33.3	6.6
	20-30	17	24.9	30.8	+5.9		47.0	0
Elbaset 2019[2]	<20%	92	14.3	18.7	+4.4§	< .001	39.1	4.4
	20-30	129	24.9	27.2	+2.3§		17.8	6.2
						< .001		
Nasciamento 2020[5]	≤15	15	9.5	10.5	+1.0	.49	13.3	13.3
	>15	42	41.1	42.1	+1.0	.21	9.5	7.2
Single-arm case series								
Nishi 2016[18]	<20	13	16.5	23.8	+7.3§	.001	53.8	0

Abbreviations: DRF, differential renal function; N/A, not available; PFK, poorly functioning kidney; Ref, reference.
* Studies are grouped by to those that (1) compared the outcome based on a DRF cut-off and (2) assessed only patients with PFK.
† Values are expressed as the mean change, except by Nishi and Singla et al, who reported median values.
‡ Values represent median change and hence do not necessarily match the difference between postoperative and preoperative DRF values.
§ Statistically significant ($P < .05$ if not otherwise specified).

patients exhibited a decrease >5% in DRF value after pyeloplasty.

Three studies compared the frequency of DRF outcomes (improved, stable, or deteriorated) between groups. Singla et al[1] found significantly higher rates of both DRF improvement and worsening among patients with PFK. Elbaset et al[2] also observed improved DRF more often among patients with PFK, yet differences between groups did not reach statistical significance ($P = .1$). Finally, Nascimento et al[5] observed no significant difference between groups above and below the DRF cut-off.

Impact of Pyeloplasty On Symptoms

Table 3 summarizes the frequency of symptomatic patients and symptom improvement rates after pyeloplasty. Five studies, including 160 patients with PFK, evaluated baseline symptoms. The most frequently reported complaints were lumbar pain and UTI. The proportion of symptomatic patients varied between 86.8% and 100% in the selected series, resulting in 141 symptomatic patients with PFK. Among these series, 4 reported symptom improvement rates of 73.3%-93.3% after pyeloplasty. Three studies assessed symptom resolution rates according to a DRF cut-off and found no significant differences between groups.

Predictors of Kidney Function Recovery

The most frequently evaluated predictors of kidney function recovery after pyeloplasty are listed in Supplementary Table 2. All studies considered a DRF increase >5% significant, except for Li et al,[17] who used a DRF increase >10% to define success. The results for the possible predictors are outlined below.

Table 3. Proportion of symptomatic patients and symptom relief after pyeloplasty according to the cut-off established by each study

Ref	Subgroups by DRF, %	Patients, *n*	Symptomatic, *n* (%)	Improved, *n* (%)	*P* Value*
Subgroups according to baseline DRF					
Ortapamuk 2003[4]	<30	10	No data on symptoms were provided		N/A
	≥30	22			
Singla 2016[1]	≤25	15	14 (93.3)	13 (92.8)	.65
	>25	124	116 (93.5)	102 (87.9)	
Nayyar 2016[12]	≤20	15	15 (100)	14 (93.3)	NS
	21-30	17	17 (100)	17 (100)	
Elbaset 2019[2]	<20	92	85 (92.4)		
	20-30	129	112 (86.8)	N/A	N/A
Nascimento 2020[5]	≤15	15	15 (100)	11 (73.3)	.60
	>15	42	42 (100)	34 (80.9)	
Single-arm case series					
Nishi[18]	<20	13	12 (92.3)	11 (91.6)	N/A

Abbreviations: DRF, differential renal function; Ref, reference; N/A, not available; NS, nonsignificant.
* Comparing symptom improvement rates between groups above and below the DRF cut-off.

Age. The relationship between the patient's age at pyeloplasty and significant recovery was investigated in three studies. Both Li et al[17] and Singla et al[1] used an age cut-off of 35 years to evaluate age as a predictor of recovery after pyeloplasty, but they reached opposite conclusions: The former found age younger than 35 years to be associated with significant recovery, whereas the latter observed age older than 35 years to be associated with stable or significantly improved DRF values. Finally, in the largest series on the topic, Elbaset et al[2] found no association between age and kidney function recovery among 92 adults with PFK after pyeloplasty.

Baseline Differential Renal Function. Baseline DRF indicates the kidney's residual functional capacity. Thus, lower baseline function could limit the recovery potential of a PFK. This rationale apparently supports the recommendation of nephrectomy for PFK. Nevertheless, four studies comprising 530 patients observed no significant association between lower baseline DRF values and significant recovery.

Comorbidities. In the presence of conditions known to provoke kidney injury over time (eg, hypertension, diabetes, cardiovascular disease), the recovery potential may be limited. Singla et al[1] tested whether an American Society of Anaesthesiologists physical status ≥2 could predict kidney function recovery and found no significant association. Li et al[17] also found no significant association between a history of hypertension, diabetes, smoking status, or alcoholism with DRF recovery.

Degree of Hydronephrosis. Persistent obstruction generally results in hydronephrosis progression. Consequently, greater dilation might indicate more advanced disease and provide an insight into the kidney's recovery potential. Four studies investigated whether the degree of hydronephrosis could predict functional outcome after pyeloplasty. Li et al[17] found higher Society for Fetal Urology dilation grades to be significantly associated with poorer DRF responses. Elbaset,[2] Nishi,[18] and Harraz[19] also assessed the relationship between hydronephrosis and DRF improvement but did not find any significant association.

Parenchymal Thickness. Parenchymal thickness may estimate the residual viable kidney tissue and thus indicate the recovery potential of a PFK. Harraz et al[19] observed a significant association between cortical thickness on preoperative computed tomography scan and DRF improvement after pyeloplasty. In contrast, Ortapamuk et al[4] found no significant association between parenchymal thickness >5 mm on preoperative ultrasound and DRF improvement.

Kidney Biopsy at Pyeloplasty. One study investigated the role of a kidney biopsy performed at the time of pyeloplasty in adult patients. The investigators found that a 'normal' (vs 'pathologic') kidney biopsy histopathology predicted significant DRF recovery.

Miscellaneous. Many parameters have been investigated by individual studies as possible predictors of recovery. Li et al[17]found a significant association between a lower kidney resistive index on preoperative Doppler ultrasound and an extraparenchymal renal pelvis (vs. intraparenchymal) with DRF recovery. They also assessed patient sex, body mass index, affected side, and pyeloplasty access (open vs laparoscopic) and observed no significant association with DRF improvement.

Other nonsignificant predictors of DRF improvement included the anteroposterior diameter of the renal pelvis on ultrasound,[2] presence of crossing vessels,[2,18] surgeon's expertise,[2] previous stenting/percutaneous nephrostomy,[1] and preoperative symptoms (vs asymptomatic patients).[1]

DISCUSSION

PFK constitute a clinical dilemma in the management of adults with UPJO. This systematic review revealed, based on a low level of evidence, that pyeloplasty may effectively relieve symptoms and stabilize DRF in most cases. Some patients may show a significant improvement in DRF, yet no consistent predictor of recovery could be identified among the included studies.

The rationale for nephrectomy for patients with PFK is that kidney damage becomes irreversible below a certain threshold. Pyeloplasty is then unable to provide recovery of function despite adequate obstruction relief. Pyeloplasty failure may also occur as a result of poor urine flow through the anastomosis; pelvic distortion leading to nongravitational urine drainage; and stasis, with precipitation of amorphous urates and crystals.[12]

Impact On Differential Renal Function and Symptoms

The possibility of performing pyeloplasty despite poor DRF was first investigated in the pediatric population. Castagnetti et al[20] published the only systematic review of pyeloplasty outcomes and predictors of DRF improvement in children. When examining PFK, significant recovery was unlikely when UPJO was diagnosed antenatally, while it occurred in 56%-100% of children diagnosed after birth. Such promising outcomes were observed in children, whose kidneys are developing and may have an optimal potential for recovery, but they are not necessarily valid for adults.

Five studies comprising 153 adult patients with PFK showed a marginal increase of 1.0%-7.2% in mean DRF values. Postoperative DRF values remained stable in 46%-80% of cases, indicating that pyeloplasty may be effective in preventing further loss of function. More importantly, however, patients with PFK whose kidney would have been removed sustained significant DRF improvement. Thus, there may be a subset of PFK with a recovery potential greater than their higher-functioning counterparts. This finding is supported by Singla et al,[1] who found significantly more DRF increases >5% among patients with PFK. Elbaset et al[2] also observed a difference in DRF outcomes favoring PFK without attaining conventional levels of statistical significance (P = .1). The heterogeneity among DRF measurement techniques — 4 different radiopharmaceuticals among 9 studies—may limit generalization of the findings. Still, they suggest that the rationale of systematic nephrectomy for a PFK should be revisited.

Expectant management is an option for asymptomatic individuals with PFK. Other than loss of kidney function, symptoms are the most common indication for surgery. Accordingly, 86.8%- 100% of patients in 5 studies underwent pyeloplasty for pain, stone, or UTI. No study provided a detailed description of symptoms or used a validated instrument to quantify pain or UTI.

In this scenario, a nephron-sparing procedure should obviate kidney function loss and consistently treat symptoms. The available evidence indicates that it may be the case for pyeloplasty: Symptoms improved in 73.3%- 100% of patients. Of note, patients with PFK showed no significant difference in symptom improvement rates.

Predictors of Recovery

A reliable predictor of DRF recovery would be useful for refining the indication of pyeloplasty. Age, comorbidities, and apparent residual parenchyma on imaging studies are empirically used in clinical practice. Six studies comprising 629 patients investigated the association of several variables with significant DRF recovery. Both Doppler kidney resistive index and the degree of hydronephrosis on ultrasound were found to predict significant DRF recovery in 1 study.[17] These findings, though promising, need further validation before clinical application. Kidney biopsy findings may also be useful for predicting recovery,[21] but its use is limited as it implies performing an invasive procedure before pyeloplasty.

Conversely, intuitive factors, such as comorbidities and parenchymal thickness, were not significantly associated with DRF recovery. Age yielded conflicting results, with series favouring younger patients,[17] older patients,[1] or no significant association at all.[2] These results may be the result of the low number of patients, selection and attrition bias, or the lack of a real association. Furthermore, lower baseline DRF values were not associated with functional outcomes in any of the included studies, supporting a possible role for pyeloplasty for PFK. These series have a high risk of selection bias, however, and may overestimate the recovery potential, accounting for this apparent lack of difference. The bottom line is that the current literature lacks consistent predictors of recovery to support clinical decision-making.

Limitations and Future Perspectives

This systematic review retrieved studies in the lower spectrum of evidence. Our results reveal that the interest in nephron-sparing alternatives for adults with PKFs has increased in the past decade. This fact, combined with the relative rarity of such cases, may explain why only retrospective surgical series exist. They are prone to significant selection bias, however, as none followed an a priori protocol. Less favorable cases may have undergone different procedures (eg, nephrectomy). No study indicated how many PFK did not undergo pyeloplasty or how they were managed.

Follow-up between 9 and 67 months among selected studies is also an important limitation because most patients were operated on in the third and fourth decades of life. It has been demonstrated that pyeloplasty success rates decline on longer follow-up, whereas symptoms may recur.[22] The series also do not report on patients lost to follow-up, resulting in a high risk of attrition bias. Significant heterogeneity among studies limits the identification of predictors of recovery. Age and DRF, for instance, were tested sometimes as continuous variables, other times as categoric variables. Also, the 3 studies dedicated to predictors of recovery included patients within all DRF levels, so they provide limited insight specifically for PFK.

The limitations aside, our findings indicate that some adult patients with UPJO in PFK may benefit from pyeloplasty. Systematic nephrectomy for a PFK probably implies removing recoverable kidneys, so caution is recommended in the indication of this procedure. No reliable preoperative feature could be identified in the literature to support the decision for either procedure, yet several potential predictors await further validation. Above all, this systematic review highlights the need for prospective studies to better elucidate the role of pyeloplasty in PFK and to define predictors of recovery. Multi-institutional initiatives are the key to overcoming the relative rarity of this presentation. Until then, pyeloplasty may be considered for select cases of UPJO in PFK based on a low level of evidence.

CONCLUSION

Based on a low level of evidence, pyeloplasty may relieve symptoms and stabilize kidney function in adults with UPJO in PFK. A minority of patients may sustain significant DRF improvement, yet no consistent predictor of kidney function recovery was identified in the literature. More studies are needed to define the role of pyeloplasty in this scenario. Until then, caution is recommended before proceeding with kidney removal.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.urology.2021.05.017.

References

1. Singla N, Lay AH, Cadeddu JA. Poor split renal function and age in adult patients with ureteropelvic junction obstruction do not impact functional outcomes of pyeloplasty. *Can J Urol.* 2016;23:8457–8464.

2. Elbaset MA, Zahran MH, Sharaf MA, Elmeniar AM, Ezzat O, Elgamal M, et al. Long term functional success after pyeloplasty for pelvi-ureteral junction obstruction in unilateral poorly functioning kidney in exclusively adults population. *Urology*. 2019;131:234–239.
3. Autorino R, Eden C, El-Ghoneimi A, Guazzoni G, Buffi N, Peters CA, et al. Robot-assisted and laparoscopic repair of ureteropelvic junction obstruction: a systematic review and meta-analysis. *Eur Urol*. 2014;65:430–452.
4. Ortapamuk H, Naldoken S, Tekdogan UY, Aslan Y, Atan A. Differential renal function in the prediction of recovery in adult obstructed kidneys after pyeloplasty. *Ann Nucl Med*. 2003;17:663–668.
5. Nascimento B, Andrade HS, Miranda EP, Barbosa JABA, Moscardi PR, Arap MA, et al. Laparoscopic pyeloplasty as an alternative to nephrectomy in adults with poorly functioning kidneys due to ureteropelvic junction obstruction. *Int Urol Nephrol*. 2020;53(2):269–273. https://doi.org/10.1007/s11255-020-02626-4.
6. Wagner M, Mayr J, Häcker FM. Improvement of renal split function in hydronephrosis with less than 10% function. *Eur J Pediatr Surg*. 2008;18:156–159.
7. Gupta DK, Chandrasekharam VV, Srinivas M, Bajpai M. Percutaneous nephrostomy in children with ureteropelvic junction obstruction and poor renal function. *Urology*. 2001;57:547–550.
8. Aziz MA, Hossain AZ, Banu T, Karim MS, Islam N, Sultana H, et al. In hydronephrosis less than 10 % kidney function is not an indication for nephrectomy in children. *Eur J Pediatr Surg*. 2002;12:304–307.
9. Bansal R, Ansari MS, Srivastava A, Kapoor R. Long-term results of pyeloplasty in poorly functioning kidneys in the pediatric age group. *J Pediatr Urol*. 2012;8:25–28.
10. Menon P, Rao KL, Bhattacharya A, Mittal BR. Outcome analysis of pediatric pyeloplasty in units with less than 20% differential renal function. *J Pediatr Urol*. 2016;12:171.e1–7.
11. Gnech M, Berrettini A, Lopes RI, Moscardi P, Esposito C, Zucchetta P, et al. Pyeloplasty vs. nephrectomy for ureteropelvic junction obstruction in poorly functioning kidneys (differential renal function <20%): a multicentric study. *J Pediatr Urol*. 2019;15:553..e1–8.
12. Nayyar R, Yadav S, Singh P, Kumar R, Seth A, Dogra PN. Outcomes of pyeloplasty in very poorly functioning kidneys: examining the myths. *Urology*. 2016;92:132–135.
13. Rivas JG, Gregorio SA, Eastmond MP, Gomez AT, Togores LH, Sebastian JD, et al. Renal function recovery after laparoscopic pyeloplasty. *Cent European J Urol*. 2014;67:210–213.
14. Liberati A, Altman DG, Tetzlaff J, Mulrow C, GØtzsche PC, Ioannidis JPA, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *BMJ*. 2009;339:b2700.
15. Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ et al, eds. Cochrane handbook for systematic reviews of interventions, Version 6.1; 2020. Available at: https://training.cochrane.org/handbook/current. Accessed at: January 21, 2021.
16. Wells GA, Shea B, O'Connell D, Peterson J, Welch V, Losos M et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomized studies in meta-analyses, 2020. Available at: http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp. Accessed January 21, 2021.
17. Li XD, Wu YP, Wei Y, Chen SH, Zheng QS, Cai H, et al. Predictors of recoverability of renal function after pyeloplasty in adults with ureteropelvic junction obstruction. *Urol Int*. 2018;100:209–215.
18. Nishi M, Matsumoto K, Fujita T, Iwamura M. Improvement in renal function and symptoms of patients treated with laparoscopic pyeloplasty for ureteropelvic junction obstruction with less than 20% split renal function. *J Endourol*. 2016;30:1214–1218.
19. Harraz AM, Taha DE, Shalaby I, Hafez AT. Evaluation of factors predicting recoverability of renal function after pyeloplasty in adults. *Urol Int*. 2014;93:403–405.
20. Castagnetti M, Novara G, Beniamin F, Vezzú B, Rigamonti W, Artibani W. Scintigraphic renal function after unilateral pyeloplasty in children: a systematic review. *BJU Int*. 2008;102:862–868.
21. Bhat GS, Maregowda S, Jayaram S, Siddappa S. Is renal biopsy a better predictor of the outcome of pyeloplasty in adult ureteropelvic junction obstruction? *Urology*. 2012;79:321–325.
22. Madi R, Roberts WW, Wolf JS. Late failures after laparoscopic pyeloplasty. *Urology*. 2008;71:677–680.